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Arthroplasty-Cervical

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P001: Two level ACDF(2L-ACDF) versus hybrid total disc replacement (HTDR) for bilevel cervical radiculopathy/myelopathy- minimum 2 year early follow up comparative study of Indian population

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Introduction: ACDF has long been a gold standard for cervical fusion in spondylotic myelofaculopathy of cervical spine. Adjacent segment degeneration (ASD) is a known complication of ACDF, which is asymptomatic most of the time, but if becomes symptomatic may need revision surgery at the new segment of degeneration. To counteract this known complication, use of total disc replacement (TDR) of cervical spine came into vogue. Recent development in total disc replacement at mobile level with fusion at spondylotic level known as hybrid fixation has added new armamentarium for such disorders. The aim was to study the outcomes of two level anterior cervical discectomy and fusion (2L-ACDF) versus hybrid Total disc replacement (H-TDR) for cervical Myelofaculopathy. **Material and Methods:** Data were collected from electronic data base as well as medical record section of the institute. Radiological features and outcome were studied from data collected on Insta-PACS (picture archiving and communication system) version 4.. Clinical details included- Visual analogue scale (VAS) for arm

pain, Neck disability Index (NDI) for neck pain, Japanese orthopaedic association (JOA) score for myelofaculopathy patients. Radiological assessment included - Range of motion (ROM) of prosthesis (The difference in the angular measurement between the lower endplate of upper vertebra and upper endplate of lower vertebra in flexion and extension X-rays), ROM of adjacent level (Difference in the angular measurement at the supra-adjacent level), C2-C7 alignment. **Results:** 2L-ACDF (n = 22), with H-TDR (n = 27) were included. Mean follow up duration was 4.0 ± 1.5 years in H-TDR and 3.1 ± 1.1years in 2L-ACDF. Mean Neck disability index (NDI) decreased from 26.1 ± 7.6 to 6.5 ± 3.9 at final follow up in H-TDR group, similarly it decreased from 27.6 ± 7.2 to 6.4 ± 4.8 at final follow up in 2L- ACDF. Disc height at suprajacent level in 2L-ACDF group was 4.12 ± .48 (preoperatively), 4.10 ± .45, and 4.05 ± .48 at 1 year and final follow up respectively. Disc height at supradjacent level in H-TDR group was 4.28 ± .36 (preoperatively), 4.20 ± .32, and 4.19 ± .34 at 1 year and final follow up respectively. In H-TDR group, at final follow up heterotopic ossification was seen in 7 (25.93 %) patients. HO restricting mobility was seen in 3 patients, grade III HO in 2 (7.4 %) patients and grade IV HO in 1 (3.7 %) patient. Hence at the final follow up, mobility on prosthesis was seen in 88.9 %. Mean JOA was calculated in six patients (three in each group), which increased from 13 to 15.5 with time over final follow up in both groups. **Conclusion:** There was significantly improved Neck disability Index (NDI) in both groups. Adjacent segment disc height loss was more in 2L- ACDF group than in H-TDR. Supra-adjacent segment ROM was more in 2L-ACDF group than in H-TDR group but not statistically significant (p value- .304). These both finding supports radiographic ASD but symptomatic ASD was absent in both groups. Its usage for treatment of bilevel cervical myelofaculopathy is significantly hopeful in developing country with its 2 year follow up outcomes.



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P002: Clinical and radiological outcomes of hybrid surgery (HS) in double level cervical degenerative disc disease (CDDD) at 3 years follow-up

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Introduction: Cervical Degenerative Disc Disease (CDDD) is a common cause of pain associated with radiculopathy, myelopathy or both. Anterior Cervical Discectomy and Fusion (ACDF) is a widely performed surgery for CDDD. However adjacent level degeneration is commonly associated with ACDF in the literature. Cervical Total Disc Arthroplasty (TDA) is a motion preserving surgical option available nowadays, with encouraging outcomes. Optimum management of multilevel CDDD is debatable. Hybrid Surgery (HS) with ACDF and TDA for multilevel CDDD has encouraging Results. This study presents our experience with HS in double level CDDD and clinical and radiological outcomes at 3 years follow-up. **Materials and Methods:** Single center, single surgeon, retrospective observational study was performed on 21 patients with symptomatic double level CDDD who were treated with ACDF coupled with TDA. All patients underwent the HS in a single stage procedure. Clinical evaluation was based on Neck Disability Index (NDI) and Japanese Orthopaedic Association (JOA) score. Radiographic evaluation included the angular ROM from C2 to C7 at one month, three months, one year and three years. All patients were followed up for a minimum of 36 months. Biological fusion was analysed at 3 months and 12 months follow-up. **Results:** All patients exhibited significant improvement in NDI and JOA scores compared to pre operative scores. All improved scores were maintained at 3 years follow-up. The angular ROM improved significantly at 12 months follow-up. Cervical lordosis was maintained and patients had significant symptomatic relief at 3 months follow-up, which was maintained at 3 years follow-up. No patients had adjacent level degeneration, nor device migration. Adequate biological fusion could be seen in all the patients. **Conclusions:** Motion-preserving TDA combined with ACDF has promising and encouraging Results. HF is a safe, single stage procedure with good patient compliance.

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P003: Risk factors for readmission and extended length of stay following cervical disc arthroplasty from 2016-2018

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Introduction: Cervical disc arthroplasty (CDA) has emerged as a viable alternative to Anterior Cervical Discectomy and Fusion (ACDF) for the treatment of cervical spondylosis, myelopathy, and radiculopathy. However, little is known about which clinical and patient characteristics are risk factors for suboptimal outcomes and readmission following CDA procedures. There is currently a paucity of literature surrounding clinical predictors of readmission and overall length of stay following CDA. The aim of the current study is to investigate the impact that various demographic and intraoperative variables have on short-term CDA outcomes using data from the Healthcare Cost and Utilization Project Nationwide Readmissions Database (HCUP-NRD). **Material and Methods:** A retrospective cohort study was conducted on elective adult cervical disc arthroplasties from 2016-2018 as reported by the Healthcare Cost Utilization Project National Readmission Database (HCUP-NRD). Our goal was to identify risk factors associated with 30/90 day readmissions and prolonged lengths of stay following elective cervical disc arthroplasty (CDA) procedure. The 2016-2018 NRD was queried for single or multilevel CDA's with the ICD-10 code (0RR30xx). Non-elective cases and patients under 18 years old were excluded. Patient demographics, comorbidities, and readmission data were collected for patients undergoing CDA. Univariate and multivariate analysis was performed on the cohort of prolonged length of stay patients. Due to the limited number of readmissions, a multivariate regression was not performed on these cohorts. Rather, those readmitted within 30 or 90 days were propensity matched with those not readmitted and univariate analysis was performed. **Results:** 6477 patients were identified. Several factors were significant within univariate analysis for prolonged LOS. Patient and surgical factors associated with prolonged LOS included female gender, ages 70-79, medicare status, drug abuse as well as intraoperative, neurologic, respiratory, and gastrointestinal complications. For the 30- and 90- day readmissions, 110 and 224 patients were readmitted respectively. **Conclusion:** To our knowledge, this study presents the largest and most up to date cohort analysis of CDA patient data. The findings in the present study indicate demographic and procedural complications that contribute to prolonged LOS, which is associated with increased healthcare costs. The readmission data, however, differs from previous findings and warrants further research before definitive **Conclusions** can be drawn.

Arthroplasty-Lumbar

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P004: Perioperative outcomes of general versus spinal anesthesia in the lumbar spine surgery population: a systemic review and meta-analysis of data from 2005 through 2021

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Introduction: Spinal anesthesia for elective lumbar spine surgery is increasing in popularity. Proposed benefits include better pain control, decreased postoperative nausea/vomiting, and decreased total operative time. However, data on its utility is mixed, with some studies suggest no benefit over traditional general anesthesia. **Material and Methods:** PubMed was queried for manuscripts reporting perioperative outcomes for patients undergoing one to three-level lumbar spine surgery (including decompression, fusion, and decompression with fusion) using either general or spinal anesthesia. Inclusion criteria included studies published from 2005-2021, in English, involving primary data from human subjects. Studies were further screened for data on total operative time, blood loss, intraoperative hypotension, pain scores, postoperative nausea and vomiting, time required in postoperative anesthesia care unit (PACU), PACU pain anesthetic requirement, and length of stay. Potential predictors of outcome were compared using univariate analysis, and variables potentially associated with outcome were subjected to meta-analysis using Cochran-Mantel-Haenszel testing to produce standard mean differences (SMD) or odds ratios (OR) and 95% confidence intervals (CI). **Results:** In total, 12 studies totaling 2,796 patients met inclusion criteria. 1,414 (5.6%) and 1,382 (49.4%) patients underwent lumbar spine surgery with general anesthesia and spinal anesthesia, respectively. Patients undergoing spinal anesthesia were statistically more likely to have coronary artery disease and respiratory dysfunction. Total operative time (SMD: -12.62 minutes, 95% CI -18.65 to -6.59), estimated blood loss (SMD: -.57 mL, 95% CI -.68 to -.46), postoperative nausea and vomiting (OR = .20, 95% CI .15 to .26), time required in PACU (SMD = -.20 min, 95% CI -.32 to -.08), and length of stay (SMD = -.14 day, 95% CI -.18 to -.10), all statistically significantly favored spinal anesthesia over general

anesthesia ($P < .05$). **Conclusion:** In one to three-level lumbar spine surgery, current literature supports spinal anesthesia as a viable alternative to general anesthesia. As this was a heterogeneous patient population, prospective randomized trials are needed to corroborate findings.

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P005: A decreasing national trend in lumbar disc arthroplasty

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Introduction: Lumbar spondylosis is one of the most common causes of disability in the United States. In patients undergoing surgical management, lumbar arthrodesis is frequently performed and can result in satisfactory clinical outcomes. However, lumbar arthrodesis is associated with complications such as adjacent segment disease and pseudoarthrosis. Lumbar disc arthroplasty (LDA) was introduced nearly three decades ago as a possible alternative to lumbar arthrodesis. However, LDA utilization across the United States has not paralleled the enthusiasm noted for cervical disc arthroplasty (CDA) for many reasons including narrow indications, technical challenges, and insurance reimbursement. The aim of this study was to investigate the national trend of LDA utilization from 2005 to 2017. **Material and Methods:** Patients undergoing primary LDA between 2005 to 2017 were identified in the National Inpatient Sample (NIS) database. Year of the procedure, demographic, socioeconomic, hospital, and cost parameters were analyzed. The data was weighted using provided weights from the NIS database to generate national estimates of LDA procedure incidence. Lastly, we assessed the incidence of CDA between 2005 to 2017 to serve as a historical comparison. **Results:** An estimated 20,460 patients underwent primary LDA in the United States between 2005 to 2017. There was an initial decrease in LDA procedures between 2005 to 2006 and then a plateau between 2006 to 2009. From 2010 to 2013, there was a significant year-over-year decrease in annual LDA procedures performed, followed by a second plateau from 2014-2017. Overall, LDA procedures decreased 82% from 2005 to 2017. Over the same time, the annual incidence of CDA utilization increased 795% from approximately 474 procedures in 2005 to 4,245 procedures in 2017 ($P < .01$). **Conclusion:** Lumbar disc arthroplasty utilization decreased 82% from 2005 to 2017, with a significant decrease in the rate of utilization noted after 201. The utilization of LDA to treat select degenerative lumbar conditions has not paralleled the increasing popularity of CDA, and, in fact, has demonstrated a nearly opposite utilization trend.

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P006: Trends in lumbar disc replacement relative to fusion for lumbar degenerative disc disease and spondylosis in the United States, 2010 to 2018

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Introduction: In the treatment of lumbar degenerative disc disease (DDD) and spondylosis that has failed conservative measures, lumbar fusion (LF) remains the gold standard. Approved in 2004, lumbar disc replacement (LDR) is designed to preserve motion. Initial studies showed LDR was used in 2.7% of surgeries for DDD and spondylosis. We aim to analyze the trends, complications and costs associated with LDR compared to LF using a large national database. **Material and Methods:** The National Inpatient Sample (NIS) was queried from 2010 to 2018 to identify patients undergoing single and double-level LF and LDR with a diagnosis of lumbar DDD and spondylosis using ICD-9 and ICD-10 diagnostic and procedure codes. Revision procedures were excluded. Propensity score matching (PSM) with a ratio of 2:1 was performed to compare health care utilization metrics and index hospital complications for patients undergoing single-level LF or LDR. **Results:** A total of 1,232,515 and 7,512 LF and LDR procedures occurred during the study period, with 375,198 (3.4%) LF and 626 (8.3%) LDR two-level procedures. The total number of LDR performed in the US decreased from 1,755 in 2010 to 730 in 2018. Of all procedures, the proportion of LDR decreased from 1.1% in 2010 to .4% in 2013 and stayed roughly constant to .4% in 2018. For single-level procedures, the proportion of LDR decreased from 1.2% in 2010 to .5% in 2013 and increased slightly to .8% in 2018. The total number of two-level procedures increased from 23,498 (14.8%) in 2010 to 68,400 (46.5%) in 2018, while single-level procedures decreased from 134,954 to 68,400 over the same period. In analysis of single-level patients, LDR patients were significantly more likely to be younger (mean age 4.6 vs 57.0, $P < .001$) and healthier (mean ECI .82 vs 1.74, $P < .001$). LDR procedures were slightly less likely to be performed in urban academic centers (53.5% vs 58.0%, $P < .001$). On PSM analysis, hospital charges for LDR procedures were \$5,090 less than fusion procedures ($P < .001$). LDR patients stayed on average .64 days shorter in the hospital ($P < .001$), and were less likely to be discharged to a facility (1.8% vs 4.2%, $P < .001$) than LF patients. LDR patients had lower rates of any complication (7.8% vs 14.7%, $P < .001$), neurologic complication (3.2% vs 5.3%,

$p = .005$), and blood transfusion (3.4% vs 8.6%, $P < .001$) compared to LF patients. Differences in the rates of neurologic complication, wound complication and venous thromboembolism were not significant. **Conclusion:** While the overall number of LDR procedures decreased over the study period, the number relative to single-level LF initially decreased to before increasing slightly to roughly .8% of procedures used to treat lumbar DDD and spondylosis in 2018. After adjusting for demographic, medical and hospital variables, LDR was associated with reduced costs and LOS, and lower rates of blood transfusion.

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P007: Interlaminar decompression for spinal stenosis: a comprehensive review

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Introduction: From the 2008, there has been growth in the literature demonstrating the safety and efficacy of interlaminar decompression for spinal stenosis. In this comprehensive literature review, we reviewed studies specifically addressing uniportal endoscopic interlaminar decompression in lumbar spinal stenosis. **Material and Methods:** This literature review was conducted with the keywords “endoscopic,” “minimally invasive,” “uniportal endoscopic decompression,” “interlaminar decompression,” and “lumbar spinal surgery,” using PubMed, the Cochrane Library, Web of Science and Embase from 1990 to Nov. 2021. **Results:** Our search included 1397 records and after selection, we included 11 papers for this review including 3 RCT, 6 comparative study, 2 meta-analysis. Based on our literature review, due to the similar outcomes, decompression plus fusion is not necessary for these patients. Endoscopic decompression is a good choice due to lower early back pain, ODI, lowest complication rate, shortest hospital stays. Although there’s great scientific evidence for endoscopic decompression in interlaminar decompression for lumbar spinal stenosis, there is a lack of reporting outcomes including cost, return to work, long-term follow-up, and ethnic difference. Larger, prospective RCT are needed to confirm these findings. Full endoscopic spine surgery for lumbar spinal stenosis has the advantage of preservation of normal spine tissue and anatomy, lower risk of complications due to continuous visual control, bleeding control by radiofrequency and continuous irrigation to prevent thermal injury. **Conclusion:** Full endoscopic decompression has good evidence for better surgical outcomes than conventional and microscopic decompression. The surgical outcomes are similar in spinal stenosis with stable degenerative spondylolisthesis and scoliosis.

Basic Science

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P008: Transcriptomics study to determine the molecular mechanism by which sIL-13R α 2-Fc inhibits caudal intervertebral disc

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Introduction: Intervertebral disc degeneration is related to tissue fibrosis. A disintegrin and metalloproteinase with thrombospondin motifs (ADAMTS) can degrade the important components of the extracellular matrix (ECM) during the process of intervertebral disc degeneration, ultimately resulting in the loss of intervertebral disc function. Soluble interleukin-13 R alpha2 receptor fusion protein (sIL-13R α 2-Fc) can inhibit fibrosis and slow down the degeneration process, but the mechanism involved remains unclear. To determine the mechanism by which sIL-13R α 2-Fc inhibits ECM degradation and reduces intervertebral disc tissue fibrosis using a transcriptomics analysis. **Material and Methods:** A rat model of caudal intervertebral disc degeneration was established, and Sirius red staining was used to observe the pathological changes in the caudal intervertebral disc. Transcriptome sequencing was employed to assess the gene expression profiles of the intervertebral disc tissues in the model group and the sIL-13R α 2-Fc-treated group. Differentially expressed genes were identified and analyzed using GO annotation and KEGG pathway analyses. Real-time fluorescence quantitative PCR was used to verify the expression levels of candidate genes. The levels of Glycosaminoglycan (GAG) and Hyaluronic Acid (HA) were quantitatively assessed by ELISA, and the levels of collagen I and collagen II were analyzed by western blotting. **Results:** Sirius red staining showed that in the model group, the annulus fibrosus was disordered, the number of breaks increased, and the type I collagen protein levels increased, whereas in the sIL-13R α 2-Fc group, the annulus fibrosus was ordered, the number of breaks decreased, and the type II collagen protein levels increased. In comparison with the model group, we identified 58 differentially expressed genes in the sIL-13R α 2-Fc group, and these were involved in 35 signaling pathways. Compared with those in the model group, the mRNA expression levels of *Rnux1*, *Sod2*, and *Tnfaip6* in the sIL-13R α 2-Fc group were upregulated, and the mRNA expression levels of *Aldh3a1*, *Galnt3*, *Fgf1*, *Celsr1*, and *Adamts8* were downregulated; these **Results** were verified by real time fluorescence quantitative PCR. TIMP-1 (an ADAMTS inhibitor) and TIMP-1 combined with the sIL-13R α 2-Fc intervention increased the levels of

GAG and HA, inhibited the expression of type I collagen, and promoted the expression of type II collagen. **Conclusion:** Adamts8 may participate in the degradation of ECM components such as GAG and HA and lead to an imbalance in the ECM of the intervertebral disc, resulting in intervertebral disc degeneration. sIL-13R α 2-Fc promoted anabolism of the ECM and increased the levels of ECM components by inhibiting the expression.

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P009: Inducible expression of GDNF and ChABC in neural progenitor cells for transplantation in spinal cord injury

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Introduction: Chondroitinase ABC (ChABC) and glial-derived neurotrophic factor (GDNF) infusion combined with neural progenitor cell (NPC) transplantation have been explored in the context of spinal cord injury (SCI). However, the efficacy of these approaches is limited by poor graft survival, aberrant differentiation, and the need for invasive repeated delivery. The inducible expression of GDNF and ChABC from transplanted NPCs has the potential to overcome these limitations while combining two strategies of promoting neuroprotection and regeneration. First, grafted NPCs contribute to host cell survival through innate paracrine signalling, help restore synaptic connectivity, and myelinate host axons. Second, the ex-vivo genetic engineering of graft cells allows for regulatable local delivery of growth and plasticity-promoting factors while bypassing the blood-spinal-cord barrier: GDNF-secreting NPCs and combined delivery of NPCs with ChABC significantly increases therapeutic efficacy. While ex-vivo gene therapy strategies using neurotrophic factors have shown promise in pre-clinical studies, these have mostly been limited to non-inducible systems. Here, we used a dual safe harbour-targeting tetracycline-inducible control system, OPTi-OX, that provides superior control of gene expression by overcoming silencing. **Materials and Methods:** Human induced pluripotent stem cells (iPSCs) were targeted at the ROSA26 and AAVS1 safe harbour sites with rtTA and GDNF/ChABC, respectively. Genotyping confirmed homozygous site-specific transgene integration without off-target integration. These iPSC lines were differentiated to neural progenitor cells using dual SMAD inhibition and NPC identity was verified using qPCR and immunohistochemistry. Immunoblotting and qPCR were used to measure expression of GDNF and ChABC in-vitro. ChABC function was measured using the Morgan-Elson assay and neurite outgrowth assays. **Results:** iPSC-derived NPCs expressed neural progenitor

markers. Western blotting and qPCR confirmed doxycycline-inducible expression and secretion of GDNF and ChABC. Withdrawal of doxycycline resulted in rapid downregulation of GDNF/ChABC expression. Functional assays confirmed ChABC activity in-vitro. **Conclusion:** Dual safe harbour targeting of a tetracycline-inducible system enables robust regulatable expression of GDNF and ChABC in human iPSC-derived NPCs, which should be further evaluated in pre-clinical models of spinal cord injury.

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P010: In vivo imaging in experimental spinal cord injury

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Introduction: Traumatic Spinal Cord Injury (SCI) is one of the leading causes of disability in the world. SCI is incurable and treatment is limited to supportive care. Experimental research to understand the complex pathophysiology and potential mediators of spinal cord regeneration is essential to develop innovative translational therapies. A multitude of experimental imaging methods to monitor spinal cord regeneration in vivo have developed over the last years. However, little literature exists to deal with advanced imaging methods specifically available in SCI research. We performed a systematic literature review to examine the current standards in experimental imaging in SCI allowing for in vivo imaging of spinal cord regeneration on a neuronal, vascular, and cellular basis. **Material and Methods:** The systematic literature review was performed according to the PRISMA guidelines. The databases MEDLINE, CINAHL, Embase, Google Scholar and Science Direct were searched. Articles were included meeting the following criteria: experimental research, original studies, rodent subjects, and intravital imaging. Articles in English were assessed, and the search was performed without a time limit. **Results:** In the systematic search, 689 articles were identified for review, of which 492 were sorted out after screening and an additional 104 after detailed review. For qualitative synthesis 93 articles were included in this publication. Reviewed in detail are microstructural and functional Magnetic Resonance Imaging, Micro-Computed Tomography, Laser Speckle Imaging, Very High Resolution Ultrasound, and Microscopy techniques. **Conclusion:** With this study we give an up-to-date overview about modern experimental in vivo imaging techniques with the potential to advance the knowledge on spinal cord regeneration following SCI. A thorough knowledge of the strengths and

limitations of the reviewed techniques will help to optimally exploit our current experimental armamentarium in the field.

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P011: Biomechanics of spinal rods - A comparative study of bending characteristics

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Introduction: Pedicle screw-rod-constructs are used for a wide range of applications with strongly varying demands on construct stiffness. Rod stiffness is an important factor determining construct performance. A wide range of rod diameters and materials is available from manufacturers. No catalogue has so far been published that would permit surgeons to objectively compare rods based on their specific properties. The goal of our study was to independently and objectively compare the biomechanical properties of spinal rods. **Methods:** Testing was according to ASTM norm F2193. We measured bending stiffness, the bending ultimate moment, the bending yield moment and elastic recoil. Over 200 tests were performed on 63 rods. **Results:** We found decreasing material stiffness from cobalt-chrome (CoCr) and stainless steel (SS) via titanium (Ti) to PEEK. Surprising differences of up to 10% were found between Ti rods from different manufacturers. Differences between materials were most pronounced with small diameters: A 4.5 mm CoCr rod has about twice the stiffness of a 4.5 mm Ti rod, but the difference is only 15% with 6.0 mm rods. CoCr rods provided the highest elastic modulus with 4.5 mm diameter CoCr rods being as stiff as 5.5 mm diameter titanium rods and 5.5 mm CoCr rods being stiffer than 6.35 mm Ti rods. The stiffness of PEEK rods was only 4% that of Ti rods of the same diameter with the exception of carbon fiber-reinforced PEEK, which was close to titanium. A simplified overview is displayed in image 1. **Conclusion:** Our **Results** show surprising variability between the popular 5.5 mm Ti rods from different manufacturers. With smaller diameters, the choice of material is increasingly important and may sometimes allow for using smaller implants while maintaining construct stiffness. Ultimate moment and yield moment determine at which load a construct can be expected to plastically deform in vivo and what amount of force is required to contour the rod prior to implantation. The elastic recoil after plastic deformation makes exact contouring more difficult which makes certain rods less comfortable to use in certain applications. We found considerable differences between the diameters / materials tested for all these parameters.

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P012: Systematic review of the impact of cannabinoids on neurobehavioural outcomes in preclinical models of traumatic and non-traumatic spinal cord injury*Faheem Bhatti¹, Oliver Mowforth¹, Benjamin Davies¹, and Mark Kotter¹*¹*Department of Academic Neurosurgery, University of Cambridge, Cambridge, United Kingdom*

Introduction: The classic model of SCI consists of two phases. The first phase involves direct damage as a result of mechanical trauma. This causes immediate damage and then catalyses a second phase of injury driven by aberrant molecular, cellular and biochemical cascades. Secondary injury constitutes damage caused by ischaemia, ionic derangements, excitotoxicity, free radical damage, oedema, inflammation and apoptosis. Cannabinoid (CB) receptor agonists are a promising pharmacological approach. An endogenous cannabinoid system also exists, consisting of two CB receptors (CB1 and CB2), natural ligands (endo-CBs) such as anandamide, and enzymes involved in endo-CB synthesis and degradation. Following SCI, local modulation of the endo-CB system has been reported. Moreover, the endo-CB system has been shown to be important in neuroprotection and immunomodulation after SCI, as well after cerebral ischaemia-reperfusion injury and traumatic brain injury. Cannabinoids have been shown to downregulate processes thought to be important in the secondary phase of SCI. For example, cannabidiol (CBD) is an exogenous cannabinoid receptor agonist currently being evaluated in a number of clinical trials for multiple medical conditions. CBD has been shown to reduce reactive oxygen and nitrogen species production, chemokine and cytokine release, microglial and astrocyte activation, as well as T cell proliferation. In addition, non-selective CB receptor agonists downregulate central nervous systems neutrophil infiltration and apoptosis in multiple sclerosis, promote neural remyelination in neonatal rats experiencing hypoxia-ischaemia and relieve neuropathic pain following peripheral nerve injury in mice. The objective of this study was to evaluate the impact of cannabinoids on neurobehavioral outcomes in preclinical models of nontraumatic and traumatic spinal cord injury (SCI), with the aim of determining suitability for clinical trials involving SCI patients. **Material and Methods:** A systematic search was performed in MEDLINE and Embase databases, following registration with PROSPERO (CRD42019149671). Studies evaluating the impact of cannabinoids (agonists or antagonists) on neurobehavioral outcomes in preclinical models of non-traumatic and traumatic SCI were included. Data extracted from relevant studies, included sample characteristics, injury model, neurobehavioural outcomes assessed and study **Results.** PRISMA guidelines were followed and the SYRCL checklist

was used to assess risk of bias. **Results:** The search returned 8714 studies, 19 of which met our inclusion criteria. Sample sizes ranged from 23 to 390 animals. WIN 55,212-2 (n = 6) and AM 630 (n = 8) were the most used cannabinoid receptor agonist and antagonist respectively. Acute SCI models included traumatic injury (n = 16), ischaemia/reperfusion injury (n = 2), spinal cord cryoinjury (n = 1) and spinal cord ischaemia (n = 1). Assessment tools used assessed locomotor function, pain and anxiety. Cannabinoid receptor agonists resulted in statistically significant improvement in locomotor function in 9 out of 10 studies and pain outcomes in 6 out of 6 studies. **Conclusion:** Modulation of the endo-cannabinoid system has demonstrated significant improvement in both pain and locomotor function in pre-clinical SCI models; however, the risk of bias is unclear in all studies. These **Results** may help to contextualise future translational clinical trials investigating whether cannabinoids can improve pain and locomotor function in SCI patients.

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P013: The impact of phosphodiesterase inhibition on neurobehavioural outcomes in preclinical models of traumatic and non-traumatic spinal cord injury: a systematic review of the literature*Max Butler¹, Oliver Mowforth¹, Benjamin Davies¹, and Mark Kotter¹*¹*Department of Academic Neurosurgery, University of Cambridge, Cambridge, United Kingdom*

Introduction: Damage to the spinal cord triggers inflammatory cell recruitment. Neutrophils and macrophages release cytokines, proteolytic enzymes, and reactive oxygen species, resulting in damage to neurons, glial and vascular structures. Vascular impairment may cause increased activation of voltage-gated sodium channels, leading to sodium influx and swelling. Disrupted calcium homeostasis triggers glutamate release, leading to neuronal excitotoxicity and cell death. These changes manifest as irreversible damage to spinal cord tissue. Phosphodiesterases (PDE) have proinflammatory effects, in part through degrading cAMP, which regulates microglia homeostasis and inflammatory cytokine expression. Through elevating cAMP levels, PDE inhibitors have been found to reduce inflammatory cytokine production and promote CNS regeneration. PDE4 is the most frequently expressed cAMP specific PDE in neurological tissue and monocytes and is a primary target in the treatment of inflammatory disease and cognitive deficits. Given the pathophysiology of spinal cord injury, adjuvant therapy with PDE inhibitors may provide benefit in the treatment of traumatic or non-traumatic SCI. This is currently being evaluated in RECODE Myelopathy, a multicenter randomized controlled trial of PDE-4 inhibitor ibudilast in patients with degenerative cervical myelopathy. The objective of this

study is to evaluate the impact of phosphodiesterase (PDE) inhibitors on neurobehavioural outcomes in preclinical models of nontraumatic and traumatic spinal cord injury (SCI). **Material and Methods:** A systematic search was performed of MEDLINE and Embase databases. Studies were included if they evaluated the impact of PDE inhibitors on neurobehavioral outcomes in preclinical models of nontraumatic and traumatic SCI. Data were extracted from relevant studies, including sample characteristics, injury model, and neurobehavioural assessment and findings. The review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. To assess risk of bias the SYRCL checklist was used. The review was registered with PROSPERO (CRD42019150639). **Results:** The search yielded a total of 1537 papers. Twenty-one papers met the inclusion criteria. Sample sizes for neurobehavioural assessments ranged from 11 to 144. The PDE inhibitors used were rolipram (n = 17), cilostazol (n = 3) and PDE-I (n = 1). The injury models used were traumatic SCI (n = 17), spinal cord ischaemia (n = 3), and degenerative cervical myelopathy (n = 1). The most commonly assessed outcome measures were BBB (Basso, Beattie, Bresnahan) locomotor score (n = 12) and grid walking (n = 7). Overall, the use of PDE inhibitors resulted in statistically significant improvements in neurobehavioral outcomes in a minority of studies. **Conclusion:** In preclinical models of traumatic and nontraumatic SCI, the exclusive administration of PDE inhibitors Results in statistically significant improvements in neurobehavioral outcomes in a minority of studies.

Biomechanics

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P014: Remodulation of the deformed vertebrae using the active apex correction technique (APC) in early onset scoliosis patients: a patient-specific finite element study with simulated spinal growth

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Introduction: In adolescent idiopathic scoliosis, the overall spinal deformity is closely associated with the wedging of both vertebrae and discs. This is especially important since the vertebral body deformation increases as the scoliosis progresses. Furthermore, it is believed that vertebral axial rotation in scoliosis can occur with progressive wedging. While multiple studies have reported vertebral wedging from AP and lateral radiographs, the data could be misleading since these are projected values of three-dimensional deformation of the vertebral body. In terms of treatment modalities for AIS, the

active apex correction (APC) provides an excellent surgical option to the traditional techniques; designed to directly remodulate the most-wedged vertebra besides providing other benefits. The current study builds on earlier clinical studies on the APC technique, aiming to quantify and understand the vertebral remodulation using a finite element (FE) approach. **Material and Methods:** Five representative patient-specific scoliotic models were developed to match patient AP and lateral radiographs. These pre-op models were then used to simulate the surgery; the apex was pushed medially followed by compression of the convex side of apex (using 2 screws implanted proximal and distal to the most-wedged vertebra). The rest of sliding rod construct was then instrumented to complete the surgical simulation. Next, the effect of gravity and muscle forces was simulated followed by epiphyseal spinal growth based on the Hueter-Volkman principle. Clinically relevant data for parameters such as primary Cobb, AVT, 3D vertebral wedging etc. were recorded and analyzed for these 5 models. To ensure clinical relevance, at each step the model inputs and process were checked by a surgeon who regularly performs APC. **Results:** The correction in the ratio of convex to concave-side vertebral height for the 3 vertebrae in the compression area averaged at 2.25% (E.g., 1.1 in pre-op to 1.08 post-surgery). This change in correction of the wedging ratio was .5% in the control group (i.e., the vertebrae outside the tethering area). Additionally, the **Results** also showed excellent coronal correction post-surgery, with an average reduction of the primary curve was 45% (27 degrees) and a 46% reduction in the AVT (~2.3 cm) from the FE Models. Similarly, there was an average reduction in the Kyphosis of 7.1 degrees (27%). Most importantly, at the 6-month growth time points, the output parameters indicated a slight improvement of the correction achieved by the APC technique (reduction in the Cobb angle, vertebral wedging, and translation) for all patient models. **Conclusion:** The output parameters from the FE models indicate excellent remodulation/ correction of the vertebral wedging, with the correctional effect being transferred beyond the most-wedged wedged. This coupled with indications of further correction over the spinal growth augur well for long-term outcomes for the technique. While this study is limited in terms of follow-up time as well as sample size, it clearly indicates the enormous potential of this technique and paves the way for additional research.

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P015: Biomechanical properties of a novel morselized bone graft cage

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Introduction: Posterior lumbar interbody fusion (PLIF) is performed using various interbody spacers. Wang et al (2014) created an interbody cage by compressing morselized corticocancellous bone chips. They concluded that the newly morselized bone interbody fusion (MBIF) cage can provide appropriate stiffness at the physiologic loads. The purposes of this study were to replicate Wang et al. (2014) study by creating the MBIF cage and in case of failure, to re-design the MBIF cage and assess its biomechanical properties in comparison with PEEK cage. **Materials and Methods:** Lamina and spinous processes of fresh frozen spine segments were morselized and placed in a PEEK cage shaped mold and compressed with 8kN force. When re-designing the MBIF cage, the mold was lined with a thin layer of stainless-steel mesh acting as a scaffold. The redesigned MBIF (n = 6) and PEEK (n = 6) cages were placed between two blocks of solid polyurethane foam, simulating healthy bone and underwent axial compression while recording compressive force and displacement curve. The experiment was repeated with polyurethane foam simulating osteoporotic bone. **Results:** The MBIF cage collapsed under axial compression. In healthy bone group, peak force at 3mm displacement was significantly lower in the redesigned MBIF cage compared to PEEK cage. At 5 mm displacement, peak force did not differ significantly between the two cages. At lower levels of displacement, the redesigned MBIF construct failed by loss of height of the cage. While PEEK cage construct failed by destruction of polyurethane foam contact surface. In osteoporotic bone, peak forces at 3mm and 5 mm were significantly higher in the redesigned MBIF cage than the PEEK cage constructs. **Conclusions:** The **Results** of Wang et al (2014) were not reproducible in our study. The redesigned MBIF cage showed comparable biomechanical properties with PEEK cage in healthy bone construct and outperformed the PEEK cage in osteoporotic bone construct. The redesigned MBIF can be a viable option instead of synthetic cage in patients with poor bone quality.

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P016: Contribution of biomechanical modeling for the diagnosis and prevention of low back pain when walking at heel

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Background: You have to suffer to be beautiful, at what cost? The woman nowadays wears heels for social or professional requirements. Walking with high heels increases the difficulty of maintaining balance and stability. This disorder has an impact on the musculoskeletal system, particularly on the lumbar spine, which increases the pressure forces on the vertebrae with greater muscle activation and consequently low back pain. Biomechanical modeling presents a tool that helps to analyze the kinematics of movements and a contribution for the diagnosis and prevention of low back pain when walking at heel. **Methods:** In this study, four participants were asked to walk barefoot and with heeled shoes with a height of 8.5 cm. Movement was recorded with an optoelectronic camera system and the ground reaction forces were recorded by two force plates linked to the motion capture platform. A generic musculoskeletal model of the lumbar spine has been developed with the OPENSIM software. This model represented 242 lumbar muscles to adapt to the eight main muscle groups, which allowed us to identify muscle activations, muscle forces and joint reactions. The **Results** obtained were compared with the literature for validation. **Results:** Compared to the barefoot gait, high heels have caused a decrease in lumbar flexion of 2° with an increase of more than 40% of the lateral inclination and of the axial rotation. The intervertebral joints were slightly elongated with increased lateral flexion and axial rotation. Joint moments are reduced by 30% in the sagittal plane and increased by 10% in the frontal plane. The modeling showed a greater activation of the lumbar muscles (40%) mainly observed for the erector spinae which showed an earlier activation, in order to ensure stability also a slight increase in activation was observed for the psoas major, quadratus lumborum and the multifidus. Regarding intervertebral joint load, an increase in compressive forces was observed for all intervertebral joints. **Conclusion:** Despite limitation, musculoskeletal modeling represents a tool of great importance for understanding the dynamic phenomenon of the spine linked to the wearing of heeled shoes in order to diagnose and prevent low back pain. In fact, the model produced enabled us to identify the dangers associated with wearing heeled shoes and its repercussions on the lumbar spine.

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P017: Midline sparing in spinal stenosis procedures may lead to minimal adjacent segment alteration: a finite element analysis

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Introduction: The traditional lumbar laminectomy procedure is a gold standard method to alleviate stenosis, though minimally invasive techniques such as the bilateral and unilateral laminotomy have become more popular due to their muscle sparing nature. Furthermore, laminectomies involve a complete loss of the supraspinous and interspinous ligaments. This muscle damage along with the loss of the tension band may provoke spinal instability and need for a revision surgery. The midline sparing laminotomy technique involves preservation of these posterior ligaments and multifidus muscles. There are no studies that explore the biomechanical outcomes of these procedures which include muscle forces. We hypothesize that the midline sparing approach will provide lower stresses at the surgical and adjacent segment sites compared to the laminectomy procedure.

Material and Methods: A finite element model was developed using CT scans of a 55-year-old healthy adult spine. The model contains a ribcage, thoracolumbar spine, and fixed pelvis. This model was subject to a 10Nm to obtain range of motion (ROM). Three models were created from this intact model to simulate laminectomy, bilateral and unilateral midline sparing approaches. The ROM for all models were input into the OpenSim Thoracolumbar model. The literature states the laminotomy procedure involves 18.7% cross sectional area damage to the procedure site. This reduction was applied onto the OpenSim model in the multifidus (MF) muscles. The laminectomy procedure involved complete reduction of the MF fibers at the surgical site. Paraspinal muscle forces were obtained and input onto the models at the origin and insertion of each fiber through connector/concentrated forces. The final models excluded the thoracic spine and ribcage to save computational time and resources. Maximum intradiscal pressures (IDPs) and muscle forces were compared. **Results:** The muscle force data of the three procedures was compared to the intact case for flexion-extension. In flexion, the data showed the paraspinal muscle forces of the unilateral laminotomy is most like intact. During extension, the data of the laminectomy indicated large increases were seen in the multifidus and transverse abdominus muscle groups with decreases in the psoas and erector spinae groups. The unilateral and bilateral laminotomy cases displayed similar muscle forces in extension. IDPs in flexion for laminectomy had the greatest IDPs at L3-L4 and L4-L5 while both laminotomies had the greatest IDP at L5-S1. During extension, the laminectomy procedure showed the highest IDP at L4-L5 with negligible changes seen at other levels. **Conclusion:** Our Results emphasize the importance of muscle preservation in spinal stenosis procedures indicative of the muscle force data and IDPs. The muscle forces indicate there is a large compensation at the erector spinae and other multifidus fibers when multifidus muscles at L4-L5 have been removed. From the IDPs, the midline sparing approach indicated lower soft tissue stresses at most sites, excluding the L5-S1 site for flexion. Our Results indicate the need to preserve paraspinal musculature and the posterior tension band which is removed in the laminectomy procedure. Further studies including the annulus stresses and facet loads are required to support this claim.

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P018: Contribution of biomechanical modeling of the trunk in low back pain

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Background: The spine is maintained by the core muscles ensuring balance and stability during movement. Disc disorders of the trunk musculature are a frequent cause of back pain. The analysis of the spinal loads and the surrounding muscular forces allows us to understand and possibly predict the evolution of painful lumbar pathologies. The aim of this study was to determine the muscular activities that ensure the spinal balance during daily physical activities as well as the potential compensation mechanisms in the presence of chronic low back pain. Musculoskeletal modeling is used to estimate trunk muscle loads, reactions and joint moments during several postures and loads. **Methods:** Two healthy subjects and two patients suffering from chronic non-specific low back pain, aged 32 and 69 years, participated in this study. Subjects performed flexion tasks with and without a 12 kg load handling. Videos of load-bearing motion were recorded. A biomechanical analysis involving mathematical estimates of the strength value of the trunk muscles, the kinematics of the trunk segment and calculation of moments was performed. In this project, the model of the spine, developed with the musculoskeletal modeling software OPENSIM, constitutes the complete thoracolumbar spine and rib cage. Estimated trunk muscle loads, reactions and joint moments during several postures and loads were calculated. Inter-group comparisons were performed on the mean full-cycle model of all biomechanical variables for each task. **Results:** Biomechanical modeling revealed significant differences between groups for some muscles (lumbar and thoracic erector spine). The range of motion in flexion has been extensively studied, particularly to discriminate patients with low back pain from healthy people. We found in the healthy subject in the L5-S1 joint, the bending moment increased from 19.06 Nm in the standing position with load, up to 222.84 Nm in the flexion 90° with load, in this case it means an increase of 203.78 Nm. Despite a large variability in the responses reported in the literature, in this project, a smaller range of motion in flexion was observed in patients with chronic low back pain. Thus, the stiffening of the trunk by an increase in muscle activity is often reported as a protective mechanism in people with chronic low back pain, leading to a limitation in their movements. **Conclusion:** Biomechanical analysis of the healthy and pathological trunk, during standardized physical activity, has

made it possible to know the impact of movements and external forces on the forces applied by the trunk muscle and joint reactions. Thanks to musculoskeletal modeling, it was possible to analyze the effects of spinal flexion on its various bone and muscle components. This work is a preliminary study to test the contributions of this biomechanical analysis to the study of lumbago, opening interesting and more in-depth perspectives for this topic.

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P019: Finite element based investigation of different implants used in oblique lateral interbody fusion surgeries, and their primary stability with normal and osteoporotic bony conditions

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Introduction: The age structure of the population is currently undergoing an upward shift in developed countries, resulting a decrease in general bone quality and surgical durability. Over the past decade, oblique lumbar interbody fusion (OLIF) has become a globally accepted minimally invasive surgical technique. There are several stabilization options available for OLIF cage fixation offering different invasiveness and operative time. These options are: bilateral pedicle screws (BPS), lateral plate and screws (LPS), and the relative new self-anchored stand-alone (SSA) systems. The constructs' stability are crucial for the immediate and long-term success of the surgery. The aim of this study is to investigate the primary biomechanical effect of the 3 OLIF constructs on normal and osteoporotic bony qualities using finite element analysis. **Material and Methods:** A bi-segmental (L2-L4) finite element (FE) model was created, using the CT scan of a 24-year-old healthy male. After the FE model validation, CAD geometries of the different OLIF implants were inserted into the L3-L4 motion segment during a virtual surgery. During the simulations a 150 N follower load was applied on the models, then 10 Nm of torque was used in six general directions (flexion, extension, right/left bending, and right/left rotation), with different bone material properties. **Results:** The smallest segmental (L3-L4) ROM (range of motion) was observed in the

BPS system, except for right bending. Osteoporosis increased ROMs in all constructs, especially in the LPS system (right bending increase: 14.26%). Osteoporosis also increased the caudal displacement of the implanted cage in all models (healthy bone: $.06 \pm .03$ mm, osteoporosis: $.106 \pm .07$ mm), particularly with right bending, where the displacement doubled in SSA and LPS constructs. The displacement of the screws inside the L4 vertebra increased by 59% on average ($59.33 \pm 21.53\%$) due to osteoporosis (100% increase was observed in the LPS system during rotational movements). BPS-L4 screw displacements were the least affected by osteoporosis. **Conclusion:** The investigated constructs provide different levels of primary stability to the spine depending on the bone mineral density, which can affect the outcome of the surgery. In our model, the BPS system was found to be the most primary stable construct in osteoporosis, however it requires a longer operative time, which is not desirable in elderly patients with severe comorbidities. The presented model after further development, has the potential to help the surgeon in planning for particular spinal surgery by adjusting the stabilization type to the patient's bone quality

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P020: Development and validation of two healthy lumbar spine finite element models: literature-based versus patient-specific material assignment strategy

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Introduction: Finite element analysis (FEA) contributes to a better understanding of the biomechanical characteristic of the human lumbar spine and therefore serves as a powerful and efficient predictive tool. The objective of this study is to present the development and validation of two 3-dimensional L1-L5 finite element models with different material assignment strategies. In addition, this study aims to highlight the differences in allocated resources for the two modelling approaches. **Material and Methods:** The geometry of the osseoligamentous lumbar spine (L1-L5) finite element model (FEM) was developed based on quantitative computed tomography (QCT) scans. Subsequently, the effect of the material assignment was analyzed by applying two different sets of material properties. Literature-based model (LBM model) and patient-specific model (PSM model) were compared with a pure bending load of 7.5 Nm, a compressive follower load of 1000 N and a combination of follower and bending load.

Loads were applied to the most cranial endplate of the L1 vertebra, while the most caudal endplate of L5 was fixed in all degrees of freedom. Four biomechanical parameters: range of motion (ROM), intervertebral rotations (IVR), intradiscal pressure (IDP) and facet joint forces (FJF) of the two models were compared with the **Results** of in vitro, in vivo and in silico studies. **Results:** The biomechanical parameters mentioned above were used to validate the models. The total ROM of the LBM model in pure flexion-extension, lateral bending and axial rotation were 3.9°, 29° and 13.7°, respectively (PSM: 31.6°, 28.6°, and 14.1°). Under compressive follower load, the IDP values for the LBM and PSM models were calculated to be .99 MPa and 1.02 MPa, respectively. The FJF values of the LBM model were 51.2 N, 8.5 N and 89.4 N against pure extension, lateral bending and axial rotation (PSM: 51.9 N, 8.5 N and 83.7 N). The computational time of the PSM model to complete against combined load in flexion, extension, lateral bending and axial rotation was 17x, 18x, 15x and 17x higher than the LBM model. **Conclusion:** This study demonstrates that the LBM and PSM models are in good agreement with in vitro, in vivo and in silico studies in terms of characteristics and magnitude, therefore both the literature-based and patient-specific models can be used to predict the biomechanical responses of the human lumbar spine. In clinically oriented biomechanical studies, the investigator needs to be aware of the increased computational demand of the patient-specific modelling approach.

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P021: Musculoskeletal modeling of healthy spine

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Background: The spine is made with passive elements (vertebral, intervertebral discs and ligaments) and active elements (muscles). The role of this anatomic elements is fundamental to prevent increased stress on intervertebral discs and secondary back pain. The evaluation of the forces and the loads represents an axis to understand these phenomena. The evaluation in recent years of computer and mathematical means has contributed to the development of modeling of the human body. The aim of this work was to develop a musculoskeletal model the healthy spine and to study the contribution of muscle forces in normal walking activity. **Methods:** A generic musculoskeletal model of the whole body with six degrees of freedom of the thoracolumbar spine and 8 muscle groups was developed with the openSim software. The third phase of the study required a measurement of the kinematics of normal walking. A quantified analysis of

walking was performed for a woman aged 25 (weight 57 kg and height 165 cm). The movement was recorded with an infrared camera system and feedback from the ground contact was recorded with force platforms at the technology platform at Compiègne University of Technology. From this kinematics, the musculoskeletal model developed has made it possible to evaluate kinematics and joint kinetics as well as to estimate activations and muscle forces of the trunk. The Results obtained were compared to the literature for validation. **Results:** For walking activity, we found a significant correlation between literature data and kinematic (joint movement), kinetic (joint moments) and muscular activations of the thoracolumbar spine calculated from the generic musculoskeletal model. Since the trunk must balance the movement of the pelvis during walking, small amplitudes of movement have been observed for the lumbar kinematics: a maximum of 6° in flexion and 3° in extension, 2° in lateral bending and axial rotation. the musculoskeletal model allowed us to quantify joint moments and muscle forces. A maximum articular momentum of 5 N was found for the flexion / extension movement. (i.e. 1% of BW). The rectus abdominis exerted a stabilizing bending force in the monopodal phase. The activity of the erector spinae, multifidus, rotator and quadratus lumborum muscles ensured the stabilization of trunk in the lateral plane during the support phase. The muscle group erector spinae has developed the largest force exceeding 600N. continuous activity of internal and external obliques was observed throughout the walking activity (with 30% activity and around 200 N of developed muscle strength). **Conclusion:** Despite the limitations of our model, musculoskeletal modeling helps us to the understand dynamic phenomena associated with the spine. Data optimization will improve more realistic future models.

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P022: The effect of the osteoporosis on the stability of different anterior column reconstruction techniques after en bloc spondylectomy: finite element analysis study

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Introduction: Several surgical strategies and solutions have been published for anterior column reconstruction after vertebral tumor resection, but each system has been developed according to a different philosophy. There is no clear, evidence-based indication in the decision of choosing the system which provides the best primary stability for a given bone mineral density. The aim of this research is to compare different reconstruction techniques depending on the age-related bone

mineral density loss, based on the numerical Results from a finite element analysis. **Material and Methods:** The 3D geometry of the L2 and L4 vertebrae and the anterior spacers used in different reconstruction techniques was created based on the CT images of a young and healthy male. Using the simplified CAD geometry of the posterior stability providing pedicle screws and rods, the virtual assembly of the surgery and the corresponding finite element model was built. The material properties of the vertebrae were modified to simulate osteoporotic material quality beside normal. **Results:** The stress distributions in the superior endplate of the L4 showed, that there were no significant variation in the osteoporotic state compared to the healthy state for any load or implant. However, with respect to the implants, stress distributions and their maximum were significantly different for both bone mineral density. In the osteoporotic state, the maximum Von Mises stress in the endplate increased for all loads and implants compared to the healthy state. In both the normal and the osteoporotic condition, the mesh cage had the highest maximum stress for all four load cases. The same anterior spacers had the lowest maximum stress for both bone mineral density in flexion, extension and axial rotation (PMMA Cage, Allograft and Implant Cage, respectively). In the case of lateral bending, Implant Cage had the lowest maximum stress in the normal state, while Allograft had the lowest maximum stress in the osteoporotic condition. The maximum stress increase between the two simulated bone quality occurred in the case of the Implant Cage in extension, lateral bending and axial rotation (57.2 %, 58.5%, 48.9%, respectively), while in the case of PMMA Cage in flexion (59.9%). **Conclusion:** According to the Results, the differences between the stress and strain distributions observed at the site of support in case of different reconstruction solutions are significant, even considering the changing bone mineral density. The PMMA cage fitted exactly on the endplate geometry with a large contact surface, compared to the other reconstructions techniques. The large contact surface and the “mirror” geometrical symmetry between the endplate and the implant reduces the risk of subsidence.

Deformity-Cervical

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P023: Surgical procedures for dropped head syndrome and postoperative complications

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Introduction: Dropped head syndrome (DHS) is a condition defined by difficulty of keeping the head up against gravity with a

severe kyphotic posture of the cervical spine. The diverse etiologies of DHS such as various neuromuscular disorders have been reported. Spinal pathologies should be taken into consideration after excluding these disorders. Not only the cervicothoracic spinal lesion, but also the thoracolumbar spinal lesion can cause DHS. However, effective surgical procedures for DHS are not still established. This study aimed to assess surgical procedures and complications in surgery for DHS. **Material and Methods:** Excluding patients with rigid deformity and history of C1/2 fixation, twenty-three consecutive patients undergoing surgery for DHS with cervicothoracic lesion were retrospectively analyzed on surgical procedures, post-operative complications and radiological parameters. **Results:** Surgical procedures were anterior and posterior fixations in 19 and only posterior fixations in 4 patients. The upper instrumented vertebrae (UIV) of posterior lateral fixations (PLF) were C2 in 11 and C3 in 12 patients. The lower instrumented vertebrae (LIV) were C7 in 1, T1 in 1, from T2 to T4 in 18 and T5 or T6 in 3 patients. Mean rages of anterior cervical discectomy and fusions (ACDF) were 3.3 levels. C5/6 and C6/7 were included in most of cases. All of patients could keep the head up against gravity and their radiological parameters of cervical sagittal balance were improved after surgery. Two patients led to instrumentation failures. One patient required revision surgery for failure at LIV of C7. Another patient with posterior fixations alone showed the back-out of rostral screws. The other two patients presented with postoperative dysphagia. Severe dysphagia soon after only posterior fixations was resolved by the reoperation of lessening cervical lordosis in one patient. Mild dysphagia was spontaneously recovered in several months after multilevel anterior fixations in the other. **Conclusions:** Multilevel ACDF with PLF is basically recommended in surgery for DHS, in order to keep a great correction of the cervicothoracic junction (CTJ) against gravity. LIV of PLF is extended to upper thoracic spine (T2-4) for including the CTJ. UIV at C3 may be sufficient when bilateral pedicle screws were inserted at C3 and C4. Multilevel ACDFs includes C5/6 and C6/7, because of main pathology at the CTJ. Excessive formation of cervical lordosis should be avoided, because it can cause severe dysphagia. Preoperative assessment of swallowing function may be necessary in elderly patients, because they have a risk of latent swallowing disturbance.

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P024: Atlantoaxial subluxation: an asymptomatic complication of rheumatoid arthritis

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Introduction: Rheumatoid arthritis is a chronic inflammatory autoimmune disease characterized by chronic synovitis of multiple joints. Atlantoaxial subluxation is a rare but potentially life-threatening complication of patients with rheumatoid arthritis. Defined when the space between the odontoid process of C2 and the arch of the atlas exceeds 3 mm. Atlantoaxial instability can result in spinal cord compression followed by secondary neurological complications. Arthrodesis surgery should be performed when there are signs of myelopathy associated with instability or radiological signs of instability with a 7 mm distance between the atlas and odontoid (atlantoaxial) anterior arch interval (in these cases there is a strong suspicion of ligament insufficiency). Surgery is usually performed using the Wright technique (fixation of the lateral mass of C1 and interlaminar of C2). Early identification of this pathology is crucial to prevent neurological symptoms. The objective of this study are to determine the characteristics of atlantoaxial subluxation in patients with rheumatoid arthritis who underwent cervical arthrodesis surgical procedure and to demonstrate the protocol performed by the Institution for screening this complication. **Methods:** A retrospective cohort screened from 2015 to 2021 by medical records. Inclusion criteria were rheumatoid arthritis patients and cervical arthrodesis surgery due to atlanto-axial subluxation. Literature review was performed to identify an algorithm for atlanto-axial instability screening. **Results:** Seven patients were enrolled. All patients had limb joint deformities. All had atlantoaxial subluxation greater than 7 mm and two had basilar invagination. Average time from arthritis diagnoses to arthrodesis procedure was 21 years (min 10y; max 31y). Only one patient reported paresthesia in the upper limbs and alteration in the physical examination, with the presence of clonus and hyperreflexia. The other patients were asymptomatic and did not present any changes in the physical examination from a neurological point of view. The median distance of anterior atlantoaxial subluxation was 8.8mm (min 8mm; max 13mm). Screening of the atlanto-axial subluxation was performed in symptomatic and asymptomatic patients with risk factors including age of disease greater than 10 years and erosive disease. The exams consists of cervical radiography in flexion, neutrality and extension. **Conclusion:** It is relevant to screen for atlantoaxial subluxation in patients with joint deformities and with long-term disease using dynamic radiography of the cervical spine, as the relationship between instability and clinical symptoms is weak.

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P025: Bilateral C6 spondylolysis with spondylolisthesis in a 23 years old man incident revealed after a traffic accident

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Introduction: Cervical spondylolysis is a rare condition described as a cleft in the articular mass of a cervical vertebra that occurs at the junction of the superior and inferior facet joints, and is considered the cervical equivalent of pars interarticularis in the lumbar spine. **Material and Methods:** We report the case of a 23 years old man presented to our emergency department after a motor vehicle accident with cranial trauma. Cervical spine examination was without abnormalities. **Results:** Cervical spine radiographs showed spondylolisthesis and oblique defect in the pars interarticularis of C6. Body CT confirmed the spondylolysis of C6. MRI was performed to eliminate a post-traumatic lesion. **Conclusion:** Spondylolysis involving cervical spine is a rare condition usually diagnosed in patients after minor trauma or as an incidental finding on routine radiography. The C6 level is most commonly involved, and the cause of CS remains unknown.

Deformity-Thoracolumbar (Adolescent)

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P026: Adolescent idiopathic hyperkyphosis: how the change of instrument in surgery, from circular rod to rail-shaped rod, has affected outcomes - A service evaluation

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Introduction: Adolescent Idiopathic Hyper Kyphosis (AIHK) is a spinal deformity characterised by an abnormal anterior curve of the spine. The surgical treatment involves the posterior placement of a metal instrument along the spine. At University Hospital Southampton (UHS), the instrument used has changed from a circular rod to a stiffer rail-shaped rod. The aim of this evaluation was to determine how the change of instrument has affected the outcomes for young people with AIHK. **Material and Methods:** Data was retrospectively collected on all AIHK patients between 2007 and 2019. All underwent surgery by a single surgeon. Patients were divided into two groups, based on the instrument used. Implant failure resulting in revision surgery was the primary variable used to determine the efficacy of the instruments. **Results:** The circular rod group (CG) comprised of 6 patients and the rail-shaped rod group (RG) of 15 patients. 16.7% (n = 1) of the CG group and 20% (n = 3) of the RG group underwent revision surgery due to implant failure. In the CG group, there were no cases of revision surgery due to spinal or surgical failure. In the RG group, 13.3% (n = 2) underwent revision surgery due to spinal failure and 6.7% (n = 1) due to surgical failure. The RG group encountered more complications than the CG group. **Conclusion:** The rail-shaped rod had a higher revision and complication rate than the circular rod but the disparity in group size limits the validity of this

Conclusion. This evaluation was unable to conclude how the change of instrument affected the outcomes of surgery.

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P027: First Latin American blended pediatric spine course: what we learned?

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Introduction: The global nature of education requires a dissemination of knowledges as its fundamental base, because physicians can only improve their skills and awareness through education. The number and quality of scientific conferences about pediatric spine around the Latin-American annual regional congresses had been found restricted and minimally focused. One of the great limitations in Latin America is the lack of resources to travel and language barriers. The increase of current technological advances and changes in the educational techniques, allowed a creation of a blended course about pediatric spine for surgeons in Latin America. **Materials and Methods:** The first Latin American blended course encompass a 4 weekly virtual (webinar Zoom platform) interactive sessions over the month of October, 2021 with a multi- institutional team of spine care providers. The primary language spoken was Spanish. The course was organized in two stages: the first part online education and the second part a face to face activity. The promotion was made through social media and email. The main topics were adolescent idiopathic scoliosis, early onset scoliosis, kyphosis and spondylolisthesis. Each academic session consisted of a general concept lecture followed by a two case presentation and discussion. A pre-course and a post-course learning objective assessment was evaluated based on 10 points Likert scale (1, not confident at all; 10, very confident) assessing their backgrounds, confidence in the diverse pediatric spine concepts (initial evaluation, natural history, conservative treatment, surgical management and complications) and their opinions of the quality of the meeting, besides a pre and post course test. **Results:** Most of the audience were young general orthopedic surgeons, with

limited experience and training in pediatric spine management (80%). We had orthopaedic surgeons from 16 Latin American countries, 4 Caribbean countries, USA and Spain. The adolescent idiopathic scoliosis session had most of the assistance (176 surgeons), followed by early onset scoliosis (92 surgeons), kyphosis (75 surgeons) and spondylolisthesis (66 surgeons). The statistical analysis compared the pre-course with post-course learning objective and test **Results** showing a statistically significant improvement between the initial and the final learning objective **Results**. On a 1-10 scale, idiopathic adolescent scoliosis **Results** changed from 6.5 to 9.3, early onset scoliosis from 7 to 9.3, kyphosis from 5.1 to 8.8 and spondylolisthesis from 5 to 9 in average. Feedback obtained from this course on usefulness and personal impact to improve their performance and outcome in the pediatric spine was 89% positive for the attendees. **Conclusion:** This course shows the great interest and need for knowledge and skills in the management of pediatric spinal conditions in Latin America. Blended learning approach shows that it is a feasible and effective way through showing the statistically significant change in the participants knowledge in the spinal complex problems. The final result encourages the organization for more educational experiences in the future, delivering integrated and engaging spine subjects through diverse platforms that can be extrapolated to other underdeveloped regions.

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P028: Pre-operative use of traction views in adolescent idiopathic scoliosis surgery

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Purpose of Study: To review the use of traction x-rays pre surgery in the management of adolescent idiopathic scoliosis using pedicle screw constructs. **Description of Methods:** This is a retrospective study. Ethics clearance No M190333 from human research ethic committee of the University of Witwatersrand. Data collected between March 2015 March 2019. Patients were recruited from Charlotte Maxeke Johannesburg Academic Hospital. Demographic data and pre-operative x-rays were acquired. Use of neuro monitoring in all cases. All patients received Total Intravenous Anesthesia (TIVA). Linear traction views were obtained in all cases under pre-operatively under anesthesia. Data was entered into an excel sheet. Statistic software was used to analyze the data. **Summary of Results:** A total number of 23 patients with 31 curves were enrolled in this study. Average age was BETWEEN 3- 22years. Mean pre-operative Cobb angle will be calculated. Mean angle degrees will obtain for both traction views and post-operative views.

With this data available, Total Correction Index (TCI) will be calculated. **Conclusion:** Traction views under anesthesia were found to be a good predictor of correction in the late onset scoliosis.

Deformity-Thoracolumbar (Adult)

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P029: Thoracolumbar slope is related with health-related quality of life and aggravation of sagittal imbalance in patients with adult spinal deformity: prospective observational cohort study

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Introduction: The purpose of the present study was to evaluate the natural course of primary degenerative sagittal imbalance (PDSI), its aggravating factors, and health-related quality of life (HRQOL) associated with various SAPs in patients with PDSI who have not undergone surgery. **Material and Methods:** 103 participants volunteered to participate. The spinal alignment parameters (SAPs), including T1 pelvic angle (T1PA), thoracolumbar tilt (TLT) and slope (TLS), were measured on whole-spine standing radiographs. The back and lumbar muscle volumes were measured. To determine HRQOL at baseline and at 2-year follow-up, face-to-face questionnaires were administered, which included visual analogue scale (VAS) of the back and leg, Physical Component Summary (PCS)/Mental Component Summary (MCS) of Short Form-36 (SF-36), Oswestry Disability Index (ODI), and Mini-Mental State Exam (MMSE). **Results:** Overall HRQOL measures had improved after 2-years of follow-up compared to baseline. PDSI aggravation was observed in 18 participants (26.1%). TLS, sagittal vertical axis (SVA), and T1PA were strongly correlated with each other. TLS, SVA, and T1PA were correlated with ODI score. Among them, TLS was most highly correlated with ODI score. TLS greater than -3.5o was a predicting factor for PDSI aggravation ($p = .034$; confidence interval: 1.173-63.61, odds ratio 8.636). **Conclusion:** The present study implied that PDSI does not necessarily worsen with aging. TLS is an appropriate parameter for assessing the clinical situation in patients with PDSI. Furthermore, a TLS greater than -3.5o predicts PDSI aggravation; thus, TLS may be a useful parameter for predicting prognosis in PDSI.

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P030: Investigation of screw backout after adult spinal deformity surgery - comparative study between cobalt chrome rods and titanium alloy rods

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Introduction: Several risk factors relating with proximal junctional kyphosis (PJK) after adult spinal deformity (ASD) surgery have been reported. Although rod material could be one of the factors, few articles have mentioned the difference in screw backout between cobalt chrome rods (CoCr) and titanium alloy rods (Ti). The purpose of this study is to evaluate screw backout and sagittal alignment of the spine using CoCr rod or Ti rod. **Material and Methods:** We retrospectively reviewed 56 patients who underwent ASD surgery. 37 patients were corrected using CoCr rod (CoCr group) and 19 patients were corrected using Ti rod (Ti group). The preoperative and postoperative sagittal alignment parameters were measured on the standing lateral radiographs preoperatively, at 1 week postoperatively, and at 6 months postoperatively. Screw insertion rate was defined as length of pedicle screw into the vertebral body divided by sagittal diameter of the vertebral body. Oswestry Disability Index (ODI) and Visual Analogue Scale (VAS) were used to evaluate functional status and pain. **Results:** The two groups had no significant difference in demographic data, bone mineral density, preoperative sagittal alignment parameters and location of UIV. In CoCr group, the screw insertion rate was 5.4% at 1 week postoperatively and significantly decreased to 43.5% at 6 months ($P < .01$). In Ti group, although the screw insertion rate decreased from 54.5% at 1 week to 51.7% at 6 months, there was no significant change ($p = .12$). While pelvic tilt (PT), thoracic kyphosis (TK) and sacral slope (SS) improved postoperatively, the both groups showed no significant change in PT, TK, and SS at 6 months. There was no significant difference between the two groups in the presence of PJK (CoCr: 29.7% vs Ti: 26.3%, $p = 1.00$), ODI (CoCr: 21.5 vs Ti: 28.9, $p = .31$) and VAS (CoCr: 17.7 vs Ti: 19.2, $p = .87$) at 6 months. **Conclusion:** In this study, the screw backout was identified in CoCr group than Ti group, despite of no significant difference in demographic data, bone mineral density, preoperative sagittal alignment parameters between the two groups. These indicate that the backward load due to spring-back may be larger in CoCr rods since the forward tilting of patients may be equivalent between the two groups. Although there was no significant difference in the occurrence of PJK at

6 months, PJK may result from the contradiction between forward tilting of patients and the backward load due to spring-back of rods.

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P031: In adult spinal deformity surgery, are all mechanical complications created equally?

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Introduction: When each specific type of mechanical complication occurs and how it impacts patient-reported outcomes (PROs) after adult spinal deformity (ASD) surgery remains unknown. We sought to: a) describe the time course of each mechanical complication, and b) compare mechanical complications with regards to demographics, operative variables, radiographic measurements, and preoperative PROs. **Material and Methods:** A single-institution, retrospective cohort study was undertaken of patients undergoing ASD surgery from 2009-17. Exposure variables included patient demographics, operative variables, radiographic measurements, and preoperative PROs, including Oswestry Disability Index (ODI) and Numeric Rating Scale Back/Leg pain scores (NRS-Back/Leg), EuroQol-5D (EQ-5D), and satisfaction. The primary outcome was occurrence of a mechanical complication and time to complication. Due to overlapping occurrence, rod fracture and pseudarthrosis were grouped into one category. **Results:** A total of 145 patients underwent ASD surgery. Patients with mechanical complications had more comorbidities ($P = .005$), higher rates of COPD ($P = .033$), and higher NRS-Leg pain preoperatively ($P = .011$). Of those patients with mechanical complications, 59 (4.7%) required reoperation at a median of 16.3 months. Of patients with proximal junctional kyphosis (PJK), 30 (63.8%) required reoperation at a median of 16.3 months, whereas 27 (87.1%) patients with pseudarthrosis/rod fracture underwent reoperation at a median of 18.4 months. Time to reoperation significantly differed in PJK (16.3 m) vs. pseudarthrosis/rod fracture (18.4m) (log-rank test; p -value = .034). Distal junctional kyphosis (DJK) ($N = 3$; 2 reoperation) and implant-failures ($n = 4$; 0 reoperations) had low numbers, which limited analysis. PJK had significantly lower Hounsfield Units compared to pseudarthrosis/rod fracture (138.2 ± 43.8 vs 16.3

± 41.0 , $p = .038$), more prior fusion (51.1% vs 25.8%, $p = .026$), fewer instrumented vertebrae (9.2 ± 2.6 vs 1.7 ± 2.5 , $P = .013$), higher postoperative thoracic kyphosis (TK) (46.3 ± 12.7 vs 34.9 ± 1.6 , $P < .001$), and higher spine sagittal alignment (SVA) (8.7 ± 72.1 vs 51.9 ± 57.3 , $P = .081$). No differences were seen in preoperative PROs. **Conclusion:** Patients with pseudarthrosis/rod fracture had higher rate of reoperation compared to patients with PJK, though patients with PJK required reoperation sooner. Taken together, even though mechanical complications are often analyzed as a single group, this study shows that delicate differences exist between them.

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P032: What radiographic and clinical factors ultimately lead to a C2-sacrum instrumented spinal fusion?

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Introduction: Deformity patients sometimes undergo multiple operations, and a subset require C2-sacrum fusion. There is a paucity of literature on the reasons for such extensive spinal reconstructions. **Material and Methods:** Consecutive C2-Sacrum fusion patients operated on by 4 surgeons at a single-center from 2015-2020 were reviewed. Demographics, comorbidities, indications, and surgical history were collected. **Results:** 23 patients underwent C2-sacrum instrumented fusion. 13 (57%) were male, and 21 (91.3%) were adults. Mean age was 44 years (range 5-71) at first spine surgery and 53 years (range 14-72) at the time of C2-sacrum fusion. 26% (6) of patients had osteoporosis, and 26% (6) of patients had neurologic comorbidities -including Parkinson's disease (4), cerebral palsy (1), and Brown Sequard syndrome (1). 4 (17%) had connective tissue disease. Two patients underwent C2-sacrum fusion as an index procedure: (1) 67M with myelomatous fractures and 140° of cervicothoracic kyphosis; (2) 28F with Marfan syndrome with 140° thoracic scoliosis and 130° thoracic kyphosis. The remaining 21 (91%) underwent C2-sacrum fusion for complications from prior surgeries - on average, 4 prior surgeries (range 1-13) over 1.5 years (range .3-37.4). Revision C2-sacrum procedures included 16 (76.2%) for sagittal malalignment (15 PJK; 1 DJK), 2 (9.5%) for coronal

malalignment, 2 (9.5%) for implant failure, and 1 (4.8%) for myelopathy. **Conclusion:** Most patients requiring C2-sacrum fusion were treated as revisions of prior fusions due to sagittal malalignment, with a mean of 4 prior surgeries over 10 years. 26% had neurologic conditions, and 26% had osteoporosis. Revision to C2-sacrum fusion was usually for PJK (71%), followed by implant failure (9.5%) and coronal plane deformity (9.5%).

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P033: Effectiveness of pars repair technique in young patient with spondylolysis using pedicle screw and U-shaped rod construct

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Introduction: The first written description of spondylolysis is attributed to Herbiniaux, a Belgian obstetrician, in 1782, who described anterior subluxation of L-5 onto S-1. The introduction of lumbosacral CT scan and MRI has led to facilitate the diagnosis and the knowledge of the natural history of this spinal pathology. First Mayerding, then Wiltse and Newman and recently Mac-Thiong have proposed classifications systems, which help the surgeons discriminating patients who need to be surgically treated from those who need not. In addition, surgical options have evolved and differentiated, proposing different technical strategies to obtain on one side the better fusion sacrificing the mobility of the pathologic segment, and on the other side the reparation of the osseous defect, respecting as much as possible the dynamic and mobility of the spine, with the objective of evitate the worsening of degenerative pathology on the junctional segments (especially in young patient). **Material and Methods:** The grown number of young patients who receive a diagnosis of Spondylolysis and consult our team to solve that problem, has led us to get interested in minimal invasive technique. We have found very interesting the reconstruction technique with screw and rod proposed by Gillet and Petit, and so we have perfectionated the surgical technique and we have collected patients data. We have proceeded selecting young patients, characterized by an optimal bone repair capacity, with lower grade of listhesis. This highly selected patients have been operated

with the isthmic reconstruction technique and then they are studied in order to comprehend if this technique is effective in this patients. **Results:** The patients selected was 6 from 2015 to 202. All the patients are young adult (age from 15 - 44 years old, with a mean age of 30 years old) and they present a complete spondylolysis L5/S1 with or without discopathy. All of them have underwent to all conservative treatment (such as Drugs, Physical therapies, Physiokinesic and Pain Therapy) without any satisfactory Results. All of them have underwent to our observation because of a poor quality of live and a very disabling symptoms. In all cases we realized the isthmus reconstruction technique. The screws have been positioned without complication and there hasn't been any complication in the first month after surgery. The patients have all been treated after the first month with Physical therapy and Physiokinesic. We collected then data in a year follow-up. All the patients have referred an improvement in the back pain in the 2 month after the surgical procedure. One patient has presented a worsening 3 month after surgery, with failure of the various conservative treatment, and so he has needed a new surgical procedure, undergoing to L5/S1 arthrodesis with progressive improvement. **Conclusion:** In our experience Isthmic reconstruction is a good surgical alternative to the spine fusion in very selected patients with spondylolysis. So we think that this technique must be always considered as treatment option and must be offered to all patients that have right criteria.

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P034: Heterogeneity of surgical approach for adult spinal deformity patients

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Introduction: As the population ages and surgical techniques and implants improve, more adult spinal deformity (ASD) patients are being treated surgically. Many studies have focused on outcomes measures and complications rates as a way to evaluate ASD surgery, but there is little literature describing the optimal surgical approach. Variability of surgical approach exists across institutions and physicians because no approach has been shown to be superior to others. The authors objective was to describe the heterogeneity of surgical approach at the thoracolumbar junction at one academic institution over a ten year period. **Material and Methods:** A retrospective chart review of ASD patients undergoing primary fusion from the thoracolumbar junction (T10 through L1) to the pelvis from 1/2010-5/2020 was conducted. Surgical approach, staging, duration of surgical time, and blood loss were collected from the operative report.

Results: 52 patients (16M/36F) were eligible for inclusion. Average age of the cohort was 67.3 years (31-83) and average BMI was 28.76 (18.76-38.22). 11/52 (21%) were multistage procedures. For multistage procedures, all had two stages, of which 1/11 utilized a single approach (Post); 8/11 (73%) utilized two approaches (Lat/Post or Ant/Post); and 2/11(18%) utilized three approaches (Ant/Lat/Post). 41/52 were single stage procedures. For single stage procedures, 37/41 (90%) were performed using a single approach (post); 2/41 (5%) utilized two approaches (Ant/Post or Lat/Post) and 2/41 (5%) utilized three approaches (Ant/Lat/Post). Average blood loss (2005mL v 1661mL; $P = .85$) and skin to skin operative time (10hr 20min v 7hrs 25min; $P = .052$) for multi and single stage procedures, respectively, were not statistically significant. Average total OR time between multi and single stage procedures (12hr 57min v 8hr 59min, respectively) was statically significant ($P = .036$). **Conclusion:** Single stage, posterior fusion was the most prevalent approach, but significant variation exists in the surgical treatment of patients undergoing primary spinal deformity surgery.

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P035: Placement of multiple points of pelvic fixation in spinal deformity surgery

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Introduction: Pelvic fixation is an evolving topic with aim to minimize failure of fixation construct. Our objective is to evaluate the use and frequency of multiple implant constructs at our institution for pelvic fixation. **Material and Methods:** We retrospectively reviewed a consecutive series of patients receiving pelvic fixation for adult spinal deformity (ASD) over a 10-year period. Pelvic fixation constructs in the study included traditional iliac screws, S2-alar-iliac (S2AI) screws, and triangular titanium implants (TTI). **Results:** The total amount of implants placed over the 10-year period was 810 implants with an average of 2.18 implants per patient among the 372 patients. 46 patients received multiple implant constructs in total. 82.6% of patients received multiple implant constructs in the more recent 5-year period, with 76.1% of patients undergoing surgery in the last 2 years. The majority of the multiple implant constructs were dual, stacked S2AI screws. 12 patients received triangular titanium implants along with S2AI screws all of which were within the last 9-months of the cohort. **Conclusion:** At our institution, there is an increasing trend to using multiple implant constructs for pelvic fixation including iliac screws with S2AI screws, multiple stacked S2AI screws, and S2AI screws used in conjunction with triangular titanium implants.

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P036: Cost benefit of implementation of risk stratification models for adult spinal deformity surgery

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Background: Numerous factors have been postulated to influence adverse events in the setting of adult spinal deformity (ASD) surgery including the Lowest Instrumented Vertebrae (LIV) at pelvis, frailty, and sagittal deformity blood loss, and surgical time. The impact of these individual parameters on cost-effectiveness of deformity surgery is not well understood. **Purpose:** To assess the extent to which defined risk factors of adverse events are drivers of cost-effectiveness. **Study Design/Setting:** Retrospective cohort study. **Patient Sample:** 727 ASD patients. **Methods:** ASD patients with baseline (BL) and 2-year (2Y) Health-Related Quality of Life and radiographic data were included. The highest tertiles of frailty, sagittal deformity, blood loss, and surgical time were defined

as possessing these risk factors. Cost was calculated using the PearlDiver registry. We compared cost effectiveness (cost per QALY) at 2Y between cohorts based on the number of risk factors present at baseline. Statistically significant differences in cost-effectiveness by number of baseline risk factors were determined using ANOVA. **Results:** 727 patients met inclusion criteria for this study. By two years, 74% of the cohort experienced any type of complication, 31% experienced a major complication, and 23% underwent a reoperation. Patients with 2 or less risk factors had significantly less major complications. Patients with 2 risk factors improved the most from baseline to 2Y in ODI. Average cost increased by \$11,566 per risk factor ($R^2 = .897$). When considering initial surgical cost, there was a \$3,844 increase in expenditures per risk factor ($R^2 = .8703$). Cost per QALY at 2Y increased by \$45,852 per risk factor ($R^2 = .4151$). However, patients with 1 and 2 risk factors achieved the most cost-effective outcomes overall compared to each group with 0, 3, or 4 risk factors (all $P < .001$). **Conclusions:** The number of defined risk factors at baseline were significantly associated with increased index surgical costs, reduced HRQL outcomes and diminished cost-effectiveness. Yet, patients with one or two risk factors fared the best in terms of costs per QALY at two years. Therefore, preoperative or intraoperative measures to optimize patient physiology and minimize higher surgical risk would likely reduce healthcare expenditures and improve the overall cost-effectiveness profile for ASD interventions.

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P037: Identifying delays in adult spinal deformity surgery in the setting of a multidisciplinary approach

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Introduction: Adult spinal deformity surgery is associated with high rates of perioperative adverse events (AE). To minimize the risk of AEs, our institution requires that patients undergo a rigorous pre-operative evaluation and optimization. The decrease in AEs brought out by this optimization may come at the cost of an increase in delay to surgery date. We aimed to determine the origin of any delay so that our team and those with similar systems might better anticipate and address these delays. **Material and Methods:** This study is a retrospective case series where complex spine procedures for treatment of adult spinal deformity from 1/1/18 to 8/31/21 were identified. Procedures for infection, tumor, and urgent/emergent cases were excluded. Surgeries that were delayed due to COVID, or those that deviated from the established care pathway were also excluded. The electronic health record was

used to identify the cause of preoperative scheduling delays. **Results:** Of 235 patients scheduled for complex spine surgery, 193 met criteria. Of these patients, 35 had a surgical delay (18.1%). The reasons for delay from most to least prevalent were medically unoptimized ($n = 1.5$, 5.4%), peri-operative medical complication ($n = 7$, 3.6%), patient directed delay ($n = 6.25$, 3.2%), patient illness/injury ($n = 4.75$, 2.5%), scheduling complication ($n = 3.5$, 1.8%), insurance delay/denial ($n = 2$, 1.0%), and unknown ($n = 1$, .5%). **Conclusion:** At a single multidisciplinary complex spine center, we identified a variety of reasons for surgical delays. Of the identified delays, over a third were inevitable (patient directed delays, patient illness/injury, and insurance denials ($n = 13$, 6.7%)). For delays that were not inevitable, we suspect that the preoperative protocol might increase delays for unoptimized patients (e.g., patients still using nicotine), as the protocol is intended to ensure patients receive surgery only when they are medically ready. Further research is needed to determine the economic and system impact of delays related to a preoperative optimization protocol weighed against the reduction in adverse events these protocols can provide.

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P038: Evaluation of coronal alignment from the skull using the novel orbital-coronal vertical axis line

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Introduction: In the evaluation of patients with adult spinal deformity (ASD), radiographic measurements evaluating coronal alignment above C7 are lacking. The current objectives were to: 1) describe the new orbital-coronal vertical axis (ORB-CVA) line that evaluates coronal alignment from cranium to sacrum, 2) assess correlation with other radiographic variables, 3) evaluate correlations with patient-reported outcomes (PROs), and 4) compare the ORB-CVA to the standard C7-CVA. **Material and Methods:** A retrospective, cohort study of adult spinal deformity (ASD) patients from a single-institution was undertaken. Traditional C7-Coronal Vertical Axis (C7-CVA) measurements were obtained. The Orbital-CVA (ORB-CVA) was defined as the distance between the central-sacral vertical-line and the vertical line from the mid-

point between the medial orbital walls. The ORB-CVA was correlated with traditional coronal measurements, including C7-CVA, maximum coronal Cobb angle, pelvic obliquity (PO), leg length discrepancy (LLD), and coronal malalignment (CM) defined as a C7-CVA >3cm. Measures of clinical improvement were: 1) group means, 2) minimum clinically important difference (MCID), and 3) minimal symptom scale (MSS) (ODI < 20 or SRS-pain+function>8). **Results:** 243 patients underwent ASD surgery, and 175 had 2-year follow-up. 90/243 (37%) patients had preoperative CM. Mean (range) ORB-CVA at each time point was: preoperative 2.9 ± 3.1 (-14.2-25.6), 1-year postoperative 2.0 ± 1.6 (-12.4-6.7), 2-year postoperative 1.8 ± 1.7 (-6.0-11.1), ($P < .001$ from preoperative to 1-year and 2-year). Preoperative ORB-CVA correlated best with CVA ($r = .842$, $P < .001$), max coronal Cobb ($r = .166$, $p = .010$), PO ($r = .293$, $P < .001$), and LLD ($r = .158$, $p = .006$). Postoperatively, ORB-CVA correlated only with CVA ($r = .627$, $P < .001$) and LLD ($r = .160$, $p = .013$). 155/243 (63.8%) patients had an ORB-CVA that was ≥ 5 mm different from C7-CVA. The ORB-CVA correlated as well and sometimes better than C7-CVA in SRS-22r subdomains. After multivariate logistic regression, a higher ORB-CVA was associated with an increased odds of complication, whereas C7-CVA was not associated with any of the three clinical outcomes. A larger difference between the ORB-CVA and C7-CVA was significantly associated with readmission and reoperation after univariate and multivariate logistic regression analysis. A threshold of ≥ 1.5 cm difference between the preoperative ORB-CVA and C7-CVA was found to be predictive of poorer outcomes. **Conclusion:** The ORB-CVA correlated well with known coronal measurements and PROs. ORB-CVA was independently associated with an increased odds of complication, whereas C7-CVA was not associated with any outcomes. A ≥ 1.5 cm difference between the preoperative ORB-CVA and C7-CVA was found to be predictive of poorer outcomes.

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P039: Improvements in outcomes and costs after adult spinal deformity corrective surgery between 2008 and 2019

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Introduction: Surgery for adult spinal deformity (ASD) is an effective intervention, but one that is also associated with large initial healthcare expenditures. As surgical techniques and technology advance, so should improvements in patient outcomes and efficacy for these procedures. Changes in the cost profile for ASD surgery over the last decade has not been evaluated previously. **Material and Methods:** ASD patients who received surgery between 2008-2019 and who also had baseline (BL) and up to 2-year (2Y) HRQL data were included. ANCOVA was used to marginal means for outcome measures (complication rates, reoperations, HRQLs, total cost, utility gained, QALYs, cost efficiency [cost per QALY]) by year of initial surgery adjusting for covariates including age, gender, decompression or osteotomy, surgical approach, invasiveness, and BL deformity (Pelvic Tilt, Pelvic Incidence, Lumbar Lordosis), with trend-line slope used to account for annual alterations. Cost was calculated using the PearlDiver database and represented national averages of Medicare reimbursement for services within a 30-day window including length of stay and death differentiated by complication/comorbidity, revision, and surgical approach. Internal cost data was based on individual patient DRG codes, limiting revisions to those within 2Y of the initial surgery. Cost per QALY over the course of 2008-2019 were then calculated.

Results: There were 1236 patients included with no significant differences in baseline ODI by year. There was an overall decrease in rates of any complication (.78 vs .61), any reoperation (.25 vs .10), and minor complication (.54 vs .37) between 2009 and 2018 (all $P < .05$). Minor complications decreased by 2.48% per year ($R^2 = .5179$), with a 1.84% yearly decrease in any complication ($R^2 = .8322$), 1.33% decrease in any reoperation ($R^2 = .2211$), and .82% decrease in major complication ($R^2 = .1435$). BL to 2Y difference in SF-36 PCS had the greatest improvement (.2526 increase per year, $R^2 = .3985$), while ODI BL to 2Y difference improved by .3687 per year ($R^2 = .3683$). National average 2Y cost decreased at an annual rate of \$3,194 ($R^2 = .6602$), 2Y Utility Gained increased at an annual rate of .0041 ($R^2 = .57$), 2Y QALYs Gained increased annually by .008 ($R^2 = .57$), and 2Y Cost per QALY decreased per year by \$39,953 ($R^2 = .6778$). **Conclusion:** Between 2008 and 2019, rates of complications have decreased concurrently with improvements in patient reported outcomes, resulting in improved cost effectiveness according to national Medicare average and individual patient cost data. The value of ASD surgery has improved substantially over the course of the last decade.

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P040: The varus knee phenomenon in spinal deformity patients

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Introduction: There is scant literature describing coronal compensatory mechanisms of the lower extremities in patients with complex spinal deformities. This study aims to report the prevalence of compensatory varus knee phenomenon in spine deformity patients and assess the change in lower extremity mechanical axis after deformity correction surgery. **Material and Methods:** A retrospective, single-center radiographic review of all patients receiving spinal deformity surgery by a single surgeon between July 2015 and July 2018 were included in this study. The postoperative films from the first follow-up were used for the analysis. The mechanical axis deviation (MAD) is the distance measured from the lower extremity mechanical axis to the center of the tibial spine. The

varus knee position was defined when the center of the knee was 20 mm lateral to the mechanical axis of the lower extremity. Logistic regression was used to identify if spinal deformity surgery could restore the lower extremity mechanical axis deviation. **Results:** Among the adult patients with malalignment, there were significant improvements in MAD, SVA, and KFA after surgery. MAD decreased from 28.2 ± 15.6 mm to 2.2 ± 17.5 mm on the right lower extremity ($p = .02$); on the left, MAD decreased from 28.5 ± 16.5 mm to 2.2 ± 15.8 mm ($p = .003$). SVA decreased from 73.2 ± 68.9 mm to 39.5 ± 36.0 mm ($p = .003$). KFA decreased from $15.1 \pm 8.0^\circ$ to $12.3 \pm 8.9^\circ$ ($p = .009$). Specifically, those with varus malalignment experienced significant improvement in these parameters while those with valgus alignment did not. Among those with varus malalignment, MAD changed on the right from 29.9 ± 17.4 mm to 21.1 ± 19.1 mm ($P < .001$). On the left, MAD changed from 31.8 ± 17.4 mm to 2.3 ± 14.1 mm ($p = .002$). SVA changed from 76.4 ± 73.9 mm to 37.8 ± 36.6 mm ($P < .001$). KFA likewise decreased from $16.1 \pm 11.6^\circ$ to $12.6 \pm 9.8^\circ$ ($p = .02$). Such improvements were not seen among those with valgus malalignment. Among pediatric patients with malalignment, there was an improvement in MAD on the left side following surgery from 26.4 ± 14.8 mm to 11.6 ± 7.8 mm; however, the other parameters did not change significantly following operative intervention in the pediatric subjects. **Conclusion:** The coronal lower extremity malalignment in spinal deformity patient is present in 19.7% of the adult cohort. More than 50% of adult patients with the varus knee phenomenon self-corrected to neutral lower extremity mechanical axis after spinal deformity correction. Within the varus group, the spinal deformity surgery improved the SVA, KFA, and mechanical axis deviation.

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P041: Predictors of cervical sagittal range of motion 2-years postoperative following thoracolumbar spinal deformity surgery

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Introduction: Given the extensive flexibility of the cervical spine, it carries a significant burden to maintain adequate range of motion (ROM) in order to preserve horizontal gaze. Although static cervical alignment has been studied following thoracolumbar (TL) deformity surgery, little is known about the dynamic functionality of the cervical spine, measured with cervical spine range of motion (CSROM). We aim to evaluate predictors for postop CSROM in patients undergoing TL deformity surgery. **Material and Methods:** Patients undergoing TL deformity surgery at a single-center from 2016-2018 with pre- & 2-year postop cervical flexion/extension (F/E) x-rays were included. CSROM was measured using the C1-7, C2-7 & O-C7 Cobb angles using F/E cervical x-rays. Cervical malalignment was measured using T1 Slope–Cervical lordosis (TIS-CL). Cervical degeneration (CD) was measured as detailed by Gore et al. (0-100). Multivariate linear regression was performed to assess the association between several preop variables & postop CSROM. **Results:** 36 TL spinal deformity patients (78% female) with a mean age of 62.2 years were identified. Mean levels fused was 16.5 and 32(89%) pts had a UIV above T4. The average preop C1-7 CSROM was $59.6^\circ \pm 16.89^\circ$. There was a significant positive correlation between preop C1-7 CSROM ($r = .579$, $p = .00002$) and postop C1-7 CSROM. There was a significant negative correlation between preop T1SCL ($r = -.512$, $p = .001$), T2-5 kyphosis ($r = -.437$, $P = .0097$), and age ($r = -.473$, $p = .005$) with postop C1-7 CSROM. Patients with a preop CD of > 40 experienced a significant decrease in their postop C2-7 CSROM [$-6.8063^\circ (\pm 11.4840^\circ)$, $P = .0316$]. A linear regression model revealed that the following factors were significantly associated with increased postop C1-7 & O-C7 CSROM: higher preop CSROM, lower T1-SCL, decreased age & less T2-5 kyphosis ($r^2 = .4901$, $P = .0076$). **Conclusion:** This is the first study to show that prior to TL deformity surgery, the strongest predictor of postop CSROM is preop CSROM. In addition, the following preop factors were also significantly associated with greater postop CSROM: younger age, less upper thoracic kyphosis, and minimal cervical sagittal malalignment.

Study Design: A retrospective cohort study. Objective: Our goal was to evaluate the perioperative complications in patients with a staged pedicle subtraction osteotomy (PSO) in the setting of iatrogenic flat back syndrome. **Summary of Background Data:** Complications after a PSO in the setting of iatrogenic flat back syndrome are increasingly high due to the complexity of the osteotomy and the prolonged procedure time. The present study is directed at assessing the merit of staging PSO's in a previously fused spine in an attempt to decrease the perioperative complications and increase surgeon performance. **Methods:** A retrospective cohort study was performed of patients who underwent a staged PSO for iatrogenic flat back syndrome between August 2015 to November of 2020 by a single fellowship trained spine surgeon. Perioperative complications (within 90 days of surgery) were analyzed to include 90 day readmission, neurologic and medical complications. Length of stay (LOS), estimated blood loss (EBL), and comorbidities were reviewed. Radiographic data was also analyzed. **Results:** Fifteen patients underwent a staged PSO (1 at L2, 12 at L3 and 3 at L4) in the setting of iatrogenic flat back syndrome with a mean follow up of 17.70 months (range 3-54 months). Mean age was 65.9 ± 3.1 years and BMI 3.4 ± 1.1 . Mean hospital stay was $8.4 \pm .5$ days. There was a mean of $3.6 \pm .2$ days between the first and second case. Patients were 53% female with 40% having a smoking history but none within the last 30 days. There was a 46% 90-day readmission rate with 40% of the patients having a deep infection. Only 2 (13.3%) patients had neurologic complication post-operatively that otherwise resolved by twelve weeks. Radiographically, there was statistically significant improvement in sagittal vertical axis (SVA) ($P < .001$), lumbar lordosis ($P < .001$) and pelvic incidence to lumbar lordosis mismatch (PI-LL) ($P < .001$). One death occurred within 90 days but was unrelated to the surgical procedure. There were no major medical complications during the perioperative period including myocardial infarction, cerebral vascular accident, or pulmonary embolism. **Conclusion:** Peri-operative complication rates in the setting of a staged PSO are high with infection being the most common major complication. The complication profile may differ in the setting of a staged PSO with a lower perioperative medical complication rate. A larger sample of patients is needed to confirm the significance of a staged PSO in the setting of iatrogenic flat back syndrome.

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P042: Perioperative complications of staged pedicle subtraction osteotomy in the setting of iatrogenic flat back syndrome: retrospective cohort study

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P043: Coronal balance of severe scoliosis: a novel gravity balance classification

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Introduction: A coronal balance classification in severe scoliosis based on the gravity perspective was proposed and we aimed to verify its influence on the surgical outcomes. **Material and Methods:** Coronal balance state was classified based on the coronal balance distance (CBD) between C7 plump line (C7PL) and central sacral vertical line (CSVL): Type I: $CBD \leq 2$ cm, CSVL lied between the pedicles or touches the apical vertebral pedicle of the lumbar curve; Type II: $CBD \leq 2$ cm, the thoracic and lumbar curves were separated by CSVL. Type III: $CBD > 2$ cm, the upper thoracic curve and thoracolumbar curve were separated by CSVL. Type IV: $CBD > 2$ cm, the main thoracic curve shifted to the convex side. Type I-II were defined as coronally balanced; Type III was defined as coronally gravity balanced and Type IV was defined as coronally imbalanced. **Results:** A total of 80 adolescent and adult idiopathic scoliosis patients who underwent posterior spinal fusion (PSF) without three-column osteotomy were recruited. The average Cobb angle of the main curve was 107.25 ± 21.11 degrees. The mean follow-up was 3.76 ± 1.38 (2-8) years. Forty-six patients presented as preoperative Type I balance, among which 23 (50%) patients turned to Type IV imbalance postoperatively and 13 (28.26%) patients were still imbalanced in the final follow-up. There were 10 patients presented as preoperative Type II balance, among which 6 (60%) turned to Type IV imbalance postoperatively and 3 (30%) patients were still imbalanced in the final follow-up. Ten patients presented as preoperative gravity balanced (Type III). None of them had postoperative immediately coronal imbalance and only 1 patient (10%) lost the coronal balance in the final follow-up. There were 14 patients presented as preoperative Type IV imbalance, among which 10 patients (71.43%) were still imbalanced at the final follow-up. **Conclusion:** This study showed that Type III gravity balanced patients were at lower risk of postoperative coronal decompensation following PSF without three-column osteotomy in severe idiopathic scoliosis.

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P044: Frailty as a risk factor for postoperative complications in adult patients with degenerative scoliosis underwent posterior long segment corrective surgery: a retrospective cohort study

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Background: With the population aging worldwide, adult degenerative scoliosis (ADS) is increasingly paid attention to.

Frailty, instead of chronological age, is used for assessing the patient's overall physical condition. In recent years, some studies have applied frailty assessment tools to preoperative assessment, and the Results show that frailty is strongly related to a variety of postoperative adverse events and even mortality. In ADS patients administered a posterior approach, long-segment corrective surgery, frailty's association with postoperative outcomes remains undefined. **Objectives:** The predictive effect of preoperative frailty assessment on postoperative complications in adult degenerative scoliosis was analyzed by using frailty assessment tools. The effects of preoperative frailty assessment on postoperative imaging parameters and health related quality of life in adults degenerative scoliosis were analyzed using frailty assessment tools. Establish and verify a model for predicting postoperative complications of posterior long-segment fusion with degenerative scoliosis in adults. **Methods:** This project is a retrospective clinical study. Retrospective data were collected from adult patients with degenerative scoliosis admitted to The Department of Orthopedics, Beijing Chaoyang Hospital, Capital Medical University, who underwent posterior long segment fusion surgery from January 1, 2014 to December 31, 2017. Patients were assessed for frailty according to the Modified Frailty Index (mFI) and then divided into frailty group and non-frailty group. The distribution of frailty was analyzed, and demographic data, general clinical data, radiographical data, surgical data and other clinical data were collected. Analysis of frailty related factors. Major postoperative complications (including cardiovascular complications, Respiratory complications, acute renal failure, delirium, stroke, nerve injury, deep vein thrombosis, acute abdomen, etc.) were recorded, and the predictive effect of frailty assessment on postoperative complications was analyzed. Radiographical data and subjective health-related quality of life scores were collected preoperatively and 2-year follow-up. The postoperative prognosis was analyzed. And the risk prediction model of postoperative complications was established. Then, the model was clinically verified. **Results:** A total of 161 patients were included: 47 (29.2%) and 114 (7.8%) in the frailty and non-frailty groups, respectively. Major postoperative complications were more frequent in the frailty group than the non-frailty group (29.8% vs. 1.5%, $p = .002$). Multivariable logistic regression analysis showed that frailty was independently associated with major complications (adjusted odds ratio [aOR] = 2.77, 95% confidence interval [CI] 1.12–6.89, $p = .028$). Radiographic and HRQOL parameters were improved at 2 years but with no significant between-group differences. **Conclusions:** Frailty is a risk factor for postoperative complications in ADS after posterior single approach, long segment corrective surgery. Frailty is an independent risk factor for postoperative complications after posterior long segment fusion in adults with degenerative scoliosis and needs attention. Frailty screening should be applied preoperatively in all patients to optimize the surgical conditions in ADS.

Degenerative Cervical

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P045: The effect of operative order on clinical outcomes for patients undergoing anterior cervical discectomy and fusion and rotator cuff repair

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Introduction: Cervical spondylosis and the resultant radiculopathy or myelopathy are common indications for anterior cervical discectomy and fusion (ACDF), especially in the elderly population. A concomitant diagnosis of rotator cuff tear can lead to difficulty with correctly establishing the cause of the patient's primary source of pain. This may make it difficult to decide whether to perform the rotator cuff repair (RCR) or the ACDF first. Even after the respective ACDF or RCR procedure, some patients with concurrent neck-shoulder pathology continue to report persistent pain. The purpose of this study is to evaluate the impact of operative sequence on clinical outcomes for patients undergoing ACDF and RCR. **Material and Methods:** All patients over 18 years of age who underwent primary one- to four-level ACDF and primary arthroscopic or open RCR at a single academic institution within the past 10 years were retrospectively identified. Patients were divided into two cohorts based on their first procedure (ACDF or RCR). Patient demographics, surgical characteristics, surgical complications, readmissions, reoperations, and patient-reported outcomes measures (PROMs) were collected and compared between the two groups utilizing independent t-tests or Pearson's chi-square tests. Multivariate logistic regression models were developed to measure the effect of demographical and surgical variables on the likelihood of reoperation after each procedure. P-values < .05 were considered statistically significant. **Results:** A total of 189 patients were included in the final analysis. 95 patients (5.3%) underwent RCR first, while 94 patients (49.7%) underwent ACDF first. Patients who underwent RCR prior to ACDF had higher rates of spinal stenosis (67.4% vs. 52.1%, $p = .047$), epidural injections prior to ACDF (42.1% vs. 23.4%, $p = .010$), and 90-day complications after ACDF (28.4% vs 13.8%, $p = .023$). Patients who underwent ACDF prior to RCR had a higher rate of reoperation on the cervical spine for adjacent segment pathology (12.8% vs 1.05%, $p = .007$). Logistic regression analysis showed that undergoing ACDF prior to RCR (OR = 5.09, $p = .007$), male sex (OR = 3.89, $p = .031$), and an increased time between both procedures (OR =

1.002, $P < .001$) significantly increased the likelihood of a cervical spine reoperation, while a diagnosis of a herniated disc (OR = .16, $p = .004$) or myeloradiculopathy (OR = .15, $p = .043$) significantly decreased the likelihood of a cervical spine reoperation. Further analysis showed that an increased Charlson Comorbidity Index (CCI) score (OR = 1.85, $p = .007$) significantly increased the likelihood of a rotator cuff reoperation. **Conclusion:** Undergoing an ACDF prior to RCR, male sex, and an increased time interval between surgeries all increased the likelihood of a cervical spine reoperation. This is likely due to the increased incidence of adjacent segment disease as the length of time between the procedure and follow-up increases. However, patients with myeloradiculopathy due to a herniated disc had a decreased likelihood of a cervical spine reoperation. Therefore, the data suggests that either RCR or ACDF are viable primary surgical procedures in patients with concomitant pathology and the decision to proceed with either should be jointly decided by the patient's symptomatology and the surgeon's expertise.

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P046: Three level anterior cervical decompression and fusion with peek cages

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Introduction: To review the clinical and imaging Results of patients who underwent 3-level anterior cervical decompression and fusion with PEEK cages with a minimum follow-up of 12 months. **Material and Methods:** Serie of cases. Clinical outcome was assessed using the Visual Analogue Scale (VAS), Neck Disability Index (NDI), modified Japanese Orthopaedic Association (JOAm), Nurick scale and SF-36 scale. The radiographic evaluation included cervical lordosis, vertebral body height and disc height. Descriptive statistics were carried out for quantitative variables through measurements of central tendency and dispersion. **Results:** Records of 21 patients (11 females and 10 males), aged 56 to 76. 8 patients with a diagnosis of myelopathy, the most frequent intervened levels were C3-C4, C4-C5, C5 -C6. After 18 months of follow-up, the mean IDC, JOA, EVA improved ($p = .001$), as well as SF-36, PCS ($p = .01$) and Nurick ($p = .003$). The radiographic follow-up after 18 months showed a significant improvement in cervical lordosis ($p = .03$) and disc height ($p = .0001$). **Conclusion:** 3-level anterior cervical decompression and fusion with PEEK cages showed improvement in radiographic parameters as well as in clinical scales. Preserved

lordosis and improvement in disc height, showing significant decrease in pain and an improvement in patients quality of life.

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P047: Trends in the treatment of cervical ossification of posterior longitudinal ligament with or without concomitant myelopathy

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Introduction: Ossification of the posterior longitudinal ligament (OPLL) is a relatively rare but increasing diagnosis in the USA. As a result, the standard of care is still in development, particularly in cases with the concomitant diagnosis of other spinal pathologies. Aim of the current study is to assess whether patients having concomitant diagnosis of OPLL and myelopathy in the cervical spine undergo different treatment modalities, encompassing both surgical and conservative approaches, compared to patients with a diagnosis of OPLL without myelopathy, and if the complication profiles are different. **Material and Methods:** Patients of all ages who were diagnosed with OPLL with and without concomitant diagnosis of myelopathy between 2010 and 2019 were identified using a national insurance database. Following the diagnosis, patients were tracked to determine the rate at which the identified populations underwent surgical intervention (decompression, anterior fusion, posterior fusion) in comparison to conservative therapy (bracing, epidural steroid injection [ESI], physical therapy [PT]). Various medical and surgical complications will be assessed post-operatively. **Results:** This study identified 14,590 patients diagnosed with OPLL between 2010 and 2020, of which 5,340 (36.6%) received a concomitant diagnosis of myelopathy. Incidence rates for both groups were relatively flat between 2010 and 2014 before increasing substantially in 2015 and flattening at the new level from then until 202. In the OPLL without myelopathy group, the average incidence was 434 new cases per year between 2010 and 2014 and 1,164 new cases per year between 2015 and 2019. In the OPLL with myelopathy group, the average incidence was 329 new cases per year between 2010 and 2014 and 660 new cases per year between 2015 and 2019. Of the procedures undergone by patients with OPLL without myelopathy, 92.6% were conservative (84.1% PT, 4.7% bracing, 3.8% ESI) and 7.4% were surgical (3.6% posterior fusion, 3.1% anterior fusion, .7% decompression). In the OPLL with myelopathy group, 62.8% of procedures were conservative (42.5% PT, 1.7% bracing, 9.6% ESI) and 37.2% of procedures were surgical (19.7% anterior fusion, 13.3%

posterior fusion, 4.2% decompression). **Conclusion:** In this study, patients diagnosed with OPLL and myelopathy constituted about one-third of the population but had a higher rate of procedures than OPLL without myelopathy (37.2% vs. 7.4%). This study identified trends and next steps include the analysis of surgical complications between the two groups (the OPLL with myelopathy group underwent more anterior fusion, posterior fusion, and decompression). Future studies should elucidate the clinical decision making underlying these trends and explore further topics such as complication rates by procedure and differences in outcomes between surgical and conservative treatment approaches.

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P048: Application of machine learning in long-term outcome prediction after osteophyctomy in Forestier disease

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Introduction: Forestier disease is an enthesopathy also known as diffuse idiopathic skeletal hyperostosis (DISH). Formation of anterior cervical osteophytes can cause dysphagia and airway obstruction. Surgical osteophyte resection is a safe and effective procedure but complete symptom relief is hard to estimate. Prediction of unfavorable surgical outcome is highly desirable for surgeons and patients. With the use of machine learning (ML), we evaluate its potential for neurosurgical outcome prediction. **Material and Methods:** The authors conducted a systematic review of publications containing DISH cases afflicted with dysphagia in the following databases: Google Scholar, Cochrane Database, PubMed EBSCO Medline, EMBASE from 01.01.2009 to 01.01.202. The PRISMA IPD protocol was used for data gathering. Cervical trauma, laryngeal structure pathology, tumor, previous spine or laryngeal surgery, acute infection, neuromuscular diseases and postoperative history shorter than 6 months have been set as exclusion criteria. Depending on the surgical final outcome, patients were divided into two groups (asymptomatic/symptomatic). The Pareto principle (80-20) was used for model training and to evaluate predictive value. All ML models were created with Python programming language and in use of 'Scikit-learn' library. ML models used: Decision Tree, Random Forest, K nearest Neighbors, Support Vector Machine and Naïve Bayes. **Results:** A total of 110 osteophyctomy treated DISH patients were found. After exclusion of incomplete patient data 59 records were included. The average postoperative history was 29 months (range: 6-96). Factors taken into consideration by each algorithm were:

age, gender, severity of dysphagia, respiratory compromise at admission, comorbidities, symptoms (neck pain, sleep apnea, halitosis), weight loss, aspiration pneumonia history, dysphonia, limited range of motion, vertebrae levels affected by DISH, early postoperative complications, emergency admission. Models were evaluated with test data sets. **Results** for: Decision Tree, Random Forest, K nearest Neighbors, Support Vector Machine and Naïve Baye are respectively: .5, .42, 0,75, .67, 0,33. From five different ML classifiers created, the best result had the algorithm K nearest Neighbors. **Conclusion:** With the usage of ML we developed a model that predicted negative surgical outcome (persistent dysphagia) after DISH surgical treatment. Our analysis shows the applicability of ML to predictive modeling after DISH surgery. ML algorithms, particularly K nearest Neighbors, can improve the prediction of long-term outcome after osteophyte resection.

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P049: Postoperative complications associated with the use of gabapentin and pregabalin in cervical spine fusion procedures

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Introduction: Given the state of the ongoing opioid epidemic and that opioid medications are standard of care analgesics used in postoperative pain management, it is imperative to investigate non-opioid alternatives. Few studies have examined if non-opioid analgesics can effectively manage postoperative pain following common cervical spine procedures. The non-opioid analgesics Gabapentin and Pregabalin have exhibited a perioperative opioid “saving-effect” in various orthopedic procedures. This study aims to compare the postoperative complications in patients who received either common opioids or a mixture of opioids and a non-opioid analgesic (Gabapentin or Pregabalin) for postoperative pain management following common cervical spine procedures: anterior cervical discectomy and fusion (ACDF) and posterior cervical fusion (PCF). **Material and Methods:** This was a retrospective study of patients who had undergone either an ACDF or PCF between 2010 to 2019 using the MSpine national database and relevant Current Procedural Terminology (CPT) codes. Those groups were then queried using National Drug Codes (NDC) to form cohorts of patients who had received either only opioids or a mix of opioids and Gabapentin or Pregabalin for postoperative pain management. The postoperative surgical and medical complications (neurologic, GI, respiratory, DVT and pulmonary embolism, pruritus, mental disorders, urinary incontinence, and

postoperative pain) were identified by searching the database using the relevant International Classification of Diseases (ICD-9 and ICD-10) codes. Propensity score matching for age, gender, and Charlson Comorbidity Index (CCI) was done to control for potential confounding factors. Odds ratios and CI will be used to compare postoperative complication rates between the various groups. The alpha value for this study was set to .05. **Results:** The ACDF-opioids group included 27,277 patients (48.6% male, and 51.4% female) and the ACDF-mix group included 5,454 patients (39.2% male, and 6.8% female). After propensity score matching, each group included 5,424 patients. The PCF-opioids group included 10,175 patients (5.2% male, and 49.8% female) and the PCF-mix group included 2,862 patients (39.8% male, and 6.2% female). After propensity score matching, each group included 2,825 patients. The incidence of psychological complications at three weeks postoperative was greater in ACDF-opioids (6.99%) than ACDF-mix (5.40%) (OR 1.32, $P < .05$). However, the incidence of postoperative pain at six weeks postoperative was lower in ACDF-opioids (3.23%) than ACDF-mix (5.58%) (OR .56, $P < .05$). Similarly, the incidence of postoperative pain at six weeks postoperative was lower in PCF-opioids (5.49%) than PCF-mix (8.99%) (OR .59, $P < .05$). Although other postoperative complications of interest were different between the opioid and mix groups in both cohorts, these differences were not statistically significant ($p > .05$). **Conclusion:** Patients undergoing ACDF or PCF and receiving opioids and either Gabapentin or Pregabalin for postoperative pain management had a higher incidence of postoperative pain. Additionally, patients who underwent an ACDF and received a mixed pain medication had a lower incidence of psychological complications.

930

P050: The untold story of a coughed out screw

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Introduction: Anterior cervical plating is a common procedure performed for various indications. Early and late complications pertaining to oesophageal injury is reported in literature and are not uncommon. Early presentation is due to injury to oesophagus while doing exposure and instrumentation. Patient presents with disproportionate dysphagia, wound dehiscence and fatal mediastinitis. Late presentation is

because of chronic injury by prominent and backed out implant or displaced bone graft. Delayed oesophageal perforations have been described occurring from weeks to years after anterior spinal surgery. Our patient had a delayed presentation probably because he was asymptomatic. **Materials and Methods:** A Case Report with regular follow up of 6 weekly basis is being presented. A 70 years old male, case of Cervical Spondylotic myelopathy (C3-C4, C4-C5) with complaints of difficulty in walking and weakness of upper and lower limbs since 6 months presented to outdoor department. Patient had restricted and painful movements of cervical spine. Patient was evaluated and then operated for anterior cervical discectomy and fusion with bone grafting at C3- C4, C4-C5. Double level plate was used but the available plate was slightly larger than the required size and that was the smallest size available. We tried to direct the screw trajectory downward using that smallest plate available in the set. This prevented the proper locking of proximal screws. Patient was non-compliant with the use of cervical collar. Once the union of graft appeared adequate we tried to convince the patient for early removal of prominent and protruding implant as the proximal screws were backing out but patient refused surgery. He finally presented with a coughed out screw in his mouth in emergency. Endoscopy did not show any obvious fistula or rent in the oesophagus. Later on patient agreed for implant removal. Through previous incision implant was exposed and it was removed. We could not identify any obvious rent in oesophagus except an area of probable fibrosis. Recovery was uneventful. **Results:** After first surgery. 1. Pre-op VAS Score improved from 8 to 2. 2. Nurick Score improved from grade 4 preop to grade 2 postop. After removal of implant the surgical wound healed well and he didn't complaint of any difficulty in deglutition. **Conclusion:** Loosening of implants after anterior cervical spine fusion surgeries adds morbidity to the procedure. Proper size and low profile implants with good locking mechanism can reduce the complication rates. Adequate pre-operative planning is a must for successful outcome of cervical spine surgeries. Ensuring the availability of proper size implant is of vital importance. It should be mandatory to ensure that all standard sizes of plates and screws are available on table. Backed out and prominent implant should be taken out to avoid oesophageal injury.

998

P051: Combine laminoplasty with artificial disc replacement for the treatment of cervical spondylotic myelopathy

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Background: Cervical spondylotic myelopathy (CSM) is a very common and devastating spine disease. Congenital cervical stenosis (CCS) was a high risk factor causing CSM. We aim to elucidate the security, effectivity and feasibility of surgery combining of laminoplasty with artificial disc replacement (ADR) to treatment those patients had CSM with radiculopathy, especial for the preservation of range of motion. **Methods:** Between August 2008 and April 2019, there are 39 patients who had multiple CSM caused by CCS were enrolled in this study. All patients received laminoplasty surgery first then ADR. Use retrospective collection of data for evaluation the functional outcomes and radiologic outcomes, especially the preservation of range of motion (ROM) in all patients and be traceable for at least two years. **Results:** Each patient underwent postoperative at least 2-years follow-up. The Japanese Orthopedic Association (JOA) score had great improvement post-operative 6 months. The index level ROM could preserve during 2-years follow-up. The sub-axial cobb's angle could also be retained. The spinal canal diameter could be obviously expanded more than 50% (52.6%). There were no severe complication or side effect found and no patients need re-do surgery. **Conclusions:** A concept of surgical approach to treat CSM is "Target" treatment. We could directly expand the spinal canal and only 1 or 2-level ADR to treat patients who had CSM caused by CCS with radiculopathy. According to the data of our study, we find this combined surgical strategy to treat those patients is secured, safe, effective and could preserve range of motion.

Keywords

CSM, CCS, ADR, laminoplasty, ROM

1117

P052: Hard collar immobilisation following elective surgery on the cervical spine: a cross-sectional survey of UK spinal surgeons

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Introduction: Although most commonly used in the management of trauma, hard collar immobilisation is also used to support recovery following elective surgery of the cervical spine. This is justified by the hypothesis that bracing will reduce risk of non-union, reduce pain and provide a subjective sense of security to patients. Existing survey data suggests hard collars are used frequently following surgery. However, a

growing body of evidence suggests that hard collar immobilisation may be unnecessary in certain post-operative scenarios and may in fact directly cause adverse events. There is limited evidence concerning the frequency of hard collar use and no dedicated study has been performed in the last decade. The primary aim of this study is to provide an updated assessment of the post-operative bracing patterns of surgeons. We aimed to understand surgeon rationale for use and gain surgeon perspectives on compliance and complications. **Material and Methods:** Neurosurgeons and spinal orthopaedic surgeons completed a web-based survey distributed via email by the Society of British Neurological Surgeons (SBNS) and the British Association of Spinal Surgeons (BASS). Professional information captured included level of experience and whether surgeons had a specialist interest in spinal surgery. Questions first focused on frequency and duration of hard collar immobilisation for common decompressive procedures. Later questions captured surgeon rationale, perceptions of patient compliance, complications, and collar removal. **Results:** A total of 86 practicing surgeons completed the survey, 83% of whom were spinal specialists. In total, 33 (38%) surgeons recommend a hard collar following one of the listed procedures. Collars were most commonly recommended following cervical corpectomy (30%). The support of fusion and bone healing was the most common reason for considering a post-operative collar (82%), with post-operative pain (39%) and limiting patient activity (45%) also considered. Most surgeons (69%) agreed that patients were compliant. All listed types of complications were reported, with impaired activities of daily living (41%) and impaired sleep (34%) the most frequently cited. **Conclusion:** Current post-operative use of hard collars is much lower in the UK than previously reported in the US. Surgeon decision making is inconsistent and may benefit from greater standardisation. Future work is needed to help develop guidelines and further characterise use.

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P053: Association of cervical spondylosis and vertigo

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Introduction: Cervical spondylosis is one of the most common degenerative condition of the spine. Vertigo complaints with cervical spondylosis is found in some patients and cervical spondylosis as a cause of vertigo is sometimes considered as a myth. Thus, the aim of this study was to analyse the effect of degenerative cervical spondylosis on blood flow velocity through vertebral artery during cervical

spine rotation in different head positions and its association with vertigo. **Methods:** Total 120 patients in a varying age group of 21-82 years, divided in 2 study groups were recruited. First group of 62 patients with cervical degenerative spondylosis with complaints of vertigo, compared with second study group of 58 patients having spondylosis without vertigo. Plain cervical radiography was used to evaluate cervical degenerative changes using cervical degenerative index (CDI). Arterial colour doppler sonography was used to measure vertebral artery blood flow with the head in neutral position first and then in 60° lateral head position with 30° extension. The same procedure was repeated in opposite side. Measurements performed on both right and left vertebral arteries were: the spectral wave pattern, peak systolic blood flow velocity and end diastolic blood flow velocity. **Results:** Among patients with cervical spondylosis, patients having vertigo showed significantly more evident degenerative changes (CDI ≥ 25.5) ($p \leq .001$). Despite the fact that Doppler ultrasound examination with head in neutral position was found to be similar in all groups; cervical spondylosis patients with vertigo had statistically significant lower blood flow parameters with head rotation in the left and right vertebral arteries than cervical spondylosis patients without vertigo. **Conclusion:** This study highlights important pathophysiological mechanism of vertigo observed in patients of cervical spondylosis. The magnitude of reduction in vertebral artery blood flow was significantly higher in patients with advanced cervical spine degeneration presenting as vertigo due to an ineffective compensation mechanism. This will be of further significance in terms of intervention and management of cervical spondylosis patients with vertigo.

1274

P054: Validation of Hindi Version of Indian Modification of Japanese Orthopaedic Association score for cervical myelopathy - A cross sectional study

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Study Design: Translation with validation of the Hindi translation (regional language) of the Indian modification of Japanese Orthopedic Association Score questionnaire with scoring system. **Objective:** To evaluate the validity and cross cultural adaptation of the translated Hindi version with Indian modification of the Japanese Orthopedic Association (In-JOA) for Cervical Myelopathy. **Summary of Background Data:** The translation of JOA has been done in various languages to meet the local practices and cultural adaptation for better evaluation of the disease severity of cervical myelopathy in local language. A translated Hindi version with the Indian modification of Japanese Orthopedic Association

(JOA) score has never been studied. This is one of the biggest limitations especially in Northern part of India where majority are Hindi speaking and surgeons have difficulty in assessing in disease severity. The validation of In-JOA Score will have huge impact on patient reported outcomes in planning for surgical intervention for patients suffering from cervical myelopathy. Translating in Hindi will also make it easier to translate and adapt to other Indian vernacular languages. **Methods:** The JOA score for evaluating cervical myelopathy was translated in Hindi (regional language) using Guillemin et al methodology for the transcultural adaptation. The acceptability, validity, responsiveness, reproducibility and cross cultural adaptation were evaluated for the Hindi version (In-JOA). The study included a cross sectional study of one ninety three patients, from November 2020 to May 2021 with cervical myelopathy or neck pain with radiculopathy, satisfying the inclusion criteria with informed written consent. **Results:** The evaluation of Hindi version of In-JOA score on one ninety three patient exhibited strong correlation with modified Nurick scale with English version of In- JOA and its individual components. **Conclusion:** Our study shows good correlation between Nurick scale, Hindi version In-mJOA and English version of JOA scores with Indian modification. The acceptability, validity, responsiveness, and reproducibility were established for the Hindi version of with Indian modification In-mJOA well as the English version. We strongly recommend such patient reported outcomes in the local language and encourage to be translated in other vernacular languages. The limitation of our study was that it was a single center study.

Keywords

cross-cultural adaptation, mJOA, Hindi version

1295

P055: Risk factors for increased length of stay in one- and two-level anterior cervical discectomy and fusion and cervical disc arthroplasty

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Introduction: Anterior cervical discectomy and fusion and cervical disc arthroplasty procedures are increasingly being shown to be amenable to the ambulatory setting. Although these are increasingly being done in such a setting, there has been no study to date that has identified the risk factors predisposing patients to stays greater than 24 hours, or unanticipated admissions. The purpose of this study is to

identify risk factors for extended length of hospital stay following elective ACDF and ADR procedures for cervical radiculopathy and mild cervical myelopathy. Secondly, this study aims to identify differences in these parameters between ACDF and ADR procedures. **Material and Methods:** A retrospective chart review at a single institution with multiple attending surgeons was undertaken. Patients who were selected for the study had primary, elective, single- and two-level ACDF and/or ADR procedures from 2019-2021 without having had prior anterior or posterior spine surgery. Preliminary data has been processed. Univariate and multivariate logistic regression analyses will be performed to identify risk factors for length of stay (LOS) beyond 24 hours. A secondary endpoint included comparing ACDF to ADR in terms of LOS. **Results:** A total of 766 patients met inclusion criteria. Multivariate logistic regression analysis will be run to potentially demonstrate associations between prolonged hospitalization and risk factors such as obesity, operation length > 150 minutes, pulmonary comorbidities, and diabetes mellitus, which have been identified in preliminary data processing to be significant. **Conclusion:** Preliminary data shows promise for identification of risk factors for prolonged LOS following elective ACDF and ADR. These appear related to certain patient comorbidities; some modifiable, and some not easily modifiable. The Results of this study should elucidate which patients would be more or less likely to successfully undergo ambulatory anterior cervical procedures.

1381

P056: The incidence and aetiology of tremor in degenerative cervical myeloapthy: a systematic review

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Introduction: AO Spine RECODE-DCM (Research objectives and common data elements in degenerative cervical myelopathy) has highlighted that the subjective disability reported by people living with DCM is much broader than routinely considered today by most professionals. This includes a description of tremors. The objective of this review was to identify the incidence and aetiology of tremor in degenerative cervical myelopathy (DCM). **Material and Methods:** A systematic review registered in PROSPERO (CRD42020176905) was conducted in Embase and MEDLINE for papers studying tremor and DCM published on or before the 20th of July 202. All manuscripts describing an association between tremor and DCM in humans were

included. Articles relating to non-human animals, and those not available in English were excluded. An analysis was conducted in accordance with PRISMA and SWiM guidelines for systematic reviews. **Results:** Out of a total of 4402 screened abstracts, we identified 7 case reports and series describing tremor in 9 DCM patients. Papers were divided into three groups for the discussion. The first group includes DCM correctly identified on presentation, with tremor as a described symptom. The second group includes cases where DCM was misdiagnosed, often as Parkinson's disease. The third group includes a single case with a previous history of DCM, presenting with an otherwise unexplained tremor. This grouping allows for the clustering of cases supporting various arguments relating the association between tremor and DCM. **Conclusion:** DCM can be associated with tremor. The current evidence is restricted to case series. Further study is warranted to establish tremor prevalence, and its significance to assessment and management.

I383

P057: Lack of spinal teaching provision and consequent poor medical student knowledge may be limiting patient outcomes in degenerative cervical myelopathy: Results of a national UK study

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Introduction: Degenerative cervical myelopathy (DCM) is a common, disabling and progressive neurological condition triggered by chronic compression of the cervical spinal cord by surrounding degenerative changes. Early diagnosis and specialist management are essential to reduce disability, yet time to diagnosis is typically prolonged. Lack of sufficient representation of DCM in undergraduate and postgraduate medical curricula may contribute to the poor recognition of DCM by non-specialist doctors in clinical practice. In this study, our objective was to assess DCM teaching provision in medical schools throughout the UK and to assess the impact of teaching on the DCM knowledge of UK medical students. **Materials and Methods:** A 19-item questionnaire capturing data on medical student demographics, myelopathy teaching and myelopathy knowledge was designed. Ethical approval was granted by the Psychology Research Ethics Committee, University of Cambridge. An online survey was hosted on Myelopathy.org, an international myelopathy charity. Students studying at a UK medical school are eligible for inclusion. The survey is advertised nationally through university social media pages, university email bulletins and the national

student network of Myelopathy.org. Advertisements were scheduled monthly over a 12-month recruitment period from January 2019 until January 202. Responses were anonymised using participant-chosen unique identifier codes. A participant information sheet followed by an explicit survey question captures participant informed consent. **Results:** A total of 751 UK medical students participated from 32 medical schools. All 6-year groups of UK medical students were represented. The modal year group was year 4 students (195, 26%). A total of 120 students (16%) declared a career interest in clinical neurosciences. Most medical students had received no teaching on DCM (520, 72%) and had done no private study on DCM (402, 56%). Unsurprisingly, most students therefore believe their knowledge of DCM is poor. There was no correlation between subjective perception of knowledge and correct answers to objective questions testing DCM knowledge. Students ranked DCM as having a much higher quality of life than data published in the literature suggests. Students would like medical school lectures on DCM to be included in medical school curricula. **Conclusions:** Knowledge gaps in undergraduate and post-graduate curricula, poor knowledge of DCM amongst non-specialist healthcare professionals and delayed and missed DCM diagnoses are major current problems for the field. This large national study of UK medical students confirms the widespread lack of DCM teaching and poor DCM knowledge amongst the doctors of tomorrow. These educational deficits likely contribute to the poor recognition and diagnosis of DCM. The next steps of this work are improving DCM educational provision. Myelopathy.org has developed several initiatives to champion DCM education in the UK, including national research abstract, essay prizes and online educational materials, in addition to organising educational lectures at the University of Cambridge. Further development and expansions of these initiatives is ongoing.

I389

P058: Scoping review of existing funding sources for DCM research: opportunities and challenges for targeting the AO Spine RECODE-DCM research priorities

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Introduction: Degenerative Cervical Myelopathy (DCM) is a common, disabling condition of symptomatic cervical spinal cord compression that requires significant research advances to improve patient outcomes. AO Spine RECODE-DCM recently identified the top research priorities for DCM. To effectively address these priorities, appropriate funding of DCM research is essential. This review characterises current

funding in DCM research to consider its significance and highlight future opportunities. **Material and Methods:** A systematic review of Web of Science for “cervical” AND “myelopathy” was conducted. Papers exclusively studying DCM, with declared funding, and published between January 1, 1995 and March 21, 2020 were considered eligible. Funding sources were classified by country of origin and organisation type. A grant search was also conducted using Dimensions.ai (Digital Science Ltd, London, United Kingdom). **Results:** A total of 621 papers were included, with 300 unique funding bodies. The top funders were AO Spine (n = 87), National Institutes of Health, USA (n = 63) and National Natural Science Foundation, China (n = 63). The USA (n = 242) funded the most DCM research, followed by China (n = 209) and Japan (n = 116). Funding in the USA was primarily provided by corporate or non-profit organisations (6.3%); in China, by institutions (99.5%). Dimensions.ai data showed 180 DCM research grants explicitly awarded, with a total value of US\$45.6 million since 1996. **Conclusion:** DCM funding appears to be predominantly from USA, China and Japan, aligning with areas of high DCM research activity and underpinning the importance of funding to increasing research capacity. The existing funding sources differ from medical research in general, representing opportunities for future investment in DCM.

1390

P059: The role of osteopaths in the early diagnosis and management of degenerative cervical myelopathy

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Introduction: Degenerative cervical myelopathy (DCM) is a common and disabling neurodegenerative condition. Surgical decompression is the only evidence-based treatment to halt disease progression, however diagnosis and access to timely treatment is often delayed. This contributes to significant disability and dependence. Supporting early diagnosis and access to timely treatment is a critical priority. Exploring these challenges, Myelopathy.org has observed that people with DCM may seek osteopathy care for their symptoms, both before and after diagnosis. This study aimed to describe the current interaction between osteopaths and people with DCM and understand how this may be targeted to enhance the DCM diagnostic pathway. **Material and Methods:** Registered osteopaths completed a web-based survey hosted by the Institute of Osteopathy, as part of their institute’s 2021 census. Demographic information about respondents was captured, including age, gender, and ethnicity. Professional information

captured included year of qualification, region of practice, type of practice and the number of undiagnosed, operated diagnosed and unoperated diagnosed DCM cases encountered per year. **Results:** The demographics were heterogenous for the 547 practitioners who completed the survey. At least 69% of osteopaths reported encounters with DCM each year. Osteopaths most frequently encountered undiagnosed DCM patients, with a mean of 3 patient encounters per year. This compares to 2 encounters per year with diagnosed DCM patients. Level of practitioner experience was positively correlated with the detection of undiagnosed DCM. **Conclusion:** As a concentration point for encounters with undiagnosed DCM and a specialist workforce, osteopaths may offer a unique opportunity to accelerate DCM diagnosis. We include a decision support tool and specialist referral template as a tool to support onward care.

Degenerative Lumbar

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P060: Decrease unplanned reoperation rate of lumbar spinal surgery by perioperative intervention for high risk patients

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Introduction: Previous study indicated wound infection and spinal spondylolisthesis were the main reason for unplanned reoperation. Thus, perioperative interventions were performed to decrease the rate of unplanned reoperation. A prospective study was conducted to determine the unplanned reoperation rate and its causes during the primary admission in our institution over a 5-year duration. **Material and Methods:** Based on previous study, perioperative interventions were given for lumbar spinal disease patients with a high risk of unplanned reoperation. Then, data of all patients who underwent lumbar spinal surgery in our institution from January 2015 to December 2019 were connected. The demographics, diagnosis, operative time, estimated blood loss and postoperative complications of patients were recorded. The incidence and causes of unplanned reoperation for these patients were statistically analyzed. **Results:** During the 5 years, a total of 4431 patients underwent posterior lumbar spinal surgery. Of them, 1.65% (n = 73) had unplanned reoperation during the primary admission. From 2015 to 2019, the unplanned reoperation rate of lumbar spinal surgery decreased from 2.22% to 1.20%, with the lowest rate in 2019. The major three

reasons for unplanned reoperation were wound infection, neurologic deficit and hematoma. And patients with lumbar vertebral tumor had the highest incidence of unplanned reoperation (2.72%) during the primary admission, while lumbar vertebral fracture patients received the lowest rate of unplanned reoperation (.87%). **Conclusion:** After perioperative interventions, the unplanned reoperation rate of lumbar spinal surgery significantly decreased year by year. Patients with lumbar vertebral tumor had a high risk for unplanned reoperation.

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P061: Impact of steroid usage on degenerative lumbar spine surgery outcomes in rheumatoid arthritis patients

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Introduction: Degenerative lumbar disease in rheumatoid arthritis (RA) patients remains a major challenge, although treatment options for RA have evolved significantly since the introduction of biologic agents. Well-controlled comparisons between RA patients and their non-RA counterparts have not yet been reported because of significant differences in demographics including steroid usage. The objective of the present study was to compare postoperative outcomes of lumbar spine surgery between RA and non-RA patients using propensity score matching and to elucidate the impact of steroid usage on outcomes. **Material and Methods:** Patients who underwent primary posterior spine surgery for degenerative lumbar disease in our prospective multicenter study group between 2017 and

2020 were enrolled. Demographic data including age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification, diabetes mellitus, smoking, steroid usage, number of spinal levels involved, and preoperative patient-reported outcome (PRO) scores (numerical rating scale [NRS] for back pain and leg pain, Short Form-12 physical component summary [PCS], EuroQOL 5-dimension [EQ-5D], and Oswestry Disability Index [ODI]) were used to calculate a propensity score for RA diagnosis. One-to-one matching was performed and 1-year and 2-year postoperative outcomes were compared between groups, with the sub-analyses between steroid users and non-steroid users. **Results:** Among the 4567 patients included, 90 had RA (2.0%), who were more likely to be female, with lower BMI, higher ASA grade and lower current smoking rate than non-RA patients. Preoperative NRS scores for leg pain, PCS, EQ-5D, and ODI were worse in RA patients. Propensity score matching generated 61 pairs of RA and non-RA patients, and RA patients reported worse 1-year postoperative PCS (28.4 vs. 37.2, $p = .008$) and EQ-5D (.640 vs. .738, $p = .03$), although these differences were not significant between RA and non-RA patients not on steroids. Two-year postoperative outcomes did not differ between the two groups. **Conclusion:** RA patients showed worse 1-year postoperative outcomes after posterior surgery for degenerative lumbar disease, while steroid-independent RA cases showed equivalent outcomes to non-RA patients.

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P062: Patient, surgical, and institutional factors associated with length of stay in degenerative lumbar spine surgery: National Multicenter Cohort Analysis from the Canadian Spine Outcomes and Research Network (CSORN)

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Introduction: Prolonged length of stay (LOS) is a significant contributor to the variation in surgical health care costs and resource utilization after elective spine surgery. The primary goal of this study was to identify patient, surgical and institutional variables that influence LOS. The secondary objective is to examine variability in institutional practices among participating centers. **Material and Methods:** This is a retrospective study of a prospectively multicentric followed cohort of patients enrolled in the CSORN between January 2015 and October 202. A logistic regression model and bootstrapping method was used. A survey was sent to participating centers to assess institutional level interventions in place to decrease LOS. Centers with LOS shorter than the median were compared to centers with LOS longer than the median. **Results:** A total of 3909 patients were included in the study (1017 discectomies, 1153 laminectomies, 1739 fusions). The median LOS for discectomy, laminectomy and fusion were respectively .0 day (IQR 1.0), 1.0 day (IQR 2.0) and 4.0 days (IQR 2.0). Discectomy group had the smallest variability (SD = 1.9, Range 0-41). By site, median LOS by site varied from .0 to 1.5 day. Laminectomy group had the largest variability (SD = 4.4, Range 0-133 days). Median LOS by site varied from .0 to 2.0 days. The fusion group had an average variability (SD = 3.6, Range 0-64 days). Median LOS by site varied between 2.0 to 5.0 days. On multivariate analysis, individual patient level independent predictors of longer LOS were: higher ODI, open surgery and perioperative and intra-operative adverse events in all three surgical groups. Fifteen centers completed the survey. Institutional level factors that reduce LOS are preoperative patient's involvement in education and discharge planning in all three surgical groups. **Conclusion:** In this first study stratifying individual patient level and institutional level factors, several independent predictors were identified to enhance the understanding of LOS variability in elective spine procedures. Prospective research could help provide more robust **Results** in the influence of preoperative patient's education and involvement in discharge planning on LOS.

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P063: Prevalence and characteristics of upper lumbar disc herniations in our population. Retrospective analysis

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Introduction: Upper lumbar disc herniations (ULDH) are considered quite infrequent (1-11%). They occur mainly in elderly patients with special clinical features which hinder diagnosis and decision making on therapeutic approach. Prevalence, location, treatment and medical history of our patients were analyzed. **Material and Methods:** Data regarding gender, age, injury level, previous surgeries and patient treatment data were retrospectively collected from July 2018 to May 2021. During this time, 179 patients underwent surgery, from which 33 patients presented ULDH. **Results:** 33 patients were included in the study of which 18 were male and 15 were female. Age range varied between 39 and 85 years, predominantly elderly patients. Levels of surgical intervention were L1-L2 in seven cases, L2-L3 in ten, L3-L4 in fourteen and double level L2-L3, L3-L4 in two cases. In our population, microdiscectomy is the preferred approach and was performed in all cases, adding fusion in 4 of the 33 patients. At last, a history of Low Lumbar Disc Herniation (LLDH) was found in 16 patients. **Conclusion:** In our population ULDH are a rare entity with decreasing prevalence in higher lumbar levels. ULDH occur more frequently in elderly patients and clinical picture can vary, which represents a challenge for the surgeons. In elderly patients, the development of lumbar kyphosis due to vertebral wedging is considered a risk factor for the development of ULDH. In most cases, microdiscectomy will turn out successful. Previous low lumbar fusion surgery history does not appear to represent a risk factor; since fusion in elderly patients will present in most of the cases due to degenerative causes.

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P064: The impact of the increasing proportion of degenerative spine emergency admissions

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Introduction: Emergency admissions for degenerative pathologies have increased on average 3.2%/year from 2006 to 2019 at the study center. In 2006, 22.6% of patients with degenerative pathology were admitted in an emergency fashion compared to 34.8 % in 2019. Compromised access to surgical care with waitlists for assessment and elective surgery are inundated with patients may lead to increases in patients with degenerative spinal pathology that would ideally be treated electively, presenting to emergency rooms in states of crisis. The primary goal of this study was to compare the outcomes of degenerative cases being treated emergently to

degenerative cases being treated electively. **Material and Methods:** All consecutive patients who underwent emergent and elective spine surgery for a spinal degenerative condition at our institution between January 1st, 2006 and December 31st, 2019 were included in the study. As Covid-19 affected nearly all aspect of hospital operations in 2020 and 2021, we removed 2020 and 2021 data. Elective and emergency admission were compared. Elective patients were also compared to patients who had been placed on a waitlist but decompensated and were treated emergently. **Results:** A total of 6,217 patients were included in the analysis. A total of 4,654 patients (74.9%) were operated in an elective fashion and 1,563 patients (25.1%) were operated in an emergency fashion. Patients treated electively were older than patients treated emergently (56.0 years (SD 15.4) vs 53.9 (SD 16.9) $p \leq .001$). More patients received instrumentation in the elective group (7.0% vs 6.0%, $p \leq .001$). Patients treated emergently had a shorter operative time (2.5 hours (SD 3.0) vs 3.0 hours (SD 3.1), $p \leq .001$). Patients treated emergently had a longer median LOS of 5.1 days (IQR 2.7-11.2) compared to 3.6 days (IQR 1.3-6.4) ($p \leq .001$). More patients treated electively were discharged home (94.2% vs 78.6%, $p \leq .001$). On multivariate logistic regressions, emergency admission were 1.49 times more likely of having any AEs (95%CI 1.17-1.89). Patients treated emergently had more systemic infections (11.6% vs 6.3% $p \leq .001$). Hardware malposition was more common in electively treated patients (12.4% vs 1.7%, $p = .014$). Patients who were on a waitlist who presented emergently had a longer median LOS of 5.6 days (IQR 11.1) compared to 3.6 days (IQR 5.1) in elective patients ($p \leq .001$). Patients who were on a waitlist and were treated emergently were less frequently discharged home (76.5 % vs 94.2%, $p = .001$). On multivariate logistic regression, patients on a waitlist and presented emergently were 4.6 times more likely of having any AEs (95%CI 1.17-18.22) compared to elective patients. **Conclusion:** This study suggests worse outcomes for patients presenting emergently for treatment of degenerative spinal pathologies compared to elective patients. This finding is also true for patients who were on a waitlist and presented in a decompensated state emergently. In consideration of the human and economic cost of late presentation of spinal surgical disease, strategies that better align primary care, screening programs and surgical intervention may be the next target in decreasing health care costs. This could be explored in future cost-effectiveness analysis.

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P065: Effect of BMI on quality of life after surgery for lumbar spondylolisthesis

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Introduction: Health related quality of life surveys can be used to evaluate quality of life gained from surgery. Obesity is a common comorbid condition among those undergoing lumbar spine surgery and may affect the overall outcome of surgery. We hypothesize that higher BMI is associated with smaller improvement in quality of life after surgery for lumbar spondylolisthesis. **Material and Methods:** Patient medical records starting in January 2021 were queried to identify patients admitted for surgery for lumbar spondylolisthesis with Patient Reported Outcome Measure Information System Global 10 (PROMIS-10) scores available before and after surgery. Statistical analysis including univariate linear regression was conducted using Excel (Microsoft Corporation) and R version 4.1.0 (The R Foundation for Statistical computing). **Results:** Our query identified 16 patients admitted for surgery for spondylolisthesis and had PROMIS-10 scores available before and after surgery. Mean follow up time after surgery was approximately 6 months. Average BMI was 31.27 among these patients. Univariate linear regression was performed which demonstrated a negative correlation between improvement in quality-of-life scores after surgery and BMI ($p = .0137$, adjusted $R^2 = .3162$). When a trendline was generated it indicated negative change in quality of life at BMIs greater than 38.17. When the change in quality of life was converted to quality adjusted life years (QALYs), there remained a negative correlation. However, this correlation was not significant ($p = .175$, adjusted $R^2 = .06498$). When a similar trendline was created for QALYs, it indicated a negative change in QALYs at BMIs greater than 36.84. **Conclusion:** Increased BMI is associated with lower quality of life after surgery for lumbar spondylolisthesis at 6 months follow up. Class II Obesity and above are associated with negative changes in quality of life after surgery for lumbar spondylolisthesis. Further research is needed to better characterize this relationship. Clinical judgement should be exercised to ensure patients who are offered surgery are likely to benefit.

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P066: Outcome of lumbar spine surgery for patients with psychiatric disorders

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Introduction: In lumbar spine surgery for patients with psychiatric disorders, the surgeons sometimes hesitate to perform the surgery due to concerning about poor outcome, except for the case with paralysis or bladder bowel dysfunction. On the other hands, some of the patients are refractory to conservative therapy due to the use of psychotropic and antidepressant drugs. Furthermore, several reports

suggested that patients with depression suffered from more severe back pain associated with lumbar disease than patients without depression. This study aimed to analyze the outcome of lumbar spine surgery for patients with psychiatric disorders. **Material and Methods:** We retrospectively reviewed the medical records of patients who underwent lumbar spine surgery between January 2017 and February 2021. Twenty-one patients with psychiatric disorders were enrolled (group P). The psychiatric disorders were as follows; 11 depression, 4 bipolar disorder, 4 anxiety neurosis, 1 autonomic dysreflexia, 1 panic disorder. To compare to group P, twenty-one patients without psychiatric disorders who were randomly selected from 870 patients undergoing lumbar spine surgery were enrolled (group N). The patients in both groups were operated by the same spine surgeon in our institution to standardize the surgical technique. Oswestry Disability Index (ODI), visual analog scale (VAS) for back pain and leg pain or numbness were used for outcome measurements. BS-BOP was utilized to assess the relationship with psychiatric factors. Data were collected before and 1 month after surgery. **Results:** Preoperative patient demographic data and each score had no significant difference between group P and N, except for BS-BOP (P:18.2, N:15.3; $p = .006$). Although the ODI, VAS, and BS-BOP of both groups significantly improved after surgery (all $P < .05$), each postoperative score had no significant differences between the two groups. In dividing group P into depression and other psychiatric disorders, the postoperative outcomes had no significant difference between the two disorder groups (back pain, leg pain, leg numbness: $p = .596$, $p = .286$, $p = .511$). In dividing group P into two groups based on the mean of back pain VAS, ODI and leg pain didn't significantly improve postoperatively in the group with less back pain (ODI, leg numbness: $p = .611$, $p = .077$). **Conclusion:** Several study showed psychiatric disorders related with poor surgical outcome in lumbar spine surgery. However, in this study, the outcome of lumbar spine surgery for patients with and without psychiatric disorders were equal postoperatively and BS-BOP were improved in the group P, indicating that back and leg pain due to lumbar spine disease can influence psychiatric disorders. Leg pain of the psychiatric patients with less back pain didn't significantly improve after surgery, and might be caused by other reasons for example, restless legs syndrome due to taking antidepressant or anti-psychotic drugs.

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P067: Effectiveness and safety of transforaminal lumbar inter body fusion in revision lumbar surgery patients with previous laminectomy

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Introduction: Revision lumbar spine surgeries are technically demanding. Interbody fusion is used in such cases to improve the fusion rate, and in some patient to correct the sagittal and coronal imbalance. The postoperative fibrosis and adhesions that occurs following lumbar spinal laminectomy creates some challenges arising from dural or nerve root retraction with the posterior approach. The primary purpose of the current study was to determine the efficacy and safety of transforaminal lumbar interbody fusion (TLIF) for revision lumbar spine surgery in patients with previous laminectomy. The secondary objective was to evaluate the clinical and radiological outcome after such a procedure. **Material and Methods:** A retrospective case series study. Eighty-two patients were included. There were 48 women (58.5%) and 34 men (41.5%) with a mean age of 51 years (range 26-84) at the time of index procedure. The outpatient and inpatient charts were reviewed to identify patients' demographic data, preoperative, perioperative, and postoperative data. An independent spine surgeon and musculoskeletal radiologist reviewed the imaging studies. Outcome measures were assessed by Oswestry Disability Index and visual analog scale for back and leg pain. **Results:** The average operative time was 160 minutes (range 131-250). The average estimated blood loss (EBL) was 652 cc (100-1400 cc). Nineteen patients (23.1%) required blood transfusion. Five patients (6%) had dural tear. One patient (1.2%) had a surgical site infection. Two patients (2.4%) had thromboembolic events. The average hospital stay was 3.8 days (2-5 days). At a mean follow up of 28 months, there were statically significant improvement in the ODI and VAS for back and leg pain. None of the patients' radiographs showed hardware failure or pedicle screw loosening and no patient returned to the operating room for pseudarthrosis. **Conclusion:** The current study confirmed that TLIF approach in patients with previous laminectomy is effective, safe with good outcomes. The debate continues, on the optimal approach for revision lumbar spine surgery, front, back, lateral or combined. What to do still strongly depends on the surgeons' preference as informed by training, expertise, and the past experience of what works best in their hands.

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P068: Outcomes of spinal surgery in patients with fibromyalgia: Results from the British Spine Registry

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Introduction: Fibromyalgia is present in 2-8% of the population, characterized by a complex spectrum of symptoms

that includes widespread pain, fatigue, sleep disturbances and functional symptoms. Surgeries including various spinal procedures have been thought to produce less favourable outcomes in such patients. The literature suggests that spinal surgery neither ameliorates the symptoms nor improves the poor quality of life of fibromyalgia patients. We embarked on a first registry-based study to explore the patient-reported outcome measures (PROMS) in this group of patients to provide evidence to guide future treatments. **Material and Methods:** Pre- and post-operative EQ-5D 5L index, EQ-5D 5L VAS and Oswestry Disability Index (ODI) were obtained from BSR for patients with a diagnosis of fibromyalgia from June 2012 to June 2021 (nine years). Patients had spinal procedures for various degenerative conditions, trauma, and tumours. Follow-up PROMS ranged from 6 weeks to 2 years. **Results:** Of the 303 patients recorded on BSR with a diagnosis of fibromyalgia, 272 were females and 31 were males. Mean age was 55 years old (median: 54, range: 25 to 85). 293 underwent surgery for various degenerative conditions (cervical: 93; lumbar: 200), 8 for trauma and 2 for tumours. 158 patients had completed PROMS. Follow up ranged from 6 weeks to 2 years. At 1 year, EQ-5D 5L index increased for degenerative conditions (cervical: .23 to .35; lumbar: .14 to .31) but decreased for trauma (.48 to .36) and tumours (.8 to .53) patients. EQ-5D 5L VAS increased for degenerative conditions (cervical: 43.52 to 46.05; lumbar: 36.82 to 42.93) but decreased for trauma (71 to 15) and tumour (80 to 50). ODI decreased for lumbar degenerative conditions (66 to 55.61) and tumours (84 to 26). **Conclusion:** The Results from our study demonstrate that patients with fibromyalgia have improved outcomes with spine surgeries for degenerative conditions but potentially worse outcomes for trauma and tumour.

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P069: Depression leads to increased total episode costs following lumbar decompression

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Introduction: Lumbar decompression is among the most common surgical options for the management of degenerative disease of the lumbar spine. Lumbar decompression procedures are not inexpensive, and patients with one or more medical comorbidities are at risk of an increased cost burden

following surgery. Given that the elderly population is projected to increase substantially by 2050, the number of patients with symptomatic lumbar spinal pathology and one or more comorbid medical conditions who undergo a decompression procedure is also expected to increase. This study evaluates patient demographic variables, medical comorbidities, and surgical variables as independent risk factors for increased healthcare costs in patients who undergo lumbar decompression. **Material and Methods:** Care episodes limited to lumbar decompression surgeries were retrospectively reviewed on the Centers of Medicare and Medicaid Innovation (CMMI) Bundled Payment for Care Improvement (BPCI) reimbursement database at a single academic institution. Admission reimbursements, post-discharge reimbursements, and 90-day total episode of care reimbursements were also collected. A search of the electronic medical records was then performed to match the selected care episode to patient medical records with subsequent collection of patient demographics, surgical characteristics, and clinical outcomes. Descriptive statistics were used to report all variables in terms of mean and standard deviation or number of occurrences and percent of total. Multivariate linear regression models were developed to identify independent risk factors for increased admission, post-discharge, and total episode of care reimbursements following lumbar decompression. **Results:** A total of 226 patients were included for analysis. The average cohort age was 7.2 years and 62.4% of patients were male. The most common reported comorbidity was uncomplicated hypertension (n = 72, 31.9%). Other common comorbidities included uncomplicated diabetes (n = 38, 16.8%), depression (n = 32, 14.2%), chronic pulmonary disease (n = 27, 11.9%), hypothyroidism (n = 23, 1.2%), and cardiac arrhythmias (n = 23, 1.2%). Risk factors associated with increased admission reimbursement included age ($\beta = \$13.23, P < .012$), history of depression ($\beta = \$3515.98, P < .006$), procedure identified as a revision ($\beta = \$6752.12, P < .001$) and length of stay (per day) ($\beta = \$1602.72, P < .001$). Risk factors associated with increased post-discharge reimbursement included age ($\beta = \$164.51, P < .011$), history of uncomplicated hypertension ($\beta = \$2833.21, P < .024$), discharge to a skilled nursing facility ($\beta = \$1392.19, P < .001$) or inpatient rehabilitation facility ($\beta = \$16077.96, P < .001$), 90-day complication ($\beta = \$4331.24, P < .013$), and 90-day readmission ($\beta = \$19021.26, P < .001$). Risk factors associated with increased total episode of care reimbursement included age ($\beta = \$334.68, P < .001$), history of depression ($\beta = \$4323.23, p = .049$), procedure identified as a revision ($\beta = \$7307.08, p = .009$), length of stay (per day) ($\beta = \$3146.12, P < .001$), discharge to a skilled nursing facility ($\beta = \$12444.06, p = .007$), 90-day complication ($\beta = \$8186.36, p = .001$), and 90-day readmission ($\beta = \$19019.96, P < .001$). **Conclusion:** Among all reported medical comorbidities, only depression was independently associated with a significantly increased total episode of care reimbursement. Age, revision decompression procedure,

length of stay (per day), discharge to a skilled nursing facility, 90-day complication, and 90-day readmission were also independently associated with increased total episode of care costs.

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P070: Galveston iliac screw technique with modified lateral connectors: result of 335 consecutive patients in adult deformity surgery

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Introduction: Pelvic fixation is often found to be necessary to support the Sacral screw for long spinal fixations involving more than three motion segments. This was traditionally done with Iliac screws (IS) but S2-Alar-Iliac (S2AI) screws have been used more often recently due to hardware related issues like use of connector, prominence of Iliac screws etc. But the scientific literature still shows very high failure rates in spinopelvic fixation. This study will demonstrate our experience of pelvic fixation with traditional Iliac screws in adult spinal deformity. **Material and Methods:** A retrospective review of database was done for all patients who underwent spinopelvic fixation procedure with IS performed by the senior author (BH) between 2010 and 2021. All patients aged > 18 years, 1-year minimum follow-up were included in the study. Screws were inserted by the Galveston technique with the screw-head counter-sunk adequately and a modified lateral connector with an “end-stop” was used to allow the shortest connector to be used. **Results:** Three hundred and thirty five patients met the study inclusion criteria. Average patient age was 69.5 years. Surgical indications were degenerative scoliosis, degenerative disc disease and spinal stenosis and adjacent segment disease. Fusion levels ranged from C2-pelvis to L4-pelvis. Upper thoracic to pelvis (T2-T7) included 47 patients, lower thoracic to pelvis (T8-T12) included 268 patients, lumbo-pelvic fixation (L1-L5) included 19 patients and one patient had C2-pelvis fusion, T10-pelvis being the largest category with 247 patients. Only 6/335 patients required a revision/removal of IS due to persistent symptoms. All six patients required revision or removal due to persistent symptoms due to screw head prominence. **Conclusion:** This series is one of the largest single surgeon consecutive case series reported in the current literature and it shows one of the lowest revision rates for iliac screws. The consistent technique to counter-sink the screw head and the use of modified lateral connector minimised screw head prominence and, therefore, symptoms resulting from the prominent hardware, which is one the major reason for revision in iliac screws.

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P071: Current Results of conventional lumbar arthrodesis

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Introduction: Fusion techniques through minimally invasive surgery (MIS) ensure faster recovery time with reduced intraoperative blood loss and muscle damage, as well as faster return to work and reduced dependence on opioids for the patient. However, MIS also has several inherent negative factors, including higher levels of radiation exposure, a steeper learning curve for surgeons and complications also related to open surgeries, such as muscle retraction and rhabdomyolysis, damage to paravertebral muscle innervations, postoperative hematoma, malposition of implants, infection, dural fistulas and a higher cost. There is no clear and definitive evidence that one approach is superior to another in terms of fusion or clinical outcomes, yet the most widely used technique for bone stabilization and decompression is standard transforaminal lumbar interbody fusion (TLIF), which has been performed with little bleeding, short surgical time and a low level of radiation, besides being more affordable for health services. When properly indicated, single-level lumbar arthrodesis using the open transforaminal lumbar interbody fusion (OTLIF) technique is an excellent treatment option for lumbar degenerative disc disease, producing excellent Results with low morbidity and a very low rate of complications. The Objective of this study is to evaluate the peri and postoperative Results and clinical repercussions in patients undergoing decompression surgery and single-level lumbar arthrodesis using the traditional technique (OTLIF) and to compare with the Results of minimally invasive techniques (MITLIF) described in the literature. **Material and Methods:** Our sample consisted of 22 patients who underwent TLIF surgery using the open technique (OTLIF) in the period October 2019 to January 2021, in our hospital. We compared the patients' functional clinical Results using the Oswestry scale in the preoperative period and 15 days after surgery, analyzed variables related to the perioperative period: surgery time, length of hospital stay, blood loss, use of a suction drain, and admission to the ICU, and compared these with the Results reported in the literature for patients treated by the MITLIF technique. **Results:** The average age was 48.95 years and the most operated level was L4-L5 (55%). The average surgery time was 112.63 min. We did not use a suction drain in the postoperative period, there was no need for a blood transfusion in any patient, and no patient was admitted to the ICU. The average hospital stay was 1 day. Regarding the Oswestry Disability Index, the mean preoperative score was 44.73 and

after 15 days, it was 24.05. **Conclusion:** surgical treatment using the OTLIF technique for single-level lumbar degenerative disease showed largely positive Results, with improvement in disability scores, short hospital stay and low incidence of complications. When properly indicated, OTLIF is an excellent and safe option for the treatment of degenerative lumbar disease.

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P072: Perioperative outcomes and predictive factors of anterior lumbar interbody fusions based on American Society of Anesthesiology physical status score: a multicenter study

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Introduction: The anterior lumbar interbody fusion (ALIF) procedure is a surgical treatment that corrects lumbar instability with significant improvement in radiographic and clinical outcomes. This however requires a close operative plane to the great vessels, which increases the risk of perioperative complications. While the American Society of Anesthesiologist (ASA) score was not intended to be used as a perioperative risk tool, this study aimed to analyze its use as a potential predictive factor for adverse perioperative outcomes. **Material and Methods:** A multicenter, retrospective chart review was completed to identify a consecutive set of patients that underwent an ALIF. A univariate analysis between ASA ≤ 2 and ASA > 2 groups and a multivariate analysis was completed to identify potential predictive factors. **Results:** Out of all 205 patients 55 (26.8%) had an ASA greater than 2, while the remaining 150 (73.2%) had an ASA ≤ 2 . Patients in the ASA > 2 group had a significantly longer length of hospital stay ($p = .02$), increased blood loss ($p = .003$), and an increased rate of 90-day reoperations ($p = .007$). A greater ASA score was predictive of increased 90-day reoperations ($p = .04$), while a history of previous lumbar surgery was predictive of increased length of stay ($P < .001$), 90-day readmission ($p = .03$), and intraoperative blood loss ($P < .001$). **Conclusion:** Increased ASA physical status scores are associated with unfavorable outcomes after an ALIF and can also be used as a predictive tool for the risk of reoperations.

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P073: Prospective study comparing the functional outcomes of OPEN vs MIS TLIF in obese patients with BMI > 25 kg/m²)

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Introduction: Transforaminal lumbar interbody fusion TLIF by both Minimally Invasive (MI-TLIF) and Open approaches (O-TLIF) have been found to have similar clinical outcomes. Though both the approaches can be challenging in such patients, their comparisons for overweight and obese patients are scarce. In this study, the authors try to answer the same. **Material and Methods:** A randomised prospective study was undertaken over a 4-years duration to include all the patients with BMI > 25 kg/m². A total of 72 patients were enrolled in the study of which 63 (34 males and 29 females) were available for final analysis. Various demographic, clinical and radiological criteria were noted preoperatively and at postoperative day 1, 1 months, 3 months, 6 months and 1 year. Perioperative variables like operative time, duration of stay, blood loss, ICU stay and need for blood transfusion were also recorded. Functional outcome was assessed by Visual Analogue score (VAS) and Oswestry Disability Index (ODI) score. The return to work was also noted. **Results:** Out of the 63 patients analysed, 30 underwent O-LIF and 33 underwent MI-TLIF. There were no statistically significant differences in the demographic variables. Though the VAS and ODI scores at postoperative day 1, 1 month and 3 months were better in both the groups, the difference was significant in the MI-TLIF group. Both the scores were comparable at 6 months and 1 year. There was also lesser operative time, blood loss, transfusion rates and hospital stay including the ICU stay in the MI-TLIF group. The fusion rates at 1 year were also comparable. ($P = .9$) MI-TLIF group had significantly lower complication rates among the two. (.069) The most common complication was durotomy which was also less in the minimally invasive cohort. The patients in the MI-TLIF group returned to work significantly earlier compared to the O-TLIF group ($P = .0001$). **Conclusion:** Both O-TLIF and MI-TLIF have been studied in great details and have demonstrated that the latter is similar if not better than the previous in general. In overweight and obese patients as well, a handful of studies that have been done have demonstrated similar trends. Though both present surgical challenges of their own, the authors conclude that given the improved outcomes until 3 months in the MI-TLIF group, MI-TLIF can be considered for all such patients as the return to work was

significantly early in this cohort and the complication rate significantly less.

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P074: Is a coccydectomy an efficacious surgical treatment for debilitating coccygeal pain?

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Introduction: To determine the demographic, pre-operative, operative, post-operative, and outcome in seven patients who presented to our unit over a 5-years period and underwent a coccydectomy for coccydynia unresponsive to conservative measures. **Material and Methods:** We performed a retrospective chart review of seven patients who presented to the Department of Orthopedics at Helen Joseph hospital, University of the Witwatersrand, Johannesburg, South Africa, with coccydynia unresponsive to a trial of adequate conservative measures, and underwent operative intervention. The study period was from 01 January 2014 to 31 December 2018. **Results:** The mean age of subjects in our study was 53 years. The average length of conservative treatment prior to presentation to our unit was 8 months. All patients were taken to surgery and the mean length of surgery was 49 min and the mean volume of intra-operative blood loss was 63.4 ml. In all 7 (100%) of subjects a total coccygectomy was performed. At our 1-year end point all 7 (100%) subjects reported a favourable outcome and were satisfied – extremely satisfied with the procedure. **Conclusion:** In our study a total coccygectomy resulted in a significant reduction in coccygeal pain and subjects a 1-year follow-up end point. We recommend that in patients who fail an adequate recognized trial of conservative measures for coccydynia, a total coccygectomy should be performed.

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P075: No difference in short-term complications between inpatient and outpatient sacroiliac arthrodesis for sacroiliac joint dysfunction

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Introduction: Sacroiliac (SI) joint fusion is used successfully to treat patients with demonstrated SI joint dysfunction. The development of minimally invasive percutaneous implants has allowed for increasing numbers of outpatient procedures. Little information exists regarding the safety of outpatient SI joint fusion. We aim to compare the short-term complications of patients undergoing inpatient versus outpatient elective SI joint fusion (SIF) using a national database. **Material and Methods:** The ACS National Surgery Quality Improvement Program (NSQIP) database was queried from 2012-2019 to identify patients undergoing elective SI joint arthrodesis using CPT codes (27280, 27279, 0334T) and associated ICD9 and ICD10 diagnostics code related to SI joint dysfunction. 30-day complications were summarized by inpatient and outpatient status. Multivariate logistic regression was used to evaluate factors associated with complications. **Results:** A total of 376 patients were identified over the study period, with 86 (22.8%) undergoing an outpatient procedure. The proportion of outpatient SIF increased from 17.0% in 2013 to 48.9% in 2019 ($P < .001$). There were no differences between groups with regard to age, gender, ASA, BMI or medical comorbidities. A total of 20 patients (5.3%) experienced any complication, with 10 of those (2.7%) being unplanned readmissions. Of those 10 patients, 8 were related to medical problems (Pneumonia, COPD exacerbation) and 2 (.5%) were related to surgery (1 DVT, 1 surgical site infection). Two patients (.5%) underwent re-operation within 30 days, both for mechanical complications, neither were re-admitted. Two patients (.5%) received a blood transfusion post-operatively, 2 patients (.5%) experienced a VTE, and 3 patients (.8%) experience wound complications. On multivariate analysis, there were no differences between inpatient and outpatient SIF regarding rate of any complications, major complications or readmissions. The only variable associated with an increased risk of any complication was prolonged OR time (> 80 minutes OR 3.62, $P = .005$). **Conclusion:** SIF for SI joint dysfunction remains a rare procedure. The overall complication rate remains low, with very low rates of re-operation and readmission. We find an increasing rate of outpatient SIF and no differences between inpatient and outpatient 30-day complications. SIF is a safe procedure that can safely be performed in the outpatient setting. With increased focus on cost containment in orthopaedic surgery, it is likely that more of these procedures will be performed on an outpatient basis.

458

P076: The impact of multiple preoperative opioid prescribers on postoperative opioid use and patient reported outcomes following posterior one-level lumbar fusion

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Introduction: Patients who receive opioid prescriptions from multiple providers postoperatively receive more opioids and have a higher rate of long-term opioid use. However, there is limited knowledge on the effect of multiple prescribers in the preoperative time frame. Thus, the purpose of this study was to determine the impact of having multiple preoperative opioid prescribers on postoperative opioid usage and patient reported outcome measures (PROMs) following one-level lumbar fusion using the Prescription Drug Monitoring Program (PDMP). **Material and Methods:** Electronic medical records were retrospectively reviewed to identify patients who underwent single-level transforaminal lumbar interbody fusion or posterolateral lumbar fusion between September 2017 and February 2022. Exclusion criteria included incomplete PROMs, diagnosis or tumor/infection, fusion > 1 level, decompression > 2 levels, revisions, and those unable to be identified in the PDMP. Preoperative and postoperative timeframes were one-year before or after surgery. Univariate comparisons and regression analyses were performed to identify factors associated with postoperative outcomes and opioid usage. Alpha was set at .05. **Results:** Of 239 patients, 160 (66.9%) had one or zero preoperative prescribers and 79 (33.1%) had two or more. Patients with multiple preoperative prescribers had increased postoperative opioid prescriptions (5.72 vs. 2.29, $P < .001$), prescribers (2.00 vs. 1.37, $P < .001$), and morphine milligram equivalents (MME) (269 vs. 125, $P < .001$). Having multiple preoperative prescribers was an independent predictor of better improvement in Δ VAS Back ($\beta = -1.54$, $P = .009$) and Δ VAS Leg ($\beta = -1.69$, $P = .010$) on regression analysis, as well as increased prescriptions postoperatively ($\beta = .35$, $P = .001$) but decreased postoperative MME ($\beta = -1.69$, $p = .010$). **Conclusion:** Having multiple preoperative opioid prescribers was a predictor of better improvements in VAS Back and VAS Leg, and although it predicted more postoperative opioid prescriptions it also predicted less total MME. Total preoperative opioid prescriptions is a better metric for predicting poor postoperative outcomes and increased opioid consumption compared to the number of preoperative prescribers.

490

P077: Postoperative opioid use following single-level transforaminal lumbar interbody fusion compared to posterolateral lumbar fusion

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Introduction: Transforaminal lumbar interbody fusion (TLIF) increases blood loss, operative duration, and risk for additional surgery when compared to posterolateral lumbar fusion (PLF). However, opioid prescription usage following TLIF or PLF procedures and a comparison of opioid usage to total operative duration is lacking. Thus, the purpose of this study was to 1) compare postoperative opioid prescriptions for opioid-naïve patients undergoing single-level TLIF versus PLF and 2) identify total postoperative opioid prescriptions based on operative duration. **Material and Methods:** Patients undergoing a single-level TLIF or PLF from September 2017 and June 2020 were identified from a single institution. Exclusion criteria included any opioid use within one-year of surgery, patient unidentified in the prescription drug monitoring program (PDMP) database, > 2 levels decompressed, or patients undergoing revision surgery or surgery for infection/tumor. Patients were first grouped based on procedure type (TLIF or PLF), they were subsequently regrouped based on median operative duration. Statistical tests compared patient demographics and opioid prescription data between groups. Alpha was set at .05. **Results:** Of 345 patients meeting inclusion criteria, 174 patients (5.4%) were opioid-naïve. 101 of the opioid-naïve patients (58.0%) underwent PLF and 73 (42.0%) underwent TLIF. The TLIF group had significantly more opioid prescriptions (1.99 vs. 1.26, $P < .001$) and total morphine milligram equivalents (MME) (91.2 vs. 66.8, $p = .002$). After regrouping based on operative duration in either the TLIF or PLF groups, there were no differences in postoperative opioid prescriptions, and the Spearman's rank correlation coefficient between total MME and operative duration was $r = .014$. **Conclusion:** Opioid-naïve patients undergoing single-level TLIF receive more postoperative opioid prescriptions than patients undergoing single-level PLF. There were no differences in postoperative opioid prescriptions when assessing patients on operative duration indicating minimal correlation between operative duration and postoperative opioid prescriptions in this cohort.

495

P078: Does age less than 65 affect clinical outcomes in medicare patients undergoing lumbar fusion?

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Introduction: Medicare is a common government-based insurance coverage for spine surgery patients in the USA, but patients on Medicare are typically older than age 65. There is a paucity of research investigating clinical outcomes for patients on Medicare insurance under the age of 65. Thus, the purpose of this study was to determine if age (< 65) and Medicare status affect patient outcomes following lumbar fusion. **Material and Methods:** Patients ≥ 40 years old who underwent lumbar fusion surgery between 2014 and 2019 were queried from electronic medical records (EMR). Exclusion criteria included patients < 40 years old, > 2 levels fused, > 3 levels decompressed, incomplete patient reported outcome measures (PROMs), revision procedures, and diagnosis of tumor/infection. Patients were placed into one of four groups based on Medicare status and age: no Medicare under 65 years (NM < 65), no Medicare 65 years or older (NM ≥ 65), yes Medicare under 65 (YM < 65), and yes Medicare 65 years or older (YM ≥ 65). T-tests and chi-square tests analyzed univariate comparisons depending on continuous or categorical type. Multivariate regression for Δ PROMs controlled for significant confounders. Alpha was set at .05. **Results:** Of the 1097 patients, 567 were NM < 65 (51.7%), 133 were NM ≥ 65 (12.1%), 42 were YM < 65 (3.8%), and 355 were YM ≥ 65 (32.4%). The YM < 65 group had significantly worse preoperative VAS back ($p = .01$) and preoperative and postoperative ODI, MCS-12, and PCS-12. However, on regression analysis, there were no significant differences in Δ PROMs for YM < 65 compared to YM ≥ 65 , and NM < 65 (compared to YM < 65) was an independent predictor of decreased improvement in Δ ODI following surgery ($\beta = 12.61$, $p = .007$). **Conclusion:** Medicare patients less than 65 years of age undergoing lumbar fusion had significantly worse preoperative and postoperative PROMs. The perioperative improvement in outcomes was similar between groups with the exception of Δ ODI, which demonstrated greater improvement in Medicare patients younger than age 65 years compared to non-Medicare patients younger than age 65.

596

P079: Social determinants of health influence perioperative outcomes following lumbar spine surgery

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Introduction: There are many factors - biologic, psychological, and social - that influence outcomes following the surgical treatment of degenerative lumbar spine disorders. Disparities among social determinants of health (SDoH) can impact overall well-being and mitigating the negative impact of these factors is

a primary focus of the Department of Health and Human Services' "Healthy People 2030" initiative. We sought to identify the most impactful SDoH in patients undergoing lumbar spine surgery and evaluate the relationship of SDoH with perioperative surgical outcomes. **Material and Methods:** A retrospective observational study of 951 patients undergoing lumbar spine surgery (either decompressive laminectomy alone without fusion or decompressive laminectomy with instrumented fusion) from July 2017 to January 2021. A self-reported SDoH survey was utilized in conjunction with an EHR database to gather patient information. Univariate analysis was utilized to compare SDoH among white and non-white patients, and regression models were then used to evaluate the association between SDoH and outcome variables including length of stay (LOS), discharge to skilled nursing facility (SNF), 30-day ED return, and 30-day readmission. **Results:** A total of 951 patients underwent lumbar spine surgery. 484 (5.9%) underwent decompression alone without fusion while 467 (49.1%) underwent decompression and posterolateral/interbody fusion. Non-white patients were more likely to attend church ($p = .025$) or have any food worry ($p = .022$), but were less likely than white patients to drink alcohol four or more days per week ($p = .013$). Patients living in zip codes below the state median HHI were more likely to exercise 3 or more times per week (.020) and drink alcohol four or more days per week ($p = .001$). When controlling for age, ASA score, and surgery type using multivariate logistic regression, being currently married or having a life partner was associated with shorter LOS ($P < .001$) and decreased likelihood of discharge to SNF ($p = .005$). Financial strain was associated with longer LOS ($p = .022$), and residing in a zip code above the median HHI was associated with an increased likelihood of discharge to SNF ($p = .018$). Regarding unplanned returns, only attends church was associated with a decreased likelihood of 30-day ED return ($p = .021$). **Conclusion:** The most impactful SDoH examined were those regarding support systems and financial stability. Pre-operative optimization may require both medical and social risk reduction. Routine screening of SDoH may enable perioperative care teams to better allocate resources where needed for at risk patients. The current study presents one of the first scientific examinations of SDoH in spine surgery patients, however, further study is required to effectively implement public health interventions that target this population.

617

P080: Minimally invasive transforaminal lumbar interbody fusion versus anterior lumbar interbody fusion with pedicle screw fixation in single-level circumferential fusion

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Introduction: Low back pain due to degenerative disc disease (DDD) is a common cause of disability and one of the largest contributors to the overall global health burden. When conservative treatment options fail, anterior lumbar interbody fusion with posterior pedicle screw fixation (ALIF PPF) or minimally invasive transforaminal lumbar interbody fusion with posterior spinal instrumentation (MI-TLIF) can be utilized. While the clinical benefits of fusion have been well defined, long-term consequences between these approaches remain controversial. Therefore, the purpose of this study was to assess the long-term clinical and radiological outcomes of ALIF PPF and MI-TLIF in the treatment of single-level lumbar degenerative disc disease. **Material and Methods:** A retrospective review was performed to identify all patients between 2013-2018 with at least 2-year follow-up who underwent single-level ALIF PPF or MI-TLIF for the treatment of symptomatic DDD. Demographic data was recorded and compared between both cohorts. Revision rates, average time to revision and complications between groups were compared. PI-LL mismatch was calculated from both pre- and post-operative radiographs and degree of correction was compared. Functional outcomes were assessed with ODI, VAS-b and VAS-l measurements at follow-up visits. Standard binomial and categorical comparative analyses were performed. **Results:** A total of 273 patients were included in this study, 133 in the ALIF PPF cohort and 140 in the MI-TLIF cohort. Mean follow-up of the ALIF PPF and MI-TLIF groups were 39.3 and 44.2 months, respectively. The overall revision rates were 9.0% for the ALIF PPF group and 7.9% for the MI-TLIF group ($p = .729$). Mean time to revision was 311 ± 21.3 and 255.2 ± 189.1 days for the ALIF PPF and MI-TLIF cohorts, respectively ($p = .022$). The most common reason for revision surgery in each cohort was pseudarthrosis (45.5%) in the MI-TLIF group and recurrent radicular symptoms (33.3%) in the ALIF PPF group. Of note, two patients in the ALIF PPF group sustained common iliac vein injury intraoperatively whereas one patient in the MI-TLIF group sustained an incidental durotomy that was subsequently repaired. Each cohort achieved a similar proportion of PI-LL mismatch correction, 77.8% in the ALIF PPF group and 81.4% in the MI-TLIF group ($p = .548$). There were 76 males and 57 females in the ALIF PPF cohort compared to 84 males and 56 females in the MI-TLIF cohort ($p = .632$). Both cohorts experienced significant improvements in their functional outcome scores compared to their preoperative values. VAS-l scores decreased by a mean of 5.8 in the MI-TLIF group and a mean of 2.3 in the ALIF PPF group, a significant difference ($p \leq .001$). **Conclusion:** Our two-year **Results** suggest that ALIF PPF and MI-TLIF are reasonable alternatives for the treatment of single-level DDD. After long-term follow-up, overall revision and complication rates did not differ significantly;

however, the ALIF PPF group had a larger proportion of revision surgeries secondary to pseudarthrosis. Additionally, the MI-TLIF cohort had significantly greater VAS-l score improvement compared to the ALIF PPF cohort. Larger, prospective studies are required to corroborate these findings.

739

P081: Is it possible to return to professional sport after lumbar spine surgery? New soft fixation technique. Case series

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Introduction: Present methods of spine fixation during lumbar surgery often make it impossible for professional athletes to return to full-fledged training. In case of rigid fixation, maximum physical activity is allowed only after the completion of the fusion of the operated segment. At the same time, the use of interspinous process devices (IPD) for dynamic stabilization of the operated segment and prevention of the development of adjacent segment disease (ASD) under stress loads in the early postoperative period, can lead to dislocation of the implant and the subsequent development of neurological and biomechanical disorders. Thus, rigid fixation and dynamic stabilization cannot be the methods of choice for professional athletes and do not allow them to start training as early as possible, which indirectly reduces the likelihood of an athlete returning to elite sport. A new original surgical method of "soft fixation" in combination with adequate decompression of the stenotic spinal canal allows you to start early active postoperative rehabilitation, starting from the second or third day after surgery, and full-fledged physical activity is possible after 3-4 weeks. In this paper, we investigated the effectiveness, safety and viability of a new method of "soft fixation" in professional athletes. **Material and Methods:** The study involved 7 professional athletes competing at the level of the World and European Championships in Olympic sports. Each of the respondents had multifactorial lumbar spine stenosis at one level ($n = 5$) and at two levels ($n = 2$). All patients underwent surgery on by certain surgical team. The period of postoperative recovery was monitored. The long-term **Results** of treatment using the new "soft fixation" technique were also evaluated: the occurrence of relapses or complications associated with possible migration of implants was monitored. According to the new method of soft fixation, which includes full adequate decompression of the stenotic segment, the

creation of a congruent "space" for a specialized IPD followed by an original method of fixing the implant in this space. This method eliminates the possibility of migration (dislocation) of the implant under stressful loads. **Results:** All patients started early rehabilitation activities on the second day after surgery, and a full-fledged training process without restrictions - after 4 weeks. 6 out of 7 patients continue their sports career to this day. The duration of the postoperative period at the moment in these 6 patients varies within 2-5 years from the moment of surgery. None of the patients had implant dislocation or relapse of preoperative symptoms. 1 respondent ended his professional career a year after surgery using a new method due to a severe knee injury. **Conclusion:** The new method of "soft fixation" in the future allows athletes to return to full-fledged training as early as possible and without fear, which significantly increases the chances of a successful continuation of a professional career.

773

P082: Comparison of intra-operative radiation risk in posterolateral lumbar fusions with and without a lumbar interbody fusion

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Introduction: Instrumented fusion in the lumbar spine can be achieved with or without an interbody fusion cage. One factor that must be considered when deciding on whether to use an interbody fusion device is the risk associated with ionising radiation. This study aims to investigate whether there is an increased risk of ionising radiation exposure to the patient when an interbody cage is used. **Methods:** Retrospective single surgeon series considering estimated absorbed dose during surgery recorded on the Computerised Radiology Information System (CRIS[®]). Estimated absorbed dose of radiation (milligrays (mGy)) was recorded in adult patients undergoing posterolateral lumbar fusion with and without an interbody fusion cage from February 2017 to March 2021. Equivalent dose (millisieverts (mSv)) and additional cancer risk was calculated from the National Research Council data (2006). **Results:** 73 patients (median age 61.0 years [IQR = 53.5-67.5], 5.7% males). 52 underwent posterolateral fusion (PLF) without interbody device and 21 had a lumbar interbody fusion (LIF) using an interbody cage. Mean intraoperative radiation dose was 152.38mGy (IQR 39.3-349.7) for PLF and 347.96mGy (IQR 68.7 - 747.4) for LIF. Patients undergoing

LIF were exposed to significantly higher levels of radiation intraoperatively (U = 353; p = .019). **Conclusion:** In this series addition of an interbody fusion cage was associated with an increased risk of ionising radiation. This should be considered when choosing fusion strategy. Further investigation is required in order to investigate and quantify the additional risk involved.

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P083: Outcomes after Uninstrumented Laminectomy in Patients 55 > years of age with Low Bone Density

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Introduction: Osteoporosis is becoming an increasingly significant problem in the aging population. The demand for surgical intervention for spinal degeneration and deformity and pathological fractures has increased in this population. Due to the lack of a specific treatment algorithm, more research into outcomes after undergoing surgical correction on these patients is warranted. **Material and Methods:** Included: 142 patients age 55 or older. Chart review performed for peri-operative data and patient follow-up information. Hounsfield Units (HU) measured for 74 patients imaging software at specific regions of interest within the cancellous bone at mid-sagittal, mid-transverse and mid-coronal cuts on computed tomography (CT). The presence of osteopenia or osteoporosis was defined by CT HU < 120 or T-Score by DEXA scan < -1. The rate of revision at 2 years was assessed. **Results:** 142 total patients were included: 58 in the group with normal bone density (45% female, age 68.83 ± 8.23 years, BMI 3.2±7.94 kg/m²), and 1.71 levels fused ±1.026). 84 patients were found to have diminished bone density and allocated to the second group (69% female, age 72.32 ± 7.94, BMI 27.8 ± 5.41, 1.77 levels fused ± .95). The average HU obtained for patients in the normal OP group was 17.46 [P < .01], compared to an average of 92.93 in the OP [P < .01]. T-scores in each group were also statistically significant, with an average of .22 in the normal group [P < .01] and -1.9 in the OP group [P < .01]. EBL, LOS, RTO in 30 days, RTO in 90 days, follow-up revision surgery and post-operative complications were not significant. **Conclusion:** Perioperative CT can be used to informally assess OP in patients as well as DEXA. Though CT scans have shown to predict accurate OP compared to DEXA, further study is necessary to better define HU cutoffs on

preoperative CT scans and their on effect postoperative outcomes.

928

P084: Comparison of cortical screws versus pedicle screws

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Introduction: This is a comparison of cortical screw fixation versus pedicle screw fixation. **Material and Methods:** There were 50 cases of cortical screws and 50 cases of pedicle screws with a minimum of two year follow-up. All of the cortical screws had interbody fusion because of the limited wound exposure. The average age of the patients at the time of surgery was 55.5 for the cortical screws versus 53.3 for the pedicle screws. **Results:** The blood loss was significantly less for the cortical screws versus the pedicle screws with the average blood loss being 200mL for the cortical screws and 275mL for the pedicle screws after cell saver. The time of surgery was significantly longer for the cortical screws plus interbody fusion averaging 4 hours and 44 minutes versus 2 hours and 34 minutes for the pedicle screws. The days in the hospital were less for the cortical screws averaging 2.4 days for the cortical screws versus 3.2 days for the pedicle screws. As to the union rate and complication rate there was not enough difference to be of any significance. **Conclusion:** We conclude that the cortical screws can basically be placed through an incision with less exposure. Consequently there is significantly less blood loss and less days in the hospital. This is offset by the time of surgery which is significantly longer for the cortical screws and interbody fusion.

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P085: Single position lumbar fusion: a systematic review and meta analysis

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Introduction: Recently, a single position lumbar fusion has been described in which both the anterior or lateral interbody fusion as well as posterior percutaneous pedicle screw fixation are performed in a single position. The purpose of this study was to present and analyze the current evidence for single position lumbar fusion. **Material and Methods:** This systematic review was performed in accordance with PRISMA guidelines. Two separate meta-analyses were performed. The first compared single position (SP) surgery, both lateral and

prone, to dual position or flipped (F) surgery. The second meta-analysis compared lateral single position (LSP) surgery to prone single position (PSP) surgery. Variables were included if 1) they were a mean with a reported standard deviation or 2) if they were a categorical variable. For calculating standard error of the mean, we used sample size, mean, and standard deviation. A random effects model was used. The heterogeneity among studies was assessed with a significance level of < .05. **Results:** Twenty-one articles were included for analysis. Three studies were prospective non-randomized studies, while 18 were retrospective. Seven articles studied lateral single position only, 10 articles compared lateral single position to traditional repositioning surgery, three articles studied prone single position surgery, and one article compared prone single position surgery to traditional repositioning surgery. A detailed review is provided for all 21 articles. Seventeen studies were included for meta analysis comparing the SP versus F groups, for a total of 942 patients in the SP group and 254 in the F group. Mean operative time was significantly less for the SP group compared to the F group (SP: 127.5 ± 7.9 , F: 188.7 ± 15.5 , $P < .001$). Average hospital length of stay was $2.87 \pm .3$ days in the SP group and $6.63 \pm .6$ days in the F group ($P < .001$). Complication rates did not significantly differ between groups. Pedicle screws placed in the lateral position had a higher rate of complication as compared to those placed in a prone position (L: $1.2 \pm 2\%$, P: $1.6 \pm 1\%$, $p = .015$). Seventeen studies were included in the LSP versus PSP analysis, including 13 in the LSP group and four in the PSP group, with a total of 785 patients in the LSP group and 85 patients in the PSP group. Operative time and X-Ray exposure was significantly less in the LSP compared to the PSP group (117.1 ± 5.5 min vs 166.9 ± 21.9 min, $P < .001$; 43.7 ± 15.5 minutes versus 171.0 ± 25.8 minutes, $P < .001$). Postoperative segmental lordosis was greater in the prone single position group ($P < .001$). **Conclusion:** Single position surgery decreases operative times and hospital length of stay, while maintaining similar complication rates and radiographic outcomes. PSP surgery was found to be longer in duration and have increased radiation exposure time compared to LSP, while increasing postoperative segmental lordosis.

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P086: Preliminary clinical Results support the performance of PEEK interbody fusion devices with an integrated porous titanium coating for lumbar fusion applications

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Introduction: There are known deficiencies of polyetheretherketone (PEEK) interbody devices. The use of integrated porous titanium coating (ProTi) with nano, micro, and macro features¹ has shown pre-clinical advantages. However, clinical research has not previously been performed on these devices. The objective of this research is to examine the clinical outcomes of patients treated with ProTi interbody fusion devices to evaluate safety and performance. **Material and Methods:** Institutional Review Board approval was obtained to perform a retrospective and prospective registry to gather healing outcomes data on patients treated with the ProTi interbody fusion devices. Patients with one and two-level transforaminal lumbar interbody fusion (TLIF) with the ProTi interbody fusion devices were evaluated with patient reported outcome measurements including the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) pain scores, in addition to radiographic fusion evaluations using both computed tomography (CT) scans and radiographs. All radiographs were reviewed independently to confirm fusion. **Results:** ProTi interbody fusion devices had a significant ($P < .05$) improvement in pain (VAS back, right lower extremity and left lower extremity pain) and functionality (ODI) scores at 12 months follow-up (33.5 ± 3.5 , 21.0 ± 31.1 , 24.8 ± 35.3 , and 17.8 ± 18.9 , respectively) when compared to pre-operative scores (83.0 ± 11.7 , 66.8 ± 23.1 , 57.3 ± 45.5 , and 36.0 ± 5.8 , respectively). Fusion status was confirmed with CT scans demonstrating bone bridging across the interbody space at final follow-up. **Conclusion:** Early data in this ProTi interbody fusion device clinical trial demonstrated osteo-integration with the vertebral endplates and stabilization of the interbody space with solid bone formation based on radiographic data. Concurrently the clinical Results supported the radiographic data with restoration of patient functionality.

I 102

P087: Floseal versus Surgiflo: similar outcomes, different costs in a matched cohort analysis

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Introduction: Floseal (Baxter International Inc.) and Surgiflo (Ethicon Inc.) are two commercially available gelatin-based hemostatic matrices commonly used in spine surgery. The primary objective of this study is to compare the rate of blood transfusions following the use of Floseal and Surgiflo in elective lumbar spine surgery. The secondary objective is to compare the utilization and cost. **Materials and Methods:** Consecutive patients who received elective lumbar spine surgery by an orthopaedic spine surgeon between 2019 and 2021 were

identified for this retrospective study. Since the surgeon switched hemostatic agents in 2020, patients were divided into two cohorts based on which gelatin-based hemostatic agent was used during the spine surgery: Floseal 10mL (N = 102) and Surgiflo matrix 8mL (N = 108). The primary outcome was blood transfusion (intraoperative or postoperative). To control for surgical complexity, the Surgical Invasiveness Index (SII) and the Adult Spinal Deformity Invasiveness Score (ASD-S) were calculated. A 1:1 propensity score matching was then performed using demographic information, SII, ASD-S, and tranexamic acid (TXA) use. Standardized differences of .1 (or 10%) was used to indicate a meaningful difference between cohorts. Using the matched cohorts, statistical analysis included Student's T-test or Wilcoxon's rank-sum test for continuous variables and Chi-square analysis for categorical variables.

Results: Following propensity score matching, the Floseal and Surgiflo cohorts each consisted of 77 patients. There was no significant difference in the rate of blood transfusion (13.0% vs. 9.1%, $p = .441$) between matched cohorts. Furthermore, there was no difference in operative time ($p = .503$), estimated blood loss ($p = .541$), hospital complication ($p = .841$), or length of stay ($p = .391$). Multiple units of the Surgiflo were more likely to be used during spine surgery than Floseal ($p = .004$). Using internal hospital cost data, Surgiflo cost \$22.69 more per unit, \$9.04 more per mL, and \$102.45 more per surgery compared to Floseal. With practice of 1000 surgeries a year, switching from Surgiflo to Floseal represents a cost-savings of \$102,450 per year. **Conclusion:** There was no significant difference in transfusion rates between the matched Floseal and Surgiflo cohorts. However, Surgiflo had higher costs and usage compared to the Floseal, providing evidence for spine surgeons and hospitals to help reduce costs for their practice.

I 300

P088: Factors affecting lumbar interbody fusion

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Introduction: The aim of the present work is to present the long-term clinical and radiological Results of dorsal fusion operations on the lumbar spine in 2-years Follow Up in single center survey. Any predictors for the long-term result should be determined based on an exploratory data analysis. The rate of fusion should be assessed based on the patient's age, gender and previous medical history. **Materials and Methods:** The 156 patients in the present study were operated with mono-und multilevel interbody fusion in single centre in the period from 2016 to 2018 due to a degenerative spinal disease. This follow-up recording had to take place one and two years after the operation. Our patients were treated with a TLIF, PLIF and ALIF in lumbar segments. To evaluate the clinical outcome

were also used such criteria as age, sex, height and weight, BMI, the location of the operated segments as well as the number of operated segments, the usage of intraoperative navigation (o-arm), problems with instrumentation, type of pedicle screws (polyaxial, pre-clampable and non-pre-clampable, long-head screws), the usage of bone cement, intraoperative correction of the screw positioning, application of the vertebral body replacement, duration of the operation, need of the second operation. The important criteria for the evaluation of the fusion process were also the rate of the postoperative complications, such as misplacement of the implanted material, fistulas on the dura, postoperative bleeding, infection etc. The fusion was analyzed in the X-ray investigations as well as CT in the period of 3, 6, 9 months-1 year and 2-years after the operation. **Results:** The participants were divided into groups according to their merger Results as follow: A Group A1 included all patients who had a fusion in all segments treated. In group A2, all patients were summarized who either showed no fusion or stable pseudarthrosis either at one level or as a total fusion result with two level treatment. A Group A3 included all patients who, either one level or as a total fusion result with two level treatment, showed no fusion but a stable pseudarthrosis. The exclusion criteria were: infection and revision surgery after previous TLIF procedure. The rate of full fusion was 66%, a partial fusion 22% (88% together) and pseudarthrosis patients were 12%. The completely fusion rate in the literature was 88.2%. **Conclusions:** Our fusion rate Results are similar to most literature data. Most important Factors affecting fusion rate are: age, ASA Index (Pre-existing illness), BMI and Osteoporosis. In the case of osteoporotically changed bone, differences in fusion behavior are found due to the poor bone quality. It is also worth mentioning that factors such as diabetes, smoking or the use of NSAIDs and / or steroids have a negative impact on the fusion rate. Postoperatively in the available studies the evaluation of the formation of bony fusion bridges often took place on the basis of X-ray or CT images.

I336

P089: Novel modification of midline lumbar interbody fusion (MIDLIF): a series of 28 patients

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Introduction: The medio-lateral transpedicular cortical screw trajectory in a MIDLIF procedure enables standard midline

approach for a microsurgical spinal decompression sparing the excessive lateralisation of paravertebral muscles. Potential benefits compared to posterior LIF (PLIF)/ transforminal LIF (TLIF) procedure are smaller wound, faster mobilization, shorter hospital stay, lower need for postoperative analgesia and probably lower wound healing complications which is crucial in spinal stabilization. Our goal was to render the MIDLIF technique more precisely regarding the invasiveness to the smallest possible way in order to perform the whole surgery in comparable approach as for the standard microdiscectomy. **Material and Methods:** Median skin incision from 3 cm (1 level) to 6 cm (3 level) was made. Differing from the standard MIDLIF procedure, we performed only unilateral microsurgical approach for decompression and cage insertion after complete discectomy with eventual undercutting to the other side using the Caspar retractor. For screw placement, we took the advantage of percutaneous instrumentarium enabling the retractor removal but still using the same midline approach: Screws were inserted in the open side and the contralateral screw placement was performed transfascially without need for lateralisation of paravertebral muscles (as in PLIF, or standard MIDLIF procedure) or another skin incision (TLIF). **Results:** We have performing the modified MIDLIF procedure from February 2020 up to date. Since then, 28 patients, 19 female (67.9%) and 9 male (32.1%) with median age of 68, were included in the analysis. There were 19 patients (67.9%) with 1 level, 7 patients (28%) with 2 level and 2 patients (7.1%) with indication for 3 level surgery. Skin incision and muscle trauma was smaller compared to the standard MIDLIF, PLIF or TLIF procedure and comparable with patients after standard microdiscectomy. Mean blood loss was 215 ml, duration of the surgery 217 minutes and hospital stay after surgery 5 days. Four patients (14.3%) underwent a revision surgery due to postoperative epidural bleeding, misplaced screw, cage dislocation and late infection. Perioperatively, four cases (14.3%) of reparable dural tears occurred. **Conclusion:** The modified MIDLIF procedure is a minimal invasive procedure with smaller wound, less muscle trauma with less blood loss and necessity of postoperative analgesia. This might be an important alternative to standard TLIF and PLIF procedures with comparable complication rate. Further studies need to be addressed to analyze long term outcome to proof the superiority of this procedure.

Diagnosics

I08

P090: Neuropathic arthropathy in spine surgery. What to do?

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Introduction: Neuropathic spinal arthropathy, or Charcot's disease, a rare disorder in vertebral pathology, was first described in 1868 by Jean-Marie Charcot in patients with tertiary syphilis. One of the conditions for Charcot's disease is the underlying normal protective feedback from the spine. Their destruction occurs. Repetitive stress on the spine leads to progressive bone destruction and instability, and may also trigger symptoms associated with autonomic dysreflexion. **Aim:** To study the Results of treatment of patients with Charcot's disease. **Material and Methods:** Since 2012, 8 cases of spinal neuropathic arthropathy have been recorded in our clinic. **Results:** The usual clinical course of neuropathic arthropathy is the progressive destruction of bone tissue in the thoracic or thoracolumbar regions. Changes in neurological status in patients with paraplegia may be represented by a progressive increase in spasticity of the lower extremities, the appearance of pain in the back or lower extremities, or autonomic dysreflexia. Differential diagnosis is difficult in many cases. Progressive involvement in the destructive process of both bone structures and surrounding soft tissues, forming a kind of "cocoon" around the lesion, can imitate infection or tumor. Often, patients receive long-term treatment for diseases such as a spinal tumor or metastatic lesion. The goal of treating patients with Charcot's disease is to achieve a stable bone block in grossly unstable segments. In essence, this entails resection of all destructively altered bone tissue and reconstruction with plastics to ensure stability. In most cases, a one-stage surgical treatment from the posterior approach with stabilization of the anterior column is sufficient; this approach is also possible in case of complete damage to the spinal cord. Spinal fusion 360° and fixation with a metal structure in case of large destruction of bone tissue allows achieving the necessary stability. Non-functional root ligation facilitates ventral access and resection of the involved vertebral bodies, without the need for ligation of the dural sac. Shortening osteotomies have the added benefit of increasing bone contact, thus eliminating the need for a significant number of allografts. Due to changes in tissues, a long biomechanical lever, the presence of paraplegia, the risk of non-union in this group of patients is much higher. Therefore, resection of three columns and shortening of the spinal column from the posterior approach provides an ideal mechanical and biological solution to this problem. **Conclusion:** The appearance of spinal deformity in patients with lower paraplegia, especially those previously operated on, with destruction of bone tissue and dislocation of the vertebrae, should, in the absence of an infectious or neoplastic disease, lead the surgeon to think about Charcot's disease. The main tactic for the treatment of this disease is deformity correction with reliable spinal fusion. Such patients should be monitored for a long time due to the high risk of developing instability of the hardware and progression of the disease.

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P091: Global Alignment and Proportion (GAP) Score: validation and establishment of baseline scores in healthy US adult population

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. The GAP parameters include relative pelvic version, relative lumbar lordosis, lordosis distribution index, relative spinopelvic alignment, and an age factor of 6. The aim of the study was to validate and determine baseline GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. GAP scores of 87 healthy volunteers that met the inclusion criteria were assessed. Mean age of the selected volunteers was 54.9 ± 15.1 (20-84) years. GAP score parameters included relative lumbar lordosis (measured minus ideal lumbar lordosis), relative pelvic version (measured minus ideal sacral slope), lordosis distribution index (L4-S2 lordosis divided by L1-S1 lordosis, multiplied by 100), relative spinopelvic alignment (measured minus ideal global tilt), and an age factor. A GAP score of 0-2 was classified as proportioned, 3-6 as moderately proportioned, and ≥ 7 as severely disproportioned. **Results:** Baseline GAP scores in otherwise healthy individuals were assessed. 44.8% of volunteers had a score defined as proportioned, 39.1% of volunteers had a score defined as moderately proportioned, and 16.1% of volunteers had a score defined as severely disproportioned. **Conclusion:** Our study validated GAP scores in a healthy U.S. population. As baseline GAP scores within the general population tend to be proportioned, identification of individuals with deviation from this trend may help identify those at risk for development of complications after spinal deformity correction surgery. Change in baseline GAP score may also indicate risk of mechanical complication and revision following surgery. Further long-term studies are needed to assess for development of complications in the healthy population with baseline GAP scores defined as moderately proportioned or severely disproportioned.

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P092: Racial and ethnic variation in sagittal spinopelvic parameters in an urban settingAdam Nessim¹, Woojin Cho¹, Andrew Baddoo¹, and Doruk Somuncu¹¹Orthopedics, Albert Einstein College of Medicine, New York, USA

Introduction: Spino-pelvic (SP) alignment is influenced by a variety of factors, including, gender, age, and ethnicity. Recent literature has reported on the influence of ethnicity on pelvic incidence (PI), pelvic tilt (PT), and Sacral slope (SS) in a number of isolated Asian and African populations. Assessment of spinopelvic parameters is instrumental to appropriate the evaluation of symptomatic patients. Here we present a retrospective chart review of spinopelvic parameters among African American, Hispanic, and Caucasian population in a heterogeneous urban setting. **Material and Methods:** Inclusion criteria for this study were as follows: patients that reported symptoms of neck pain with no evidence of thoracolumbar deformity, scoliosis, or pathology. Additionally, patients did not report low back pain, and did not have any history of previous spinal surgery. Patient data regarding ethnicity were retrospectively obtained in accordance with IRB recommendations. Among patients that met the inclusion criteria, the following measurements were obtained from standing PA and Lateral films: PI, PT, SS, TPA, SB, CB, LL, and PI/LL offset. These values were then stratified according to ethnicity (Hispanic, African American, and Caucasian) and analyzed using ANOVA testing. **Results:** A total of 110 patients were included in this study, grouped into the following categories: African American (31/110), Hispanic (54/110), and Caucasian (25/110). For Black patients, mean PI, PT, SS, and TPA were $64.45 \pm 1.07^\circ$, $16.29 \pm 11.51^\circ$, $48.16 \pm 1.87^\circ$, and $16.46 \pm 8.60^\circ$ respectively. For Hispanic patients, mean PI, PT, SS and TPA were $6.20 \pm 14.34^\circ$, $11.14 \pm 9.93^\circ$, $49.05 \pm 12.80^\circ$ and $15.05 \pm 9.07^\circ$ respectively. For Caucasian patients, mean PI, PT, SS, and TPA were $57.86 \pm 14.84^\circ$, $14.10 \pm 14.79^\circ$, $43.76 \pm 14.51^\circ$ and $16.47 \pm 14.6^\circ$ respectively. There was no significant difference between the 3 groups in PI ($p = .185$), PT ($p = .126$), SS ($p = .222$), TPA ($p = .779$), SB ($p = .470$), CB ($p = .362$), LL ($p = .327$), and PI/LL offset ($p = .606$). Offset mean for African American was 7.45 ± 18.7 , for Hispanic was 1.41 ± 16.3 , and for Caucasian was 4.66 ± 22.38 . **Conclusion:** We found that spino-pelvic measurements taken among a diverse urban population can not be readily distinguished on the basis of ethnicity alone. There were no difference in SP measurements among African American, Hispanic, Caucasian population in a heterogeneous urban setting. While our study at the present time may be limited by low sample size and lack of Asian population, it forms a foundation for the establishment of baseline spinopelvic measurements in an ethnically heterogeneous population.

Further research and characterization of ethnicity-specific parameters should be undertaken to draw definitive **Conclusions.**

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P093: A comparison of sagittal spinopelvic (SP) parameters in American and Korean populationsWoojin Cho¹, Adam Nessim¹, Andrew Baddoo¹, and Doruk Somuncu¹¹Orthopedics, Albert Einstein College of Medicine, USA

Introduction: Recent literature has found variation in spinopelvic (SP) parameters such as pelvic incidence, pelvic tilt, and sacral slope among various isolated populations. Knowledge of this variation in normal anatomy is critical in assessing and managing disease of the axial skeleton. Here we present a retrospective chart review of SP parameters between 2 urban populations from America and Korea. **Material and Methods:** Data from healthy American and Korean subjects from two major urban institutions were retrospectively obtained. Patient ethnicity was obtained in accordance with both institutional review boards. The following measurements were made from standing PA and lateral films from both populations and compared using two sample T-tests: PI, PT, SS, TPA, SB, CB, LL, and PI/LL offset. **Results:** A total of 341 patients (131 American, 210 Korean) were included. Mean PI was significantly larger in Americans ($6.6 \pm 13.7^\circ$ vs. $44.2 \pm 11.8^\circ$; $P < .001$), as were mean SS ($46.56 \pm 12.50^\circ$ vs. $3.25 \pm 8.05^\circ$; $P < .001$), mean TPA ($15.56 \pm 1.00^\circ$ vs. $12.35 \pm 8.52^\circ$; $p = .002$), mean LL ($56.61 \pm 15.1^\circ$ vs. $44.21 \pm 9.04^\circ$; $P < .001$) and mean PI/LL offset ($4.02 \pm 18.8^\circ$ vs. $.03 \pm 1.20^\circ$; $p = .012$). PT, SB, and CB did not differ between the 2 groups ($p = .943$, $.765$, and $.129$ respectively). **Conclusion:** Pelvic incidence, sacral slope, T1-pelvic angle, lumbar lordosis, and PI/LL offset differ significantly in American and Korean patients. Accurate assessment of SP parameters is crucial to achieving surgical success.

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P094: Determination of Global Alignment and Proportion (GAP) trends among various ethnicities in the USAWoojin Cho¹, Ariella Gartenberg², Jeffrey Kim², Adam Nessim², Andrew Baddoo², and Doruk Somuncu³¹Orthopaedic Spine Surgery, Albert Einstein College of Medicine, Montefiore Medical Center, New York, USA²Albert Einstein College of Medicine³Bahcesehir University School of Medicine, Istanbul, Turkey

Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. The pelvic incidence is a relatively constant morphological parameter that describes “pelvic size” for any individual. The GAP parameters include relative pelvic version, relative lumbar lordosis, lordosis distribution index, relative spinopelvic alignment, and an age factor of 6. The aim of the study was to determine GAP scores trends among different ethnicities in a healthy U.S. adult population sample with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Volunteers with undetermined ethnicity were also excluded from the study. 78 volunteers have met the inclusion criteria. Mean age of the selected volunteers was 54.9 ± 15.1 (20-81) years. The cohort consisted of 19 African Americans, 36 Hispanics, 19 Caucasians, and 4 Asian Americans. GAP scores, correlation with GAP score category and GAP score means were then measured in the groups divided by ethnicity. GAP score parameters included relative lumbar lordosis (measured minus ideal lumbar lordosis), relative pelvic version (measured minus ideal sacral slope), lordosis distribution index (L4-S2 lordosis divided by L1-S1 lordosis, multiplied by 100), relative spinopelvic alignment (measured minus ideal global tilt), and an age factor. A GAP score of 0-2 was classified as proportioned, 3-6 as moderately proportioned, and ≥ 7 as severely disproportioned. Statistical significance was determined using a one-way ANOVA. **Results:** GAP scores in 76 otherwise healthy individuals were assessed among varying ethnicities. Among African Americans, 42.1% had a score defined as proportioned, 47.4% had a score defined as moderately proportioned, and 1.5% had a score defined as severely disproportioned. Similarly, among Hispanics, 38.5% had a score defined as proportioned, 41.0% had a score defined as moderately proportioned, and 2.5% had a score defined as severely disproportioned. Among Caucasian individuals 52.6% had a score defined as proportioned, 31.6% had a score defined as moderately proportioned, and 15.8% had a score defined as severely disproportioned. The Asian American cohort demonstrated 75.0% proportioned and 25% moderately proportioned. There was no statistically significant difference between ethnic group mean GAP scores as determined by one-way ANOVA [$F(3,77) = .57, p = .63$]. **Conclusion:** The GAP score is a PI-based proportional scoring system that has demonstrated efficacy in predicting risk of mechanical complication and need for revision surgery following adult spinal deformity correction surgery. As evident through this study, GAP score trends tend to remain stable among healthy individuals of varying ethnicities, with greater prevalence of

those defined as proportioned. Although larger long-term studies are needed to validate GAP score trends, our study demonstrates no significant difference in GAP score trends among various ethnicities in a healthy U.S. population.

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P095: Validation of the age factor in determination of total Global Alignment and Proportion (GAP) Score

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. The GAP parameters include relative pelvic version, relative lumbar lordosis, lordosis distribution index, relative spinopelvic alignment (RSA), and an age factor of 6. An age ≥ 60 years old receives a score of 1, while age < 60 receives a score of . The aim of the study was to validate the age factor in calculation of GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Average GAP scores with the age factor removed (GAP-A) among various age distributions were then measured in 87 healthy volunteers that have met the inclusion criteria. Mean age of the selected individuals was 54.9 ± 15.1 (20-84) years. Parameters without age factors included relative lumbar lordosis (measured minus ideal lumbar lordosis), relative pelvic version (measured minus ideal sacral slope), lordosis distribution index (L4-S2 lordosis divided by L1-S1 lordosis, multiplied by 100), relative spinopelvic alignment (measured minus ideal global tilt), and an age factor of 6. The average GAP-A scores per various age groups were compared using two-tailed t-test. **Results:** The average GAP-A score in healthy individuals ages 20-29 was 2.63, ages 30-39 was 1.89, ages 40-49 was 2.50, ages 50-59 was 2.07, ages 60-64.9 was 2.29, ages 65-69.9 was 4.85, and ages ≥ 70 was 6.29. See Table 1. Mean GAP-A scores of individuals < 70 was significantly different from GAP-A scores of those > 70 . **Conclusion:** Our study examined the age factor parameter in calculation of GAP scores in a healthy U.S. population.

Utilizing an age cut-off of 70 may be better in identifying individuals at risk for development of complications after spinal deformity correction surgery. Further studies with larger population are needed to confirm using age of 70 as the new cut-off as compared to the previous age factor of 6.

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P096: Review of non-traumatic coccygeal pathology in adults and its treatment

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Introduction: This article provides a concise yet detailed review of the current understanding of the etiologies underlying coccygeal pain, and the various modalities used to treat coccygeal pain based on etiology. A clinical algorithm and table for the treatment of coccygeal pain is also provided. **Material and Methods:** A comprehensive, retrospective narrative review of literature analyzing the current peer-reviewed data available on the electronic PubMed database was undertaken on June 1, 2018. Literature search was performed in order to identify potentially relevant studies for inclusion in this review focused primarily on the etiology and treatment of coccydynia and coccygeal pathology. Based on this information an algorithmic approach to diagnose and treat coccygeal pain was developed. The literature search and screening were performed by two independent reviewers. **Results:** Coccygeal pain has historically been a controversial topic due to varying etiologies. Coccygeal pain may have several etiologies and the best treatment for coccygeal pain is etiology dependent. Non-invasive treatment modalities include rest, ice, sitting aids, warm baths, physical therapy, and non-steroidal anti-inflammatory drugs. Non-surgical modalities of treatment include steroid injection with and without local anesthesia, and manipulation under local and general anesthesia. Surgical management centers on coccygectomy. **Conclusion:** Etiologies of coccygeal pain can be grouped into one of the following categories: psychological, pelvic musculature spasm, dural/nerve irritation, BMI related, neoplastic/infectious. A preferred method of treatment ranging from physiotherapy to surgery can be targeted to each etiology to provide the most effective treatment to the patient.

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P097: Validation of relative spinopelvic alignment (RSA) in determination of total Global Alignment of Proportion (GAP) Score

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. GAP scores of 0-2 are classified as proportioned, 3-6 as moderately proportioned, and ≥ 7 as severely disproportioned. GAP parameters include relative pelvic version, relative lumbar lordosis, lordosis distribution index, age factor of 60, and relative spinopelvic alignment (RSA). RSA categories include: $> 18^\circ$ receiving a score of 3, $18^\circ-1.1^\circ$ receiving a score of 1, $10^\circ-7^\circ$ receiving a score of 0, and $< -7^\circ$ receiving a score of 1. The aim of the study was to validate the RSA parameter in calculation of GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Average GAP scores with the RSA factor removed (GAP-R) among various RSA parameters were then measured in 87 healthy volunteers that met inclusion criteria. Mean age of the selected individuals was 54.9 ± 15.1 (20-84) years. This GAP-R score parameters included relative lumbar lordosis, relative pelvic version, lordosis distribution index, and an age factor. Average GAP-R scores were then calculated for each RSA category and compared using a two-tailed t-test. **Results:** Average GAP-R score for individuals with RSA $> 18^\circ$ was 6.5. RSA $18^\circ-1.1^\circ$ had a score of 3.93, RSA of $10^\circ-7^\circ$ had a score of 2.0, RSA $< -7^\circ$ had a score of 3.44. No statically significant difference ($p > .5$) was determined between RSA categories $18^\circ-1.1^\circ$ and $< -7^\circ$. Statistical significance ($P < .05$) was determined between RSA category $> 18^\circ$ and RSA $18^\circ-1.1^\circ$, as well as between RSA category $> 18^\circ$ and RSA $< -7^\circ$. **Conclusion:** Our study validated the original RSA cutoff measurements of the GAP score calculation in a healthy U.S. population. Total average GAP-R scores per each RSA cut off subgroup correlate directly with the scores given to each subgroup in the original GAP score system. RSA category $> 18^\circ$ showed significant statistical difference from other categories, correlating with a GAP score of 3, while categories $18^\circ-1.1^\circ$ and $< -7^\circ$ were comparable, in line with the original GAP classification's score of 1, while category $-7^\circ-1.1^\circ$ correlated with a GAP score of . Further long-term studies should assess RSA correlation with mechanical complication and revision rates after spinal deformity surgery and, thus, determine the need for inclusion of other parameters in risk assessment.

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P098: Validation of Lordosis Distribution Index (LDI) in determination of total Global Alignment and Proportion (GAP) Score

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. GAP scores of 0~2 are classified as proportioned, 3~6 as moderately proportioned, and ≥ 7 as severely disproportioned. GAP parameters include relative pelvic version, relative lumbar lordosis, lordosis distribution index (LDI), age factor of 60, and relative spinopelvic alignment. LDI categories include: < 40% receiving a score of 2, 40%~49% receiving a score of 1, 50%~80% receiving a score of 0, and > 80% receiving a score of 3. The aim of the study was to validate the LDI parameter in calculation of GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Average GAP scores with the LDI factor removed (GAP-D) among various LDI parameters were then measured in 87 healthy volunteers that have met the inclusion criteria. Mean age of the selected individuals was 54.9 ± 15.1 (20-84) years. GAP-D score parameters included relative lumbar lordosis, relative pelvic version, relative spinopelvic alignment, and an age factor. Average GAP-D scores were then calculated for each LDI category and compared using a two-tailed t-test. **Results:** Average GAP-D score for individuals with LDI <40% was 7.5. LDI 40%~49% had a score of 3.75, LDI of 50%~80% had a score of 3.07, LDI >80% had a score of 2.4. **Conclusion:** Our study validated the original LDI cutoff measurements of the GAP score calculation in a healthy U.S. population. Total average GAP-D scores per each LDI cut off subgroup correlate directly with the scores given to each subgroup in the original GAP score system. The first two subgroups of the GAP and GAP-D scores follow a similar trend, but showed significant statistical differences for the 50~80% and > 80% categories. Further studies assessing either an increase in the GAP subgroup score for the LDI 50~80% category, or a

decrease in the LDI > 80% category, would be able to reassess the accuracy of the LDI parameter in the GAP score system.

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P099: Validation of relative lumbar lordosis (RLL) in determination of total Global Alignment and Proportion (GAP) Score

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. GAP scores of 0~2 are classified as proportioned, 3~6 as moderately proportioned, and ≥ 7 as severely disproportioned. GAP parameters include relative pelvic version, relative lumbar lordosis (RLL), lordosis distribution index, age factor of 60, and relative spinopelvic alignment. RLL categories include: <2 5° receiving a score of 3, -25°~-14.1° receiving a score of 2, -14°~-11° receiving a score of 0, and > 11° receiving a score of 3. The aim of the study was to validate the RLL parameter in calculation of GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Average GAP scores with the RLL factor removed (GAP-L) among various RLL parameters were then measured in 87 healthy volunteers that have met the inclusion criteria. Mean age of the selected individuals was 54.9 ± 15.1 (20-84) years. This GAP-L score parameters included relative spinopelvic alignment, relative pelvic version, lordosis distribution index, and an age factor. Average GAP-L scores were then calculated for each RLL category and compared using a two-tailed t-test. **Results:** Average GAP-L score for individuals with RLL < 25° was 5.17. RLL -25°~-14.1° had a score of 2.30, RLL of -14°~-11° had a score of 2.07, RLL > 11° had a score of 1.86. No statically significant difference ($p > .5$) was determined between RLL categories -25°~-14.1° and < -14°~-11° and > 11°. Statistical significance ($P < .05$) was determined between RLL category < 25° and RLL -25°~-14.1°. **Conclusion:** Our study validated the original RLL cutoff measurements of the GAP score calculation in a healthy U.S. population. Total average GAP-L

scores per each RLL cut off subgroup correlate directly with the scores given to each subgroup in the original GAP score system. RLL category $< -25^\circ$ showed significant statistical difference from other categories, correlating with a GAP subgroup score of 3, while RLL category $-25^\circ \sim -14.1^\circ$ correlated with a GAP subgroup score of 2, RLL category $-14^\circ \sim 11^\circ$ correlated with 0, and RLL category $> 11^\circ$ was in line with the original GAP classification's subgroup score of 3. GAP and GAP-D scores follow a similar trend except for the $> 11^\circ$ category, which could possibly be explained by the small sample size in that category. Further long-term studies should assess RLL correlation with mechanical complication and revision rates after spinal deformity surgery and, thus, determine the need for inclusion of other parameters in risk assessment.

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PI00: Validation of relative pelvic version (RPV) in determination of total Global Alignment and Proportion (GAP) Score

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Introduction: Proximal Junctional Kyphosis has been a well-known complication following adult spinal deformity correction surgery. The Global Alignment and Proportion (GAP) score was thus developed to predict such mechanical complications following spinal correction surgery. The GAP score is a pelvic-incidence based method of analyzing the sagittal plane. GAP scores of 0~2 are classified as proportioned, 3~6 as moderately proportioned, and ≥ 7 as severely disproportioned. GAP parameters include relative pelvic version (RPV), relative lumbar lordosis, lordosis distribution index, age factor of 60, and relative spinopelvic alignment. RPV categories include: $< -15^\circ$ receiving a score of 3, $-15^\circ \sim -7.1^\circ$ receiving a score of 2, $-7^\circ \sim 5^\circ$ receiving a score of 0, and $> 5^\circ$ receiving a score of 1. The aim of the study was to validate the RPV parameter in calculation of GAP scores among healthy USA adult volunteers with no prior spinal pathology. **Material and Methods:** Retrospective review of prospectively collected data was done. Inclusion and exclusion criteria were established. Exclusion criteria included any major spinal pathology or surgery, terminal illness, morbid obesity, or any significant comorbid condition. Average GAP scores with the RPV factor removed (GAP-V) among various RPV parameters were then measured in 87 healthy volunteers that have met inclusion criteria. Mean age of the selected individuals was 54.9 ± 15.1 (20-84) years. This GAP-V score parameters

included relative lumbar lordosis, relative pelvic version, lordosis distribution index, and an age factor. Average GAP-V scores were then calculated for each RPV category and compared using a two-tailed t-test. **Results:** Average GAP-V score for individuals with RPV $< -15^\circ$ was 7.33. RPV $-15^\circ \sim -7.1^\circ$ had a score of 3.25, RPV of $-7^\circ \sim 5^\circ$ had a score of 2.07, RPV $> 5^\circ$ had a score of 2.5. Statistical significance ($P < .05$) was determined between RPV category $< -15^\circ$ and RPV $-15^\circ \sim -7.1^\circ$, as well as between RPV category $-7^\circ \sim 5^\circ$ and RPV $> 5^\circ$. **Conclusion:** Our study validated the original RPV cutoff measurements of the GAP score calculation in a healthy U.S. population. Total average GAP-V scores per each RPV cut off subgroup correlate directly with the scores given to each subgroup in the original GAP score system. RPV category $< -15^\circ$ showed significant statistical difference from other categories, correlating with a GAP subgroup score of 3, while RPV category $-15^\circ \sim -7.1^\circ$ was in line with a GAP subgroup score of 2. RPV category $-7^\circ \sim 5^\circ$ was comparable with a GAP score of 1, while category $> 5^\circ$ correlated with a GAP subgroup score of 1. Modifying the parameter by either increasing the GAP subgroup score of the $-7^\circ \sim 5^\circ$ category might better identify those at risk for complications following spinal correction surgery. Further long-term studies should assess RPV correlation with mechanical complication and revision rates after spinal deformity surgery and, thus, determine the need for inclusion of other parameters in risk assessment.

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PI01: Reliability of semi-automated spinal measurement software

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Background Context: In the treatment of patients with adult spinal deformity, analysis of spinopelvic balance is essential in determining treatment options. This includes pelvic tilt (PT) and incidence (PI), lumbar lordosis (LL), and the sagittal vertical axis (SVA). Historically, the measurement of radiographs was done by hand with poor to moderate inter-observer reliability (1, 2). More recently digital PACS tools provided improved accuracy and reliability (2), with the latest software semi-automating this process with a promise of improved efficiency. To our knowledge, no studies have examined the inter-observer reliability of semi-automated PACS software. This study aims to compare the reliability of this software versus PACS to determine if the improved efficiency occurs at the cost of reliability. **Methods:** Full

spine x-rays were retrospectively reviewed from 25 patients older than 18 years seen at a tertiary medical center between 2014 and 2017. Patients were included if they had greater than 5cm of sagittal imbalance, without prior surgical spinal fusion and/or instrumentation. Spinopelvic parameters were measured in two radiographic programs: one with basic, non-spine specific measurement tools (eUnity, Client Outlook, Waterloo, Canada); and a second with spine-specific measurement tools that semi-automate the measurement of these parameters (Sectra, Sectra AB, Linköping, Sweden). Balance parameters included SVA, PI, PT, and LL. Two authors re-measured radiographs after a 6 month interval and Results were compared to original measurements. Data were compared by examining inter-rater and inter-program reliability using interclass correlation coefficient (ICC). We hypothesized that modern semi-automated software, with its promise of increased measurement efficiency, would maintain reliable Results. **Results:** The subjects' mean age was 67.9 ± 13.8 years old, and 32% were male. The inter-program reliability was strong, with ICC values greater than .91 for each parameter. Similarly, there was strong inter-observer reliability with ICC values greater than .88. Delayed re-measurement also showed strong reliability with ICC values greater than .90 ($P < .001$ for all measurements). **Conclusions:** There is excellent inter-observer and inter-program reliability between the basic PACS and semi-automated programs. These data demonstrate that the purported efficiency of semi-automated measurement programs does not come at the cost of measurement reliability.

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1190

PI02: Why are frailty indexes not systematically used in preoperative spine consultation?

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Introduction: Frailty indices are highly predictive of major medical and mechanical complications, lengths of hospital stay, and mortality rates after spine procedures. However, several barriers limit the extent to which spine surgeons employ these indices. The main purposes of the current study were to assess the use of frailty indices by Latin-American spine surgeons and identify the main barriers perceived to restrict their clinical application. **Methods:** For this cross-sectional survey, a questionnaire evaluating the demographic characteristics of participating surgeons and their utilization of frailty indices were created in Google form and sent by e-mail to every registered member of AO Spine Latin America between October and November 2022. **Results:** Of the 1047 surgeons sent the survey, 293 responded (response rate = 28%). Half of the surgeons (51.7%) said they were unfamiliar with the terms 'frailty' and 'frailty index', while 7.3% claimed not to use any frailty scale during their pre-operative assessments. The most frequently utilized index was the modified Frailty Index (mFI) (18%). The most important perceived barrier was the excessive amount of time required to calculate each patient's frailty score. Ninety-two percent of the spine surgeons felt sure that these scores could influence their therapeutic decisions, while 91% desired an easier-to-use risk-prevention scale. **Conclusion:** The main perceived barriers restricting the use of frailty indices were the time required to complete them, lack of index validation, and need for specific instruments to calculate the index score.

Keywords

Frailty; Frailty Index; Spine Surgery; Latin-America; Complication.

Disc Degeneration

301

PI03: Analysis of long term outcome in giant calcified thoracic disc herniation operated using a unique posterolateral approach technique

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Introduction: Thoracic disc herniation (TDH) though a rare occurrence (.15-4%) causes significant neurological deficit. Labeled as Giant if herniated disc occupies > 40% of canal. Calcification is seen in 42% of herniations and intradural

extension in 70%. Incidence of myelopathy in Giant TDH ranges from 70-95%. There is a lot of confusion regarding surgical approach and technique to be used in treating these cases. We present our experience of using a unique technique through posterolateral approach for extracting giant calcified thoracic disc. **Material and Methods:** The study included 24 operated patients of Giant calcified TDH with a post-operative follow up of at least 2 years. We retrospectively reviewed the clinico-radiological aspects from the records of these 24 patients who were operated at our institute and were followed up with serial clinical examination and radiographs taken at 1, 3, 6 months, 1 year and 2 years to assess the progress. Clinical parameters taken into account were age, sex, diagnosis and neurological assessment using Frankel grading system, surgical approach, instrumentation, surgical time, post-operative mobilization and peri-operative complications. Radiological assessment included taking pre-operative X-ray, CT and MRI scans and post-operative radiographs taken immediately post op, at 1, 3, 6 months, 1 year and 2 years. Radiological parameters studied were location, number of levels affected and percentage canal encroachment. The study was conducted after taking consent from all participants and has been approved by the ethics committee of our institute. The study included only those patients with calcified thoracic disc herniations and patients with non-calcified soft disc herniations were excluded from the study. **Results:** Of 24 patients 18 were male and 6 were female. Mean age was 39.62 years. Most common level was T11-12. Mean canal occupancy was 58.2%. Neurological improvement was seen in 22 patients with no worsening in any of them. There were total 6 complications with 3 dural tears and 3 with suture site infections which were managed appropriately. Mean level of instrumentation was 4.25 levels. Mean duration of surgery was 3.708 hours with mean blood loss of 1.17 litres. **Conclusion:** Calcified thoracic disc herniations though a rare entity if not properly diagnosed and treated in time can cause irreversible damage. Study was done to show the method of approaching giant calcified TDH and its long-term outcome. Anterior approach is technically difficult and not everyone can master it as compared to posterolateral approach which is a commonly used approach in most surgeries. Since easy to master, with few modifications as shown above can be used effectively in resecting giant calcified TDH thereby minimizing the complications. The above study is done to promote and encourage surgeons to safely carry out resection of Giant TDH using the modified posterolateral approach technique.

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P104: Results of minimally invasive decompression compared with traditional microlumbar discectomy and open laminectomy

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Introduction: Lumbar disc herniations and lumbar central stenosis are among the most common pathologies requiring spine surgery, and there has been a shift towards minimally invasive methods (MIS) in recent years. Very few comparative studies with homogenous cohorts of patients and long term follow up have been performed, to date. In this regard, we sought to evaluate the impact of performing decompression with MIS technique versus standard open approaches, in the setting of microdiscectomy and laminectomy procedures. **Material and Methods:** 460 patients ≥ 18 years of age who underwent primary micro lumbar discectomy (MLD) or lumbar laminectomy, using MIS or standard open technique, with 2 year follow up were included. Retrospective review was performed at a single institution. Outcomes assessed include 90-day peri-operative complications and unplanned return to OR, and two year revision rates. **Results:** The 460 patients in this cohort underwent: 202 open laminectomies (age 66.7 ± 12.5 , BMI 29.3 ± 5.8), 36 MIS laminectomies (age 63.8 ± 13.1 , BMI 28.8 ± 4.7), 180 Open MLD (age 46.1 ± 15.2 , BMI 27.9 ± 4.7) and 42 MIS MLD (age 49.6 ± 15.1 , BMI 28.0 ± 6.0). The MIS MLD group had significant greater operative time (89.2 vs. 74.3 min, $P = .004$) and higher rate of 90 day return to OR (2.4% vs. 0%, $P = .038$) compared to open MLD. There were no differences in the rates of complications or unplanned return to the OR between the MIS and open laminectomy groups. There were also no differences between the MIS and open technique for MLD and laminectomy with regards to estimated blood loss, length of stay, and surgical site infection rates. No differences in intra-operative complication rates were noted. Intra-operative complications explored included: durotomy, neuro-monitoring disturbances, traumatic blood loss, and fractures. Nor were there differences in post-operative complication rates. Post-operative complications assessed included: acute postoperative neurological weakness, cardiac, neurological, pulmonary, urinary events, deep vein thrombosis or pulmonary embolism, and ileus. At two year follow-up, no differences were seen in rates of revision surgeries between any of the cohorts. **Conclusion:** We report increased operative time and higher rate of unplanned return to the OR at 90 days after MIS MLD compared with open MLD. However, there was no difference seen in complication rates between the MIS and open laminectomy groups, suggesting that the techniques may be equivalent. At long term follow up, there was no effect on revision rates by technique utilized, MIS or open, for either MLD or laminectomy.

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PI05: Patient with rapid onset neurological deterioration. Could a non-traumatic thoracic hernia be the cause? Case presentation and literature review

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Introduction: Thoracic herniated discs (TDS) are rare lesions, they are symptomatic in 1 in 1,000 to 1 in 1,000,000 patients, which represents .1 to 3% of all herniated discs. They occur in young adults, with a higher incidence between the third and fifth decade of life without gender difference, they are usually unique and the most frequent location is between T8 and T12; its diagnosis and treatment are usually difficult, its course is usually progressive. Selecting the appropriate surgical approach is often challenging, as the posterior approach has long been associated with an increased risk of deterioration from mechanical microtrauma and ischemic injury, so alternatives, such as the posterolateral, lateral, anterior open and thoracoscopic. Next, the case of a patient with a diagnosis of thoracic hernia is presented, describing its clinical course, diagnostic methods, treatment and follow-up. **Material and Methods:** Case presentation: A 27-year-old male with a 2-month history, characterized by paresthesia and hypoesthesia in the lower limbs, dorsolumbar pain, changes in sensation on the lateral aspect of the thighs and legs, difficulty walking due to loss of strength, as well as symptoms quick installation urinals; He was diagnosed with transverse myelitis and treated with methylprednisolone boluses, with partial improvement for a month and subsequent relapse. Clinically hypoaesthesia at the bilateral supra and infra-umbilical abdominal level, with greater sensory deficit on the lateral aspect of both lower limbs in the thigh and leg region, hip flexion 4/5, quadriceps extension 4/5 and bilateral 3/5 foot dorsiflexion. Bilateral patellar hyperreflexia and bilateral achillea, bilateral Babinski positive without neurotension data. MRI: left paracentral disc herniation T6-T7, which generates spinal compression. **Results:** It was decided to perform surgical management by transfacet posterolateral discectomy with the use of a microscope and unilateral instrumentation of the segment. During the follow-up, the patient presented full recovery of neurological involvement at 8 weeks, achieving a gait with normal characteristics, with adequate strength and sensitivity in the pelvic limbs, with no evidence of spinal involvement. **Conclusion:** HDTs are rare and present special clinical characteristics that make diagnosis difficult and delay. The presence of neurological deterioration and signs of myelopathy are surgical indications. The approach should be selected according

to the characteristics of the hernia to be treated. The use of a microscope during the discectomy not only provides excellent vision, but could also reduce the risk of trans-surgical neurological injury and improve the clinical Results of the patient.

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PI06: Intradiscal injection of autologous platelet rich plasma for the treatment of lumbar disc degeneration - a clinical study for discogenic low back pain patients

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Introduction: Intervertebral disc (IVD) degeneration is an important clinical problem that often contributes to low back pain and degenerative disc diseases. Degeneration of the IVD induces annulus tears and fissures, which can cause severe discogenic low back pain. Because the IVD has little potential to self-regenerate, treatment of degenerative disc disease is one of the most challenging clinical problems facing the spine surgeon. Platelet-rich plasma (PRP) is a fraction of plasma that contains platelets and multiple growth factors concentrated at high level. Because activated platelets have the potential to release growth factors including IGF-1, TGF- β , PDGF and EGF, PRP has been clinically used to accelerate wound healing and tissue regeneration in orthopedic and oral surgery. The soluble releasate isolated from platelet-rich-plasma (PRP) has recently been demonstrated to influence the metabolism of intervertebral discs in vitro. Furthermore, an intradiscal injection of autologous PRP has been shown to induce restoration of structural changes in the rabbit annular injection model in vivo. **Materials and Methods:** Inclusion criteria for this study included patients with chronic low back pain without leg pain for more than 3 months; one or more lumbar discs (L3/L4 to L5/S1) with evidence of degenerative changes on magnetic resonance imaging (MRI) and at least one symptomatic disc confirmed using standardized provocative discography. The soluble releasate, isolated from clotted PRP, was injected (2.0 ml) into the center of the nucleus pulposus under fluoroscopic guidance. Outcome measures included the visual analog scale (VAS), Oswestry Disability Index (ODI), Roland-Morris Disability questionnaire (RMDQ) and T2 quantification in Magnetic Resonance Imaging (MRI) before treatment and 6 months after treatment. **Results:** Data were analyzed from 60 patients (30 men, 30 women; mean age 34.4 years-old) who had completed 6 months follow-up. The mean platelet count of PRP was about 4.7 times greater than that of whole blood (Whole blood: 277.8 x 10³/ μ l, PRP: 1371.1 x 10³/ μ l). After treatment, no patient showed adverse events or significant narrowing of disc height. The mean pain score before treatment was significantly

decreased at six months (VAS score: 7.1 ± 1.2 to 1.8 ± 2.0 - $p = .18$, ODI: 59.4 to 26.3 - $P < .001$, RMDQ: 22 to 4 - $P < .001$). MRI showed no significant change at follow up. **Conclusion:** We have performed a preliminary clinical study of a biological therapy for degenerative disc diseases using autologous PRP. We have successfully isolated autologous PRP-releasate from activated PRP using autologous serum instead of a clinical dose of bovine thrombin. The Results of this study showed that the intradiscal injection of autologous PRP-releasate in patients with low back pain has been shown to be safe and effective for six months after treatment. Future long-term follow-up and/or randomized control studies should be performed to evaluate the efficacy of this therapy.

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P107: Analysis of the capacity to correction lumbar lordosis using anterior intersomatic fusion (ALIF) L4-L5 / L5-S1 in the treatment of lumbar sagittal misalignment after lumbar spine stabilization

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The spine and the body function within a cone of equilibrium with the focus of maintaining sagittal and coronal alignment with minimum energy expenditure. This happens with a harmonious relationship involving cervical lordosis, thoracic kyphosis, lumbar lordosis, and pelvic anatomy. On the other hand, sagittal imbalance is a front-to-back imbalance in the spine. This sagittal imbalance can be easily measured by the sagittal vertical axis (SVA) and is associated with worse patient-perceived outcome scores. The overall goal of the treatment is to reestablish overall sagittal spinal balance. The surgery is generally planned to add lordoses or reduce kyphosis. Our goal is to show the lordoses correction analyses through angled cages placed by back route in cases of post hypolordotica lumbar stabilization sagittal imbalance. This literature review involved clinical case reports, randomized controlled trials, a series of cases describing “sagittal balance”, “sagittal imbalance”, “ALIF and sagittal imbalance”, “ALIF and sagittal balance”, “lumbar fusion and sagittal balance” and “lumbar fusion and sagittal imbalance”. The research was performed using the Pubmed database targeting all English language publications available involving sagittal imbalance. The review was organized applying the MeSH terms “sagittal balance”, “sagittal imbalance”, “ALIF and sagittal

imbalance”, “ALIF and sagittal balance”, “lumbar fusion and sagittal balance” and “lumbar fusion and sagittal imbalance”. The Pubmed / Medline search on 5.582 articles. After that, 15 papers were recovered. After analyzing the titles of the articles, they were selected for a summary review, considering the relevance and relationship with this article. All relevant data were collected and tabulated in a Microsoft Excel© spreadsheet. All eligible articles for this study were case reports and literature reviews. We analysed 25 patients with lumbar sagittal misalignment after hypolordotic lumbar arthrodesis for treatment of lumbar degenerative disease without previous support or with previous support complicated with pseudoarthrosis, in which the necessity revision lumbar arthrodesis at L4-L5 and/or L5-S1. All patients were analyzed preoperatively for sagittal balance. These patients had the secondary imbalance compensated or uncompensated. The most common diagnosis was pseudoarthrosis due to cage support. The anterior approach (ALIF) was carried by two vascular surgeons. The implants were used with a maximum 15 and autologous grafts. Immediate angular Results were obtained with radiographs or CT. In 15 patients the planned angle gain was achieved. Nine patients this gains was below the initially planned although within the acceptable mismatch standards. One patient, it was impossible for adequate correction because due to serious plato vertebral changes. Only one case presented complication relates to surgical approach. ALIF approach in association with angular cages has sufficient correction in this study. We have low complications and immediate satisfactory result even in case of surgery revision. There is a clear greater technical demand in the removal of cages and ALIF approach. The presence of a access surgeon maximizes good outcomes and minimizes the complications.

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P108: Clinical guidelines for the evaluation, assessment, and treatment of lumbar disc herniations: how accurate is the Internet?

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Introduction: Lumbar disc herniation (LDH) affects 1-3% of the population and is a common indication for spine surgery. Due to this relatively high prevalence and the potential impact of LDH on daily functioning, patients with LDH are likely to search the Internet for related information. However, previous studies have shown that health information found online is likely to be inaccurate and incomplete. To assess information online about lumbar disc herniations (LDH), searches were performed utilizing three common search engines and keywords associated with LDH. We hypothesize that the

information readily available online regarding lumbar disc herniation (LDH) is unsubstantiated, incomplete, and does not align with the evidence-based recommendations listed in the North American Spine Society Clinical Practice Guidelines. **Material and Methods:** To assess information online about LDH, searches were performed utilizing three common search engines (Google, Bing, Yahoo) and keywords associated with LDH. The top 20 websites from each search were selected, and the content regarding diagnosis and treatment of LDH was compared to the North American Spine Society (NASS) Clinical Practice Guidelines. **Results:** On average, websites mentioned only 59% of recommendations supported by Level I evidence. Websites included 3 recommendations not discussed in the NASS guidelines out of an average of 12 total recommendations. Muscle and sensory testing and physical therapy were the most frequent recommendations, appearing on over 80% of websites. Websites were equally likely to contain recommendations backed by high-quality evidence as recommendations not included in the NASS guidelines. **Conclusion:** This study demonstrates that websites regarding LDH contain a mix of information, with only a fraction of recommendations aligning with clinical guidelines. Patients who use these websites are presented with unsubstantiated information, conceivably impacting their expectations and decision making in physician offices.

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PI09: Massive lumbar disc herniation in young people: clinical characteristics and treatment outcome

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Background: Large lumbar disc herniation (LDH) has been reported to have a great tendency to resolve in clinical and pathomorphological evolutions. However, various definitions of large LDH have been used without validation, and the clinical symptoms of large LDH have not been fully elucidated specially for young people. The aim of our study was analysis to determine the clinical characteristics and the treatment outcome of massive LDH in young population. **Methods:** We retrospectively reviewed 48 cases of LDH of young people (age: 18 to 45 years). The clinical and radiological outcome parameters included back pain, Oswestry disability index (ODI), recurrences and instability of the adjacent segment. The paired t-test was used to compare when three types of treatment are used: medical treatment, discectomy, and posterior lumbar inter body fusion (PLIF). **Results:** There were 26 male and 22 female. The mean age was 35 years. At

presentation, Mean ODI was 73 ± 18.8 (range 26 - 88). Sciatica was found in 75% of cases. Neurological dysfunction was found in 14.6%. Conservative treatment was performed in 11 patients (22.9%), 23 patients (47.9%) underwent discectomy, and 13 (29.2%) underwent posterolateral fusion. Recurrent low back pain was found in 4.6% of cases, recurrences in 21.9%, and instability of the adjacent segment in 6.25%. **Conclusion:** A massive LDH in young people was found to be associated with severe back and leg pain at presentation and can cause several neurological dysfunction. Medical treatment, discectomy and PLIF have the same average of low back pain. Recurrences were almost found in discectomy. However, instability of the adjacent segment was observed in interbody fusion.

Epidemiology

26

PI10: Audit of spinal deformity surgical cases to improve future surgical outcome - A retrospective institution based study

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Introduction: An audit is important aspect of healthcare. It can be employed in any field of health system. It helps to achieve recognized standards in healthcare. This audit is targeted at identifying different epidemiological parameters, surgical parameters and complications related to deformity surgery in one of the premier spine institute of India. **Material and Methods:** A retrospective analysis of clinical and radiological data of patients who underwent deformity correction at our institute from 1st January 19 to 31st December 2019 was performed. Data was collected from electronic data base as well as medical record section. Key words used for search in the electronic database were: Kyphosis, scoliosis, deformity. All the collected data underwent preliminary scrutiny. Details on preoperative, operative and follow-up details of the patients were retrieved from the medical records section. Insta-PACS (picture archiving and communication system) 4.0 was used for radiological retrieval and radiological assessment of data. Patient's preoperative x-ray, CT-scan, MRI, and postoperative x-ray were studied. Standards were defined for the audit by inferences from the literature review as below. Inferences from other studies: Hospital stay: 5-43 days, Blood loss: 137-2100 ml, Operative time: 232-550 min, Perioperative complication: Nil-62%. **Results:** Mean age of patient was 34.92 ± 25.88 years (Range: 5-80, Median age- 22.50) with 20 male and 17 female. Mean hospital stay was 7.67 ± 4.50 days (Range 1-23). Mean blood loss was 911.67 ± 383.34 ml ($p = .095$). Mean operative

time = 379.028 ± 134.77 min ($p = .040$). There were 26 scoliosis surgeries, 5 surgeries each for kyphosis and kyphoscoliosis. Reason for surgery ranged from cosmesis to neurological deficits. 3 surgeries were staged, which were congenital kyphoscoliosis, post-tubercular kyphosis, and neuromuscular kyphoscoliosis. 33 cases were non-staged. There was complication in 3 cases. In first patient with tubercular lumbosacral kyphosis, there was neurological deficit. Similarly, in second patient with congenital scoliosis of lumbar spine, who presented in adulthood with radicular symptom, there was neurological deficit. In third patient with congenital scoliosis, there was pseudo-meningocele, which developed on second postoperative week. In both patients with neurological deficit, there was full recovery in motor. In a patient, who developed pseudomeningocele, he was managed with serial aspiration with compression bandage. Pseudo-meningocele fully disappeared at third month. After the assessment of data of audit, consensus was reached after discussion among spine surgeons of institute on different parameters of study with action plan development for reducing complications. The action plan was, for neurological deficit prevention- too much traction over nerve roots should be avoided. Intraoperative neuromonitoring is must. Proper handling of neural tissue and retractor placement is crucial. For pseudomeningocele formation, intraoperative prevention of dural tears and if happens than proper repair and sealing must be done. **Conclusion:** Surgical auditing after properly defining standards from previous studies allows spine surgeons and institution to compare its surgical Results with standards given in the literature. It allows us to strive for better Results and outcome in future. It also provides a mirror image for arenas of improvement and betterment for future patient care.

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PII1: Mazor, Mazor X Stealth Edition Robotic spinal surgery - an institution based retrospective analysis of epidemiological and logistical data

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Introduction: Robotic surgical systems have been utilized in many surgical fields, including gynecology, urology, cardiothoracic surgery, vascular surgery, and general surgery. Robotic-assisted systems in spinal surgery, however, have only become available relatively recently. With automated accuracy, reproducible outcomes, efficient integration, automatic patient registration, constrained motion for safety, and automatic compensation for patient movement addresses

many of the drawbacks of previous robotic-assisted systems are now reduced. In this study, we have tried to show the institution based epidemiological and logistical data with our early experience on robotic spinal surgery. **Material and Methods:** Retrospective single center study was done. All patients operated robotically from June 2019 to December 2020 were included in the study. Data was retrieved from Electronic Medical Record system. The epidemiological, logistical and radiological parameters were studied. **Results:** Total patients undergoing robotic surgery were 26 with male ($n = 12$), female ($n = 14$). Of all cases 46.15% cases were deformities (3.77% were congenital, 7.69% were post-tubercular and AIS), 46.15% cases were degenerative (LCS-3.77%, PIVD-7.69%, unstable compression fracture-7.69%) while 7.69% was traumatic. Mean Age of patients was 36.923 ± 23.035 (10-69 year). Mean hospital stay was 2.92 days (5-87 days). Mean blood loss was 2331.54 ± 1986.03 ml (210-5120 ml). Mean operative time was 654.62 ± 371.51 min (240-1260 min). Mean cost of Implants were 256350 ± 157614.10 INR (122689 - 487982 INR). Mean total expenditure: 790543 ± 21061.88 INR (246312 - 1378168 INR). Total screws used were 238 with mean screws per case being 9.154. A number of misplaced screws (Intraoperative medial wall breach) were 2. Number of Mesh cages used was 6. Number of PEEK cages used was 16. Number of Revision cases was 2. Mean number of C-Arm shoots was 11.2. **Conclusion:** This study represents the epidemiological and logistical data of the spine patients treated with robotic surgery, showing its usage being progressive in developing country like India.

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PII2: Calculating ex-ante Utilities from the Neck Disability Index Score: a prerequisite for quantifying the value of care for cervical spine pathology

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Introduction: The ability to calculate quality-adjusted life-years (QALYs) for neck pain and disability may enhance treatment decision making and facilitate economic analysis. QALYs are calculated using utilities, or health-related quality-of-life (HRQoL) weights. An instrument designed for neck pain and disability, the Neck Disability Index (NDI) questionnaire, would increase the sensitivity and specificity of HRQoL assessments. The objective of this study is to develop a multi-attribute utility function for the NDI. **Material and Methods:** We recruited a sample of 1200 adults from a market

research panel. Using an online discrete choice experiment (DCE), participants rated 10 choice sets based on NDI health states. A multi-attribute utility function was estimated using a mixed multinomial-logit regression model (MIXL). The sample was partitioned into a training set used for model fitting and validation set used for model evaluation. **Results:** The regression model demonstrated good predictive performance on the validation set with an AUC of .77 (95% CI: .76-.78). The regression model was used to develop a utility scoring rubric for the NDI. Regression Results also revealed that participants did not regard all NDI domains as equally important. The rank order of importance was (in decreasing order): pain intensity = work; personal care = headache; concentration = sleeping; driving; recreation; lifting; and lastly reading. **Conclusion:** This study provides a simple technique for converting the NDI score to utilities and quantify the importance of NDI domains. The ability to evaluate QALYs for cervical spine pain and disability could facilitate economic analysis and patient counseling. Clinicians may use these findings to offer treatments that maximize function in the attributes viewed most important by patients.

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PI 13: Minimally invasive versus open lumbar inter body fusion: National trends, healthcare utilization and index hospital complications

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Introduction: Multiple single institution studies have shown that minimally invasive (MIS) lumbar interbody fusion (LIF) is associated with earlier mobilization, shorter hospital stays and lower transfusion rates with similar rates of complications compared to open LIF. There have been no large nationally representative studies examining the rates of MIS LIF, as well as associated costs and outcomes compared to open LIF. We aim to analyze rates, associated costs, length of stay (LOS) and index hospitalization complications of MIS versus open one and two-level LIF using a national database. **Material and Methods:** The National Inpatient Sample (NIS) database was queried from October 2015 through 2018 to identify patients undergoing LIF with a diagnosis of spondylosis, spondylolysis, spondylolisthesis or degenerative disc disease. ICD-10 PCS codes allowed for separation of anterior approaches (anterior and lateral LIF) from posterior approaches (posterior and transforaminal LIF). MIS was defined as procedures utilizing percutaneous or endoscopic approaches. Multivariate regression

was used to compare health care utilization metrics and index hospital complications. **Results:** A total of 297,135 and 145,085 posterior and anterior LIF procedures occurred during the study period, with 3,250 (1.1%) and 1,305 (.9%) utilizing MIS techniques, respectively. For posterior approaches, 29.6% and 28.9% of open and MIS procedures were two-level ($p = .73$), compared to 4.2% and 49.0% of anterior open and MIS procedures ($p = .005$). Mean hospital costs were \$32,850 and \$44,744 for posterior and anterior LIF. On multivariate analysis, MIS was associated with a cost savings of \$1,935 ($p = .006$), with anterior \$9,711 more costly than posterior approaches ($P < .001$), and two-level \$15,449 more costly than single-level ($P < .001$). LOS was .67 days shorter for MIS versus open LIF ($P < .001$), .25 days shorter for posterior versus anterior approaches ($P < .001$) and .85 days longer for two-level versus single-level LIF ($P < .001$). Two-level LIF was associated with a higher rate of discharge to facility versus home (OR 1.93, $P < .001$), while MIS versus open approach was not significantly associated with discharge destination. Both anterior and posterior MIS approaches were associated with a lower risk for any complication (OR .50 $p = .006$ and OR .60 $p = .001$, respectively) and blood transfusion (OR .45 $p = .04$ and OR .40 $p = .001$, respectively) in the immediate post-operative period. Differences in the rates of neurologic complication, wound complication and venous thromboembolism were not significant. **Conclusion:** Utilization of MIS LIF remains relatively low nationally, with only 1% of procedures utilizing these techniques. MIS is associated with reduced hospital costs, LOS and index hospitalization complications compared to open LIF. With favorable Results in single institution and now national representative studies, it will be interesting to see if adoption of MIS techniques increases as more years of national data become available.

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PI 14: Efficacy of the National Osteoporosis Foundation (NOF) criteria in identifying osteoporosis and osteopenia in an adult spinal deformity population

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Introduction: The NOF Criteria is a standardized set of four screening criteria to identify which patients should be referred for DXA scan to diagnose OPO and OPE. The NOF criteria include women aged over 65, men over 70, either gender over 50 with personal history of fracture, or chronic glucocorticoid use. The goal of this study was to analyze the efficacy of the NOF criteria in diagnosing OPO and OPE in an ASD

population. **Material and Methods:** A retrospective review was performed of all patients seen by 2 spinal deformity physicians at a single institution within two years. 354 ASD patients over age 30 who underwent instrumented fusion were identified. Data extracted included demographics, comorbidities, and DXA. 211 were included who had a preoperative DXA scan. **Results:** 52.6% of patients had OPE, 23.2% OPO, and 24.2% normal bone density by DXA scan and WHO criteria. 77.3% of women over 65, 54.2% of men over 70, 85.2% of patients with history of fracture, and 68.2% of patients with chronic glucocorticoid use had a preop DXA scan (Table 1). For patients with a DXA scan, 71.2% of women, 41.7% of men, 7.4% with history of fracture, and 50% with chronic steroid use were diagnosed with either OPO or OPE. Using DXA as the gold standard, the sensitivity of NOF was 59.2% and specificity 56.2% in identifying OPO. For identifying poor bone health identified as OPO and OPE combined, the sensitivity of NOF was 52.5% and specificity 66.7%. **Conclusion:** NOF screening criteria for OPO in an ASD patient population is an ineffective screening tool with a low sensitivity leading to a high rate of false negatives. 75.8% of patients evaluated for ASD surgery had abnormal bone health. Practitioners treating adult spinal deformity should routinely evaluate patients for abnormal bone health and optimize prior to surgery. Alternate screening tools for ASD patients need to be developed to better identify a patient's bone health prior to spinal deformity surgery.

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PI15: The impact of a detailed statewide mandate on elective spine surgery in Washington State at the initial height of the COVID-19 pandemic

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Introduction: The COVID-19 pandemic dramatically changed the delivery of surgical care during the first half of 2020. Washington State fell into the most stringent group of 4 states that specifically described individual procedure types that were deemed elective and should therefore be cancelled/postponed in the spring of 2020. This study uses the Washington State Spine Care Outcomes Assessment Program (Spine COAP) database to describe the effect of this statewide mandate on the rate of non-traumatic and non-oncologic spine surgery procedures throughout Washington State. Given the fairly strict guidelines against elective surgery in mid-March 2020 in Washington State, we hypothesized that the start date would be followed by a very

significant decline in elective surgical case volumes, but that this decrease might be more pronounced in lumbar procedures than in cervical procedures that may be performed for myelopathy or other urgent conditions. Given that our data extends into late summer 2020, we also sought to understand the potential "rebound" effect of delayed cases. **Material and Methods:** The Spine COAP database was queried for spine surgery cases (inpatient and outpatient) from March 1, 2019 - September 30, 2020. Eleven sites were included that had continuous data throughout the study. Data was aggregated into two-week blocks, then comparisons were made between case volumes in the pre-restriction period (3/1/19 - 3/15/20), the restriction period (3/15/20 - 5/26/20) and the post-restriction period (5/26/20 - 8/30/20). **Results:** Immediately following the implementation of restrictions on March 19, 2020, the total adjusted elective spine surgeries dropped to 29.2% of pre-restriction period volume. During the 8-week restriction period, surgeries increased by 26% per biweekly period, increasing to 76.8% of the extrapolated pre-restriction trend. The immediate post-restriction time-period in May 2020 started 25.1% higher than the pre-restriction period demonstrating the expected rebound effect of postponed surgical cases. We observed significant reductions for Cervical Fusion, Lumbar Fusion and Lumbar Non-Fusion cases. Cervical surgeries had the smallest reductions, reducing to 61% of pre-restriction (Cervical Non-Fusion) and 41% (Cervical Fusion) volumes respectively. The greatest reduction occurred for Lumbar surgeries, reducing to 21% of pre-restriction volumes for Lumbar Fusion and 26% for Lumbar Non-Fusion cases. **Conclusion:** We demonstrate the real-world effect of a statewide mandate explicitly restricting elective surgical care in a clearly defined manner. Although most states and hospitals have "crisis models" which can be utilized in times of natural disaster or extreme healthcare burden, these recommendations are typically non-specific and have been demonstrated to have only a modest effect. The Results of our analysis suggest that more effective implementation is possible and we propose that this effectiveness is a direct result of the clarity provided in the state's proclamations during this time period. In future situations which may require an extended restriction on healthcare services, therefore, we suggest that healthcare leaders and government officials should provide more rather than less guidance to obtain the desired reduction in surgical case volumes and that this guidance should include clear examples of care to be restricted to guide clinicians when assessing and counseling patients.

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PI16: Scoliosis surgery in Chile in the last 20 years: epidemiological description

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Introduction: Scoliosis is a three-dimensional spinal deformity, with more than 10° of vertebral coronal inclination. It has several etiologies, being the most prevalent the adolescent idiopathic type. Most of the cases can be successfully managed orthopedically, being the surgical resolution reserved for more severe curves. As surgical management of these cases requires specialized equipment and team, it is logical to concentrate these interventions in some hospitals nationwide. The patients' epidemiological characteristics are relevant to establish public policies in health, especially in high-cost procedures as scoliosis surgery. In Chile, there is a system for the registration and coding of hospitals' outcomes centralized at the national level by the Department of Health Statistics and Information (Departamento de Estadísticas e Información en Salud, DEIS, in Spanish acronym). Since 2001, in this National registration, there is epidemiological information about patients undergoing scoliosis surgery. Our aim is to describe the epidemiological characteristics of patients undergoing scoliosis surgery in the Chilean population from 2001 to 2021. **Material and Methods:** A retrospective descriptive analysis was made of the data collected by DEIS during the last 20 years, grouping patients by pathologies, surgical interventions, and epidemiological characteristics. This analysis was performed using STATA v16. **Results:** During these 20 years, 12,819 scoliosis surgeries were realized. There has been an increase in recent years, reaching its maximum in 2016, with 975 interventions. Considering the 20 years, a uni-modal distribution is observed, highlighting its mode in the 14 years, with an average age of 20 years (SD 16.6). It is observed that 70% are women and that if we only consider patients under 25 years of age, they represent 84% of the total. In addition, it can be observed that most of the patients who undergo scoliosis surgery are beneficiaries of the public health system. The central region of Chile concentrates the most number of interventions (68%). The most common diagnosis is idiopathic scoliosis (33%). The hospitals that have performed the most scoliosis surgeries during these 20 years are the Dr. Luis Calvo Mackenna Children's Hospital and the San Borja-Arriarán Clinical Hospital. **Conclusions:** Scoliosis surgery is an intervention that has been on the rise over the past 20 years in Chile. The main factor may be associated to the implementation of the National Program of Health Guarantees (Garantías Explícitas en Salud, GES, in Spanish acronym) in July 2005, that allows early diagnosis, opportune treatment and financial support of high-cost interventions in patients under 25 years. In addition, it requires high specialization of the professionals who carry it out, which could be associated

with the fact that few centers concentrate most of the procedures performed during the study period and these centers are located in the capital of Chile.

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PI17: Opioid use after spine surgery: how much are we over-prescribing?

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Introduction: Opioid prescribing practices to control pain after spine surgery are scrutinized due to the opioid epidemic in the US. There is a lack of understanding of postoperative opioid consumption, unused opioids, and standardized prescribing practices with respect to spine surgery type. We aimed to: determine if opioids are being over-prescribed at 90-days after elective spine surgery, identify differences in the percentage of over-prescribed opioids between surgical subgroups, and determine the distributions of opioids consumed to control pain up to the 90th percentile. **Methods:** Adults (> 18 years) undergoing elective spine surgery at a multi-surgeon, single center were included. Surgery subgroups included: anterior cervical, posterior lumbar decompression, and short-segment (< 4 levels) circumferential lumbar fusion. During the 90-day postoperative period, prescribed MMEs were identified from opioid prescriptions, consumed MMEs were obtained from pill counts, and the percent over-prescribed was calculated from these values (prescribed-consumed/prescribed). Consumed MME distributions were analyzed as opioid naïve or tolerant to identify the 50th, 75th, and 90th percentiles within each subgroup. **Results:** Of 117 (48.7% male, 52 years) patients (n = 48, cervical; n = 28, decompression; n = 41, lumbar fusion), 41.9% were opioid tolerant. The percentage of over-prescribed opioids at 90-days was: 45.4% cervical, 57.3% lumbar decompression, and 37.4% lumbar fusion (p = .066). The percentage of opioids over-prescribed was greater in the opioid naïve than tolerant group (58.0% and 28.4%, respectively). Regression analysis showed that surgical group and preoperative opioid exposure were associated with over-prescribed opioids. The 90th percentile of MMEs consumed was: 660 naïve and 6728 tolerant cervical, 300 naïve and 2490 tolerant lumbar decompression, 4995 naïve and 7710 tolerant lumbar fusion. **Conclusion:** At 90-days across surgical subgroups, the average percentage of over-prescribed opioids was over 45% and was nearly double in the opioid naïve group. This suggests the need to develop standardized prescribing practices for postoperative opiates. While the Results suggest the number of MMEs prescribed can be reduced to mitigate the effects of leftover pills, larger

studies are needed to standardize opioid prescribing practices across elective spine surgeries.

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P118: Relationship between Zung Self Reporting Depression Scale and post-operative outcomes in patients undergoing spine surgery

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Introduction: Low back and neck pain are one of the top causes for years lived with disability worldwide. The most common surgical treatment is spine fusion, which relies on efficient bone remodeling and new bone formation. Bone formation is a very complex process that can be dysregulated by conditions such as mental disorders, diabetes, smoking, resulting in lower fusion rates and worse patient outcomes. Depression and anxiety have been reported to be prevalent among patients with spinal pathologies. Zung Self-Rating Depression Scale is often used as a go-to patient reported outcome (PRO). Little is known how Zung correlates to other PROs and surgical outcomes. Goal of the current study was to analyze the relationship of Zung pre- and post-op score to other PROs and length of stay. Secondary outcomes included revision surgery and post-operative infections. **Material and Methods:** For the purpose of the current study data from the international multicenter prospective spine degenerative surgery data repository, DegenPRO v1.1, hosted by AO Spine Knowledge Forum Degenerative were utilized. Patients undergoing cervical or lumbar procedure were included. Patient's demographics, Charlson Comorbidity Index and surgical information were collected at surgery, Zung score, NDI, pain related PROs and EQ-5D, and complications at surgery and at various post-op time periods. Except for hospital duration, data were analyzed, using multivariable mixed linear models. A robust linear regression model was used to assess the association between Zung score and hospital duration. All models were adjusted for gender and age. **Results:** From 862 patients in the DegenPro 42 patients had Zung score administered and with follow-ups. Among those patients 22 (52%) were within normal range, 18 (43%) were mildly and 2 (5%) severely depressed. 62% of the patients had a lumbar pathology with fusion procedures being the most common. Among non-depressed patients

55% were female, however among mildly depressed 72% were male patients. Mean age in these two groups were 58 and 61, respectively. Median EQ-5D (3L) at surgery was higher (.7, IQR: .4-.7) for patients within normal range than for those with mild (.4, IQR: .3-.7) or severe depression (.3, IQR: .3-.3) a significant difference between these groups (p-value: .05). No significant differences were found for the other outcomes at baseline. However, compared to patients within normal Zung range, mixed models, adjusted for gender and age indicated lower EQ-5D (3L) values and higher values for neck and arm pain at surgery with both PROs and EQ-5D (3L) improving in patients with depression over the follow-up time. Further, the models indicated lower back pain independent of the follow-up time for patients with depression compared to those with no depression. No association was found between Zung score and hospital length of stay. Only very few patients had a post-operative infection and revision surgeries. **Conclusion:** The initial analysis showed that 43% of the patients were mildly depressed and in their majority male patients. Zung score was correlated with post-operative improvements in EQ-5D and arm and neck pain PROs. Further analysis between Zung and primary/secondary outcomes will be done.

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P119: An updated systematic review of dysphagia and airway obstruction in diffuse idiopathic skeletal hyperostosis

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Background: Diffuse idiopathic skeletal hyperostosis (DISH) is a systemic condition characterized by progressive ossification at the spinal vertebrae and tendons, which may cause compression on the trachea and esophagus at the level of the cervical spine. In 2011, we performed a systematic review in which we identified 204 cases of dysphagia and/or airway obstruction published between 1980-2011. As the prevalence of DISH was projected to increase for the last decade, we aimed to update our previous systematic review on the epidemiological and clinical knowledge of dysphagia and airway obstruction in cervical DISH, to validate this prediction and further focus on (surgical) treatment and outcomes. **Materials and Methods:** This systematic review was performed in accordance with the preferred reporting items for systematic reviews and meta-analysis (PRISMA). We performed a comprehensive and updated

literature search of articles published in Medline and EMBASE between July 2010 and June 2021, reporting the unequivocal presence dysphagia and/or airway obstruction as a result of unequivocal DISH. No language restrictions were applied. Two investigators performed data extraction and study-specific quality assessment. Exclusion criteria included patients with a prior history of trauma and/or cervical surgery, or patients with other concurrent cervical pathologies. **Results:** A total of 138 articles (112 case reports and 26 case series) were included, describing 418 patients with dysphagia and/or airway obstruction. The mean age of the patient group was 67.3 years (range: 35–91 years), and 85% was male. An evident increase of cases was observed within the last decade. Between 2015–2020, 296 cases of dysphagia and airway obstruction were described, compared to 96 cases between 2010–2015. The most common cervical levels affected with DISH and identified as the cause of impingement on the esophagus/trachea were the levels C3–C5. Surgical treatment was chosen for 66% of patients with an anterolateral approach most commonly used (92.8%). The total complication rate after surgery was 22.1%, with 9.4% of complications occurring within 1 month. Improvement of dysphagia was observed in 95.5% of patients. After a mean follow-up of 3.7 years (range: .4–9.0 years), recurrence of dysphagia was reported for 12 (4%) patients after surgery, including 5 with osteophyte regrowth. **Conclusion:** A remarkable increase of cases of dysphagia and airway obstruction in DISH was observed in the last decade. Operative treatment with an anterolateral approach was most frequently used, and dysphagia symptoms generally resolved after surgical intervention. In some cases, dysphagia and osteophyte growth recurred even after long follow-up. No studies were found comparing different surgical treatments for osteophyte removal.

Imaging

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P120: Proposal of a new standardized method to evaluate spine flexibility using the EOSEdge low dose radiation imaging for thoracolumbar flexion/extension

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Introduction: Thoraco-lumbar vertebral mobility is one of the key parameters that must be analysed when planning a spinal surgery for spinal deformity. In 1989, Putto et al. published the first radiological procedure to get a 2D X-ray acquisition of patient in a flexion/extension posture of the spine. To date, no similar procedure has been applied to new imaging modality

such as the 3D stereoradiography (EOSEdge[®] imaging) which allow a 3D reconstruction of the spine according to the ALARA concept. This study aims to propose a new standardized method to evaluate the vertebral mobility based on the dynamic X-ray using a reproducible method applied to the EOSEdge[®] imaging technology called. An institutional IRB was obtained for this prospective study. **Material and Methods:** Patients candidate for an instrumented spinal surgery had a pre-operative full-spine flexion-extension acquisition according to the predefined protocol using two radiolucent supports easy to put in the EOS frame. Extension of the spine was obtained using a height adjustable walker placed behind the patient in the EOS machine allowing stable and safe positioning with limited pain. Patient is then asked to bend backward and keep his position during the acquisition process. To get a full-spine flexion acquisition, patient is seated on a stool and is bended forward during the EOS acquisition. Radiographic parameters such as lumbar intervertebral angulation (angulation of each lumbar and thoracic discs) and lumbar lordosis or thoracic kyphosis were analysed to get a quantitative representation of the spine flexibility. **Results:** 50 patients were included in this protocol. Positioning of patient was highly reproducible using external skin landmarks that matched with skeleton anatomy on final images. Comparison of measures between flexion and extension to regular full spine standing imaging showed significant motion and abnormal mobility at some levels not visible in static standing. Limited motion was commonly seen in degenerative spine. **Conclusion:** This study proposes a new standardized method to analyse the spinal flexibility using the EOSEdge[®] imaging technique. This method can be applied safely to allow to detect abnormal vertebral mobility and therefore a better analysis of spondylolisthesis and Degenerative Disc Disease which could not be assessed using other conventional static imaging technique.

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P121: Verifying S1 pedicle screw placement using modified pelvic inlet view: a technical note

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Introduction: Sacral pedicle screw fixation with good purchase still remains a challenging problem. Sacrum is naturally weak anatomically and biomechanically. Bicortical purchase of the anterior sacral cortex adds additional biomechanical benefit to the lumbosacral construct. However, anterior sacral penetration of the screw and drilling the anterior sacral cortex carries additional risk of neurovascular injury. Complex neurovascular and visceral structures lie anterior to the sacrum. Because of the unique anatomy, conventional anteroposterior (AP) and lateral radiographic views are relatively less reliable at determining

screw depth and penetration of the sacral cortex. We present this study to describe a new fluoroscopic technique for visualization of anteroposterior extent of S1-screw and present clinical experience. **Material and Methods:** Single Centre, Prospective study done between July 2020 - June 2021 with IRB approval and consent of the patients. We analyzed the accuracy and safety of PS implantation in S1 using fluoroscopy (FL). (Only L5-S1 TLIF patients were included). For the screw position in relation to the vertebral body, the existence of anterior cortical perforation and the risk of injury to neurovascular structures was assessed. We present a modified pelvic inlet view (ISIC-view) specifically determining screw positioning in relation to anterior cortex of sacral promontory. This view is obtained by directing image intensifier angulating cephalad (20-250) and 0-degree mediolateral, with adjustments aligning the patient's pelvic brim visualizing superior boundary S1. Our technique incorporates each individual patient's anatomy, superior sacral surface will allow visualization as tangential as possible to the proximal part of anterior sacrum different from what was described earlier in literature. We employed this simple and fast method to evaluate intra-operative pedicle screw malpositioning in S1 vertebra which provided objective evidence and ensured 100% bircortical purchase and decrease in revision rates for screw malpositioning. **Results:** A total of 50 (28/M, 22/F) (mean age, 51.2 y) L5-S1 TLIF patients were analyzed. No breach was observed at the S1 level using the technique described. Out of 100 S1 screws analyzed using the present fluoroscopy technique, 9 screws were revised for excessive anterior cortical breach which were benign in normal lateral fluoroscopic view. We were able to achieve Bicortical purchase in all the 100 screws. There were no cases of symptomatic radiculopathy/ neurovascular injury at the S1 level. There was no return to the operating room for any of the cases. **Conclusion:** Our data show that better bi-tricortical positioning of Pedicle screws is achieved using this fluoroscopic technique in nearly all S1 pedicle screws. This technique may lead not only to less complications and revision surgeries but also to biomechanically superior fixation, especially for bi-tricortical fixation of the S1 vertebra. It is a simple and fast method to evaluate misplaced screws (anterior cortical penetration extent and medio-lateral angulation). It has application in deciding whether to reposition or resize the screw intraoperatively.

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P122: Radiation doses of sliding gantry CT-based as compared to mobile cone-beam CT-based navigated pedicle screw placement in a homogenous cohort

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Introduction: Today, multiple solutions for navigation-guided pedicle screw placement are available. For the present study, we compared the applied radiation doses of sliding gantry CT-based (SGCT) and mobile cone-beam CT-based (CBCT) pedicle screw placement for spinal instrumentation. **Material and Methods:** We analyzed 183 and 54 patients who underwent SGCT-based using an automated radiation dose adjustment or standard CBCT-based pedicle screw placement for spinal instrumentation at our department between 06/2019 and 01/2020, respectively. **Results:** Baseline characteristics including the number of screws per patient and the number of instrumented levels did not differ between the two groups. Although the accuracy of screw placement according to Gertzbein-Robbins classification did not differ between the two groups, more screws had to be revised intraoperatively in the CBCT group (SGCT: 39, 2.7% vs. CBCT: 23, 6.0%; $p = .0036$). Mean \pm standard deviation radiation doses [mGy*cm] for the first (SGCT: 484.0 ± 201.1 , CBCT: 687.4 ± 188.5 ; $P < .0001$), second (SGCT: 515.8 ± 216.3 , CBCT: 658.3 ± 22.1 ; $P < .0001$), third (SGCT: 531.3 ± 237.5 , CBCT: 641.6 ± 177.3 ; $p = .0140$), and the total of all scans (SGCT: 1216.9 ± 699.3 , CBCT: 200.3 ± 921.0 ; $P < .0001$) were significantly lower in the SGCT group. The same applies to radiation doses per level (SGCT: 461.9 ± 429.3 , CBCT: 1004.1 ± 905.1 ; $P < .0001$) and radiation doses per screw (SGCT: 172.6 ± 11.1 , CBCT: 349.6 ± 273.4 ; $P < .0001$). **Conclusion:** The present Results show that the applied radiation doses are significantly lower using a SGCT for navigated pedicle screw placement in spinal instrumentation. A modern CT scanner on a sliding gantry leads to lower doses, especially through automated 3D radiation dose adjustment.

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P123: Discrepancy between DXA and CT based assessment of spine bone mineral density

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Introduction: Adequate spine bone mineral density (BMD) is necessary for successful spinal fusion with instrumentation. DXA has long been the gold standard in determining BMD. However, DXA often gives spuriously high values for spine BMD. Hounsfield units (HU) from spine CTs may provide a more accurate depiction of the local BMD encountered during spine surgery. Our objective is to determine the discrepancy rate between DXA and CT BMD determinations, and how often DXA overestimates regional BMD compared to CT.

Material and Methods: We retrospectively reviewed 93 patients with a DXA and CT (including the lumbar spine) within 6 months of each other. DXA T-scores from L1-4 vertebrae and from all sites were classified as osteoporotic (T-Score ≤ -2.5) or non-osteoporotic (T-Score > -2.5). CT HU of the L1 vertebral body were classified as non-osteoporotic or osteoporotic using thresholds of ≤ 135 HU, ≤ 110 HU, and ≤ 8 . Corresponding DXA and HU scores were compared to determine discrepancy and overestimation rates. **Results:** Using the L1-L4 DXA T-score, the discrepancy rate between CT and DXA ranged 40%-100% depending on the HU threshold. DXA overestimated the BMD 97%-100% of the time compared to CT. Using the lowest overall DXA T-score, the discrepancy rate ranged from 35.5%-70% with DXA greater than CT 69.7%-100% of the time. **Conclusion:** There is a large discrepancy between DXA and CT BMD determinations. DXA frequently overestimated the regional spine BMD encountered during spine surgery. While DXA remains the gold standard in determining BMD, CT may also play an important role in defining the local BMD pertinent to spine surgery.

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P124: Multilevel thoracic and lumbar ligamentum flavum ossification in an achondroplastic - A rare presentation

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Introduction: Achondroplasia is a rare autosomal dominant condition characterized by stenosis in spinal canal. Multilevel Ossification of the ligamentum flavum in the spine is rare occurrence which too can contribute to stenosed canal. **Material and Methods:** We report a case of an Indian achondroplastic dwarf with multilevel ossification of ligamentum flavum (OLF) at thoracic and lumbar segment. She presented in the outpatient department with bilateral weakness in legs with complete foot drop on left side and was non-ambulatory. She was managed surgically by instrumentation with multiple interbody fusions with wide decompression and excision of OLF. Patient responded well to surgery and became a walker at 2-year follow-up. **Results:** The patient was made to sit and stand with support by the day 1. At 6 months postoperatively, the patient's motor power gradually improved to Grades 3-4 at L2-L3 bilaterally and Grades 2-3 at L4-S1. The patient also has improvement in sensory symptoms. At 2-year follow-up, patient is able to walk independently without support. **Conclusion:** Achondroplastic patients may present rarely with multiregional and multilevel OLF. It is important to identify them preoperatively so as to have good surgical outcome. Wide laminectomy, removal of the ossified ligament, and

fusion with instrumentation resulted in the improvement of the patient's neurological symptoms and function.

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P125: sonance imaging in the evaluation of paediatric low back pain

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Background: Atraumatic low back pain has a high prevalence in childhood and adolescence. Even though the majority of cases are musculoskeletal in nature, it may be linked to more sinister causes. Due to its excellent tissue resolution and lack of ionising radiation, MRI scans are the imaging modality of choice for its investigation. **Aim:** This study aims to highlight the MRI findings of low back pain in paediatric patients presenting to the emergency department without an obvious underlying condition. **Methods:** 27 patients aged 8 to 17 years who had atraumatic back pain severe enough to require admission and an MRI scan over a period of 5 years were retrospectively reviewed. MRI scans were classified into positive and negative findings. **Results:** Patients who had positive MRI findings (22.6%) had a significantly longer hospitalisation stay ($p = .048$). There was no significant difference in demographics, presence of lower limb weakness or numbness, duration or location of pain between patients who had positive and negative MRI findings. **Conclusion:** The majority of severe atraumatic low back pain requiring admission is associated with no anatomical pathology. However, 22.6% of patients had MRI findings that impacted their immediate management. MRI scans are therefore mandatory in this group of patients.

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P126: CT based morphometric analysis of CIC2 vertebra to evaluate safe corridors for anterior trans-articular screw fixation in Indian Population

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Introduction: Atlanto-axial articulation is unique, mobile segment of spine which largely depends on ligamentous supports and integrity of odontoid for stability. Atlanto-axial subluxation was treated by reduction and fusion of atlanto-axial joint via posterior approach including Gallie's fusion, Brooks – Jenkins fusion, Sonntag wiring and Magerl's technique. High riding vertebral artery precludes the placement of posterior trans-articular screw, which is liable to

injury. Computed tomography scans can be used to evaluate the risk of high riding vertebral artery. Method: This study was conducted on 50 patients (40 males and 10 females). CT based morphometric analysis of atlas and axis vertebra with the help of Radiant Dicom Viewer in different views. Superior facet angle, Inferior facet length and width of C1, Superior antero-posterior and antero-posterior end plate diameter, width, anterior and posterior height of C2 vertebral body and distance between mid-sagittal line of C2 and medial border of vertebral artery groove were measured for comparison. Result: Mean age of the patients was 38.9 years. Total of nine measurements (one angular and eight linear parameters) were evaluated. There were no statistical differences in any measurements on both side. The most important anatomical landmark i.e. distance between mid-sagittal line of C2 and medial border of vertebral artery groove was 12.7 ± 2.0 (Male: 12.7 ± 2.1 , Female: 12.5 ± 1.5). **Conclusion:** Anterior atlanto-axial trans-articular screw fixation can be used as an alternative to posterior trans-articular screw fixation for achieving stabilization and fusion at C1-C2.

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P127: Early reduction in C-reactive protein following treatment for spinal epidural abscess: a potential treatment guide

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Introduction: To assess the predictive value of early C-reactive protein (CRP) trends following diagnosis of spinal epidural abscess (SEA). **Materials and Methods:** All patients treated for spontaneous SEA in a tertiary centre in New Zealand over a 10-year period were followed for at least 2 years. CRP at diagnosis and day 4-5 following treatment initiation was analyzed to determine predictors of CRP reduction of at least 50%. Proportional Cox hazards regression investigated mortality over 2 years. **Results:** 94 patients met inclusion criteria and with CRP values available for analysis. Median age was 62 years (± 17.7) and 59 (63%) were treated operatively. Kaplan-Meier analysis estimate of 2-year survival was .81 (95% CI .72-.88). CRP reduction by 50% was seen in 34 patients. Patients who did not experience a 50% reduction were more likely to have thoracic infection (27 vs. 8, $p = .02$) or multifocal sepsis (41 vs. 13, $p = .002$). Failure to achieve a 50% reduction by day 4-5 was associated with worse post-treatment Karnofsky scores (70 vs. 90, $p = .03$) and longer hospital stay (25 days vs. 17.5 days, $p = .04$). Cox regression model showed mortality predicted by Charlson Comorbidity Index, thoracic location of infection, pre-treatment Karnofsky

score, and failure to achieve a 50% CRP reduction by day 4-5. **Conclusions:** Patients who fail to reduce CRP values by 50% at day 4-5 following treatment initiation are more likely to experience prolonged hospital stay, have poorer functional outcome and have greater mortality risk at 2 years. This group has severe illness regardless of treatment type. Failure to achieve a biochemical response to treatment should prompt reassessment.

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P128: Factors to improve clinical outcomes of reconstruction surgery for patients with spinal destruction due to pyogenic spondylodiscitis

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Introduction: Invasive reconstruction surgery is required for patients with pyogenic spondylodiscitis in the spinal destructive stage. However, these patients frequently have worse general conditions, leading to become persistent for the treatment. We perform the percutaneous endoscopic debridement (PED) before the reconstruction surgery to identify the organisms and administer adequate antibiotics, resulting in improving the general condition and making the treatment more effective. Despite the improvement of general condition due to the PED, we often experience the cases with prolonged high CRP after the reconstruction surgery. The purpose of this study was to evaluate the factors associating to prolonged high CRP after the reconstruction surgery. **Material and Methods:** Thirty-two patients (22 male, 10 female) with pyogenic spondylodiscitis in the destructive stage of the Griffiths' classification were enrolled. These patients underwent the staged treatment protocol with PED and following spinal reconstruction surgery from April 2014 to February 2021 at a single institution. Total cohort was divided into two groups; Prolonged infection group (PI group) including patients with CRP of more than 1 at 3-week after reconstruction surgery and suppressed infection group (SI group) including patients with CRP of less than 1 at 3-week after reconstruction surgery. Information about age, gender and identification of organisms was obtained from the medical records. The serum CRP, serum total protein and serum albumin level immediately before the reconstruction surgery were included in measurement parameters. Factors associated to prolonged high CRP were assessed by comparing the two groups. Multivariable logistic regression was used to identify the factors which anticipate the two groups. **Results:** There was no significant difference in age, gender and identification of organisms between the two groups ($p > .05$). The mean serum CRP immediately before the reconstruction surgery were 1.2 mg/dl in the PI group and 2.9 mg/dl in the SI group. These revealed a significant difference ($p = .02$). Despite of no

significant difference in the mean serum total protein level, the mean serum albumin level was 2.8 g/dl in the PI group, which was significantly lower than 3.1 g/dl in the SI group ($p = .049$). In multivariable logistic regression, the CRP and albumin immediately before the reconstruction surgery were identified as the predictors for the two groups ($p = .01$, $p = .02$, respectively). **Conclusion:** The CRP and albumin level immediately before the reconstruction were predictors for prolonged high CRP after the reconstruction surgery for pyogenic spondylodiscitis, indicating that CRP should be controlled to less than 2 mg/dl before the reconstruction surgery using proper antibiotics, and improvement of nutrition or compensation of low albumin level are considered to be important.

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PI29: Clinical effectiveness of comprehensive medicine in treatment of pyogenic spondylitis in the elderly

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Introduction: In recent years, the number of refractory spinal infections in elderly patients with diverse co-morbidities has been increasing in Japan. In addition, elderly people are prone to low nutritional status due to age-related eating disorders and changes in digestion and absorption functions. Malnutrition affects systemic reserve, which not only makes the treatment of infections more difficult, but also affects the quality of life of patients. In this study, we examined the clinical efficacy of combining conventional orthopedic single-discipline treatment with multi-disciplinary comprehensive medical treatment of pyogenic spondylitis in the elderly. **Material and Methods:** Fifty-four patients aged 65 years and older who were treated for pyogenic spondylitis between 2016 and 2019 were enrolled. The patients were divided into two groups: 41 patients managed by a single orthopedic department (non-intervention group) and 13 patients managed with combination of conventional orthopedic single-specialty treatment and comprehensive medical treatment care. The Japanese Nurse Practitioner (JNP) played a central role in the comprehensive medical care, and in addition to the conventional orthopedic single-discipline medical care, nutritional management focusing on enteral nutrition. In addition, the JNP also plays an active role in correction of polypharmacy such as reduction of non-steroidal anti-inflammatory drugs (NSAIDs), opioids and benzodiazepine as these medications may be risky for the elderly when used excessively. Serum albumin level was used for nutritional assessment and Barthel Index for quality of life assessment, and the degree of improvement between the two points was calculated at admission and discharge. **Results:** The per capita doses of NSAIDs and opioid analgesics were reduced to

13% and 9% of the non-intervention group, respectively, resulting in acetaminophen-centered analgesic control. The mean serum albumin level at admission was 2.94 g/dl in the non-intervention group and 2.62 g/dl in the intervention group, but at discharge, it was 3.16 g/dl in the non-intervention group and 3.32 g/dl in the intervention group. The mean Barthel Index at admission was 23.1 points in the non-intervention group and 18.2 points in the intervention group, but improved to 38.8 points in the non-intervention group and 44.1 points in the intervention group at discharge. There was significant greater improvement in follow up serum albumin level and Barthel Index for the intervention group when compared to non-intervention group ($P < .05$). **Conclusion:** Nutritional and pharmaceutical management of elderly infected patients is an important factor in determining the outcome of surgical care. Correction of polypharmacy, such as nutritional management focusing on the gastrointestinal tract and aggressive polypharmacy management, resulted in a significant increase in serum albumin levels and a significant improvement in Barthel Index, an index of quality of life. Nutritional management and proper use of medications are very important in the treatment of pyogenic spondylitis in the elderly, and it is desirable to improve clinical outcomes by implementing these measures in conjunction with orthopedic care.

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PI30: Is sarcopenia a risk factor for postoperative surgical site infection after posterior lumbar spinal fusion?

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Introduction: Surgical Site Infection (SSI) is the third most common complication after spine surgery. Since the volume of elective lumbar procedures has rapidly increased over years, interest has grown in identifying risk factors associated with complications. Sarcopenia has gained significant interest in this field and has been associated to greater complication rates, discharge disposition and perioperative morbidity and mortality both in general and orthopaedic surgery. However, there are currently no studies -to the best of the Authors' knowledge- that examined the risk of post-operative infection after lumbar spine surgery in sarcopenic vs non-sarcopenic patients. Hence, this retrospective observational study aims to evaluate the impact of sarcopenia on SSI risk in patients who undergo short posterior lumbar fusion for degenerative diseases. **Material and Methods:** A review of the records of patients with degenerative lumbar spine diseases who underwent a short (3 levels or less) posterior lumbar fusion at our institution over a 10-year period (2009-2019) was performed. All consecutive patients between 55 and 75 years of age who were operated by the same surgeon with at least 2 years of follow up were included. The

Psoas Lumbar Vertebral Index (PLVI) measured on preoperative MRI was used as a measure of central sarcopenia. Demographic data, smoking history, Body Mass Index (BMI), Charlson Comorbidity Index (CCI), ASA score were also included for analysis. Postoperative infection was used as primary outcome, up to 2 years from surgery. Patients were stratified according to low vs high PLVI (with the mean value to identify baseline characteristic differences). Then, a secondary ex-post statistical analysis was performed stratifying them according to post-operative infective status. A statistical analysis was performed in order to identify risk factors for infection and to make correlations. **Results:** A total of 304 patients were included; 24 (7.9%) developed post-operative SSI. The average follow-up was 26.2 months. 24 patients developed a postoperative SSI (7.9%). Average PLVI was .74 (range .29-1.13). Low PLVI was found mostly in females ($P < .01$). Age, CCI and ASA were found to be inversely related to PLVI. However, the sarcopenic group (low PLVI) was found to have not a higher likelihood of experiencing post-operative SSI ($p = .947$). When stratifying patients according to postoperative infection, there were no significant differences in baseline characteristics or in PLVI. Only Comorbidity Index and ASA score resulted to be significantly associated with SSI ($p = .008$ and $p = .017$, respectively). **Conclusion:** The Results of the present study indicate that sarcopenia is not associated with surgical site infection after short lumbar posterior fusion. Nevertheless, this condition has been widely demonstrated to have a great impact on clinical outcome in spine surgery. Therefore, further prospective investigation is needed to deepen the role of sarcopenia in predicting morbidity and mortality in patients undergoing surgery.

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P131: Ruptured infected facet joint cyst resulting in systemic infection: presentation and management

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Introduction: Facet joint cysts can develop in the synovial joint between two adjacent spinal vertebrae as a result of degeneration. Patients are usually asymptomatic or may experience back pain. Rarely, they may become infected or produce neurological deficits. Here we discuss a rare case of ruptured infected facet joint cyst associated with extensive local and systemic infections. We discuss its presentation, investigations and management, and highlight the challenges of the treatment. We also review the literature for relevant conditions **Material and Methods:** Review of patient's medical notes and imaging, and literature review on similar/relevant conditions. **Results:** A 43 year-old male presented to the Emergency Department with 4 days of low back pain radiating to right hip and thigh. Past medical history included only hypertension, with no relevant travel, contact or sexual history. Neurological examination was

unremarkable with normal power, sensation and sphincter functions. Blood tests showed raised CRP (228) and ESR (61). Contrast-enhanced MRI revealed a right paravertebral infected collection centred at right L2/3 facet joint, likely from ruptured infected synovial facet cyst. There was also early osteomyelitis of L2 and L3 posterior elements. An epidural collection was seen L2 with crowding of cauda equina. The patient was taken to operating theatre for washout of right paraspinal collection and drainage of epidural collection. Post-operatively, his pain resolved and CRP decreased. Blood and intra-op wound cultures both grew methicillin-sensitive *Staphylococcus aureus*, and patient was started on intravenous (IV) cefazolin on Infectious Diseases recommendation. However, 3 days post-op, his low back pain recurred with new onset right lateral thigh pain. Purulent fluid was seen leaking from wound. Repeat MRI demonstrated a residual infected collection at the same site, and a persistent L2 epidural collection causing severe canal stenosis. Inflammation of paravertebral muscles appeared more extensive. The patient thus underwent a second operation, i.e. wound exploration/washout, right L2/3 medial facetectomy and decompression of L3 nerve root. Intra-op, frank pus was noted in the muscles and subcutaneous tissue. Caked epidural pus was seen over L2. Following this operation, his clinical condition and blood markers improved significantly. IV antibiotics was continued and he was discharged well with no neurological deficits. Two months post-op, the patient was reviewed in clinic. Having completed 6 weeks of IV antibiotics, his remained pain-free and successfully returned to work. Follow-up MRI showed interval resolution of the paravertebral collection, and significantly reduced epidural collection with improved canal stenosis. **Conclusion:** Our case illustrates a phenomenon whereby an infected facet joint cyst-which itself is a rare entity-ruptured and was associated with extensive local (paravertebral abscess and myositis, osteomyelitis, epidural collection) and systemic (bacteraemia) infections which was successfully treated with two surgeries and long-term antibiotics. This case highlights the importance of maintaining a high index of suspicion for potentially serious but rare conditions such as ruptured infected facet joint cyst, even for common presentations such as low back pain. Aggressive surgical intervention with adequate clearance of infection (including facetectomy of the infected joint in our case) is required to ensure clinical improvement.

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P132: Spondylodiscitis with quadriparesis caused by esophageal perforation from fish bone ingestion: a case report

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Introduction: Esophagus is the most common site, in which foreign bodies are found. It causes dysphagia and other symptoms, e.g., odynophagia, choking, and drooling that are associated with size and location of the foreign body. Esophageal perforation from foreign bodies can cause life-threatening conditions, such as retropharyngeal and parapharyngeal abscess, epidural abscess, thyroid abscess, and mediastinitis. The mortality rate is up to 22% from serious complications. But if an early diagnosis and primary repair of esophageal perforation are performed within 24 hours, the survival rate will increase up to 95%. In this report, we introduce a case with quadriplegia from a retained foreign body in the retropharyngeal space and the management. **Material and Methods:** A 55-year-old woman presented with progressive C6 quadriplegia for two months. The MRI showed spondylodiscitis of C5/6, retropharyngeal abscess, and epidural abscess along posterior vertebral bodies of C5-6 with severe spinal cord compression. This patient received delayed treatment because of delays in the referral process due to COVID-19 outbreak in Thailand. During the surgery, a fish bone was found in a phlegmon anterior to the vertebral body of C6, which formed a tract between C6 and posterior esophageal wall at level C5. We consulted a general surgeon and a head and neck surgeon to evaluate the fistula and found that it had already healed. Esophagoscopy was performed 7 days later. The findings showed red, edematous epithelium and a healed fistula. We obtained more medical history retrospectively that the patient had dysphagia before the onset of quadriplegia. The symptoms of dysphagia only presented for a week and then disappeared. We assumed that was because of the migration of the fish bone penetrating through the esophageal wall into the retropharyngeal space. In this report, we also review the intraoperative management of esophageal perforation with current evidence. **Results:** The patient underwent anterior corpectomy of C5-6, autologous iliac crest graft, and anterior plating C4-C7. Two days after the operation, the urine catheter could be removed with improved bowel and bladder function. There was also an improvement in motor power, from complete C6 quadriplegia to ASIA grade C at one week, and to grade D at two weeks after surgery. **Conclusion:** Esophageal perforation from fish bone ingestion can cause serious complications. Early diagnosis and detailed medical history are necessary in order for the patient to receive early treatment and better outcomes.

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P133: An agreement assessment of a novel classification of pyogenic spinal infections. Can we predict treatment based on such classification?

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Introduction: In 2017, Pola et al. described a clinical-radiological classification of pyogenic spinal infections (PSI) based on magnetic resonance imaging (MRI) features including vertebral destruction, soft tissue involvement and epidural abscess, along with the neurological status. We performed an inter- and intra-observer agreement evaluation of this classification. **Material and Methods:** Complete MRI studies of 80 patients with PSI were selected and classified using the scheme described by Pola et al. by seven evaluators. After a four-week interval, all cases were presented to the same assessors in a random sequence for repeat assessment. We used the weighted kappa statistics (w_k) to establish the inter- and intra-observer agreement. **Results:** The inter-observer agreement was substantial considering the main categories ($w_k = .77; .71-.82$), but moderate considering the subtypes ($w_k = .51; .45-.58$). The intra-observer agreement was substantial considering the main types ($w_k = .65; .59-.71$), and moderate considering the subtypes ($w_k = .58; .54-.63$). **Conclusion:** The agreement at the main type level indicates that this classification allows adequate communication and may be used in clinical practice; at the subtypes level, the agreement is only moderate.

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P134: A novel spinal instability score to determine spinal instability and assess surgical candidacy in active spinal tuberculosis

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Introduction: Multidrug chemotherapy has made spinal tuberculosis (STB) mainly a medical disease. However, instability in STB leads to disabling spinal deformity and neurological deficit. The ability to identify and estimate instability remains largely subjective based on experience resulting in overdue or delayed surgical treatment with serious consequences to the patient. We aimed to develop an objective scoring system to determine instability in STB. **Materials and Methods:** The study is a Modified Delphi Consensus and Observational Study. The study was conducted in four phases. 1) A 10-member expert panel of spine surgeons with 25 years' experience performed an extensive review of the literature to enlist all factors influencing management in STB, and a questionnaire was developed. 2) 68 experienced spine surgeons from 12 different nations opined on the importance of each factor in an online survey. Five factors deemed important by > 70% of participants were included for further analysis 3) 60 representative cases of STB were analyzed for several factors and their association with instability. A preliminary scoring system was developed, and a threshold score for determining instability was derived. 4) Results were validated in a new set of 30 cases. Ten spine fellows and orthopedic residents naïve to the scoring system evaluated these cases before, and after employing the scoring system, and the overall agreement, reliability and reproducibility were analyzed. This project was self-funded. **Results:** 68/76 of the invited spine surgeons participated, and factors considered important by > 70% of the participants were – 'Spine at risk' signs deemed important by all (100%), followed by the severity of vertebral body loss (89.56%), Cervico-thoracic/Thoraco-lumbar junction involvement (86.57%), age below 15 at presentation (85.07%), and kyphotic deformity ≥ 30 degrees (8.60%). All these five factors considered in the scoring system were found to be associated with instability: age ≤ 15 years (p-value,.05), cervicothoracic/thoracolumbar junction involvement (p-value, .028), sagittal deformity angle ratio (DAR) ≥ 15 degrees ($P < .001$), vertebral body loss-segmental ratio $\geq .5$ ($P < .001$) and presence of spine at risk signs ($P < .001$). A total score of $\geq 3/10$ was indicative of definite instability with good sensitivity (77%) and excellent specificity (100%). The scoring system was validated in a new set of 30 cases with excellent accuracy. The overall diagnostic agreement assessed by Inter-rater Intraclass co-efficient

improved following usage of the scoring system to predict instability in both spine fellows [.794 to .971] and orthopedic residents [.683 to .957]. Repeatability/reproducibility assessed using Pearson's correlation analysis showed a good agreement (.9625), and the overall Cohen's kappa coefficient was strong (.809) even after one month of initial measurement. **Conclusion:** A simple objective method of scoring system for predicting instability in STB has been developed using five main factors; young age, junctional involvement, the severity of the deformity, vertebral body loss, and presence of spine at-risk signs.

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P135: Comparative analysis of long term outcome of anterior reconstruction in thoracic tuberculosis by direct anterior vs posterior approach

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Introduction: First described by Sir Percival Pott, tuberculosis is an age-old problem affecting millions worldwide with developing countries being affected the most. Thoracic spine is the most common site affected with anterior column involved more commonly leading to kyphotic deformity and neural compression. The goal of surgery in Pott's spine is thorough debridement and neural decompression, maintenance and reinforcement of stability, prevention and correction of deformity. The selection of whether anterior or posterior approach is still a matter of debate. The above study was done to compare the long term outcome in these two approaches. **Material and Methods:** A total of 245 patients with proven tuberculosis of thoracic spine were included, of which 127 were operated by posterior-approach and 118 were operated by anterior-approach using versatile approach technique. Patients with at least 1-year of post-operative follow up were included and their data was retrospectively analyzed. Patients were assessed clinically, radiologically and data regarding demography, affected levels, surgical approach used, operative time, blood loss, neurology as per Frankel grade, pre & post-operative alignment, percentage correction of kyphosis, time for fusion, fusion grade using Bridwell criteria, percentage loss of correction at the end of 1year, time for mobilisation and complications if any were collected, analyzed and compared in anterior versus posterior approach. **Results:** Mean age of patients in anterior-approach was 36.03years & 39.83years in posterior approach. Mean operative time in anterior-approach was 6.11hours & 5hours in posterior approach. Mean blood loss was 1.6litres in anterior approach & 1.11litres in posterior approach. Mean kyphosis angle in posterior-approach was 34.803° pre-operatively & 11.286° ($P < .001$) at 3months post-operative follow up with percentage of correction being 67.216%. Mean loss of correction at 1year was 4.186°. Mean kyphosis angle in anterior-approach was 41.154°pre-operatively & 9.498° at

3months post-operative follow up with percentage of correction being 77.467% ($P < .001$). Mean loss of correction at 1year was 6.184°. Mean time for fusion was 4.69 months in anterior-approach and 6.34 months in posterior-approach with mass considered fused as per Bridwell criteria. Mean time for mobilisation in posterior-approach was 1.18weeks & 2.51weeks in anterior-approach. Significant improvement in neurology was seen in patients operated by either approach, but slightly better improvement was seen in those operated by anterior-approach. Complications were slightly more in posterior-approach. **Conclusion:** Decompression and deformity correction are the only answer to prevent progression of kyphosis, neurological deficit and late onset paraplegia in these complex cases. Single stage anterior reconstruction and posterior stabilization via anterior approach allows for thorough debridement, neural decompression and much better anterior column reconstruction and deformity correction than posterior approach. Direct visualization of cord while correcting kyphosis reduces chances of neurological complications significantly. Both approaches have their own unique advantages and limitations. The age old saying of increased morbidity and poorer Results with anterior approach have been proven wrong in this study. Though posterior approach is easy to master but the Results shown by anterior approach cannot be overseen. We would like to conclude that better functional outcome and significantly better kyphosis correction by the anterior approach are strong pointers favoring the anterior approach.

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P136: Cefazolin prophylaxis in spine surgery: heavier patients are frequently underdosed and at increased risk for infection

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Introduction: Perioperative antibiotics are critical in reducing the risk of postoperative spine infections. Currently, there is no global standardization of weight based perioperative cefazolin dosing in spine surgery, potentially leading to antibiotic under-utilization with a resultant increase in the incidence of infections for patients undergoing elective spine fusion. Thus, the objective of this study was to determine 1) if perioperative cefazolin dosing affects the infection rate in spinal fusion surgery and 2) what is the appropriate preoperative cefazolin dose based on patient weight. **Material and**

Methods: Patients ≥ 18 years of age undergoing posterior cervical or lumbar spinal fusion between 2000 to 2020 were identified from a single institution. Exclusion criteria included incomplete weight, inadequate perioperative data, a preoperative diagnosis of tumor and/or infection, patients receiving perioperative antibiotics other than cefazolin, and anterior cervical decompression and fusion procedures. Patients were grouped based on dosing adequacy, with an adequate dose defined as 1g for < 60 kg, 2 g for 60-120 kg, and 3g for > 120 kg. Univariate comparisons and multivariate regressions were used to determine the effect of an inadequate dose on infection rate. Patients were subsequently regrouped into cefazolin dose (grams) administered and a linear regression and receiver operating characteristic curve (ROC) were compiled to determine the probability of infection based on cefazolin dose and patient weight. Alpha was set at .05. **Results:** 2,814 patients met inclusion criteria and 101 infections (3.6%) were identified. The infection rate was significantly higher in the inadequate dose group (5.8% vs. 2.6%, $P < .001$). Receiving an adequate dose of cefazolin was an independent predictor of decreased rate of infection (Odds Ratio (OR): .48, $P < .001$). On subgroup analysis, receiving an adequate dose of cefazolin was an independent predictor of decreased rate of infection in lumbar fusion (OR: .43, $P = .001$), but not cervical fusion (OR: .45, $P = .055$). Patients were subsequently regrouped into one, two, or three grams of cefazolin administered resulting in a 5.08%, 2.75%, and 3.8% infection rate, respectively ($P < .001$). Weight ($\beta = .03$, $P < .001$) and two grams cefazolin ($\beta = -1.52$, $P < .001$) were independent predictors of infection. The area under the curve (AUC) and 95% confidence interval for one [.834 (.759-.908)], two [.572 (.493-.650)], and three [.861 (.646-.999)] grams cefazolin. **Conclusion:** Patients receiving an inadequate weight-based dose of preoperative cefazolin had an increased risk of infection following spinal fusion surgery. Two grams prophylactic cefazolin significantly reduces the likelihood of infection during spinal fusion procedures.

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P137: Comparison of outcomes between three different surgical treatment in spontaneous lumbar pyogenic spondylodiscitis

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Introduction: Spondylodiscitis is an infectious disease of the intervertebral disc space and adjacent vertebral end plates. Continued bone and disc destruction from prolonged, chronic infection may progress to significant spinal deformity in a subset of patients, with resultant worsening quality of life. The goals of this study is to compare the clinical outcomes between patients with lumbar pyogenic spondylodiscitis who underwent three different surgical treatment. **Material and Methods:** Twenty-six

patients with spontaneous lumbar pyogenic spondylodiscitis who underwent surgical treatment between February 2015 and December 2018 were retrospectively reviewed. 12 patients underwent posterior decompression with or without instrumented fusion (Group A), 7 underwent endoscopic discectomy and debridement (Group B), and 7 underwent combined anterior and posterior surgery with autogenous iliac bone graft (Group C). Clinical outcomes were evaluated using Visual Analog Scale (VAS), Oswestry Disability Index (ODI), white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) at serum. Assessment of clinical outcome were checked at pre and postoperatively and every 3 months after discharge at least 1 years. **Results:** There were no significant differences at baseline in terms of mean age, sex, VAS, WBC and ESR between groups. CRP level was significantly higher in group C. Causative organisms were identified in 15 patients (57.7%): *Staphylococcus aureus* in 8 patients, *Streptococcus* species in 4 and *Enterococcus* in 3 patients. Mean duration of inflammatory biomarker to normalize was 8.9 weeks after surgery (8.8 weeks in group A, 9.3 weeks in group B, 8.2weeks in group C). Postoperative mean VAS and ODI were significantly lower in group B. However, there were no significant differences between groups at the final follow up. **Conclusion:** In the treatment of patients with lumbar pyogenic spondylodiscitis, surgical treatment showed excellent clinical Results. In the comparison of the three surgical techniques, endoscopic discectomy and debridement predominates in the clinical outcomes immediately after the surgery. However, the final outcomes do not show any differences according to the surgical techniques.

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P138: Factors associated with inadequate treatment response in spondylodiscitis: experience from 2 hospitals in Latin-America

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Introduction: Spondylodiscitis is the main manifestation of haematogenous osteomyelitis in patients aged over 50 years, representing 3-5% of all cases of vertebral osteomyelitis, its incidence range from 2 to 24 per million per year in developed countries. Its associated with a high burden of disease in terms of lengthy and expensive hospital stays and considerable morbidity and mortality among patients. The treatment modalities include a long course of antibiotics and in selected cases some surgical procedures are necessary. Spondylodiscitis may be classified as mycobacterial, fungal, or pyogenic. Nowadays, most cases are

monomicrobial, and *Staphylococcus aureus* is the dominant organism (30-80%). The incidence of spondylodiscitis is increasing worldwide, calling for improvement in diagnosis and management of this spinal infection in order to reduce the burden of the disease. The evaluation of treatment response in spondylodiscitis, during the course of treatment, is less frequently addressed in global literature, and have not been studied in Latin-American (developing countries). We describe in this study the characteristics at presentation, risk of inadequate treatment response, relapse and death of patients with spondylodiscitis determining the risk factors for inadequate treatment response among them. **Material and Methods:** Following institutional review board approval, patients with a diagnostic of spondylodiscitis (Pyogenic, mycobacterial or fungal) admitted in 2 hospitals at Medellin, Colombia between January 2015 to January 2019 was assessed. Medical records, imaging reports, and surgical notes were reviewed and logistic regression was used to determine odds ratios (OR). **Results:** Of 325 patients reviewed, only 62 met the inclusion criteria and were included in the final report, 22 (35.4%) patients had inadequate treatment response, risk factors associated with inadequate treatment response were : vertebral body infection > 50% (aOR 8.26, 95% confidence interval (CI) 1.69 - 4.4, $P = .009$), positive culture after spine biopsy with statistical value on univariate analysis (OR 3.1, CI 1.0 -9.62, $P = .045$) but not statistical value in the multivariate analysis (aOR 1.32, CI .30 - 5.88, $P = .711$), neither diabetes, HIV infection, intravenous drug users, infective endocarditic or alcoholism were of statistical value. Six patients had mycobacterium spondylodiscitis and pulmonary tuberculosis, but was not of statistical value to inadequate treatment response (OR 1.94, CI .35 - 1.5, $P = .657$), neither previous spinal surgery (OR 2.7 CI .56 - 13.5, $P = .233$). One year crude mortality was 3.53%, neurological deficits were present in 32.3% (majority with motor impairment), and Methicillin-Sensitive *Staphylococcus aureus* was the most frequent organism found. No fungal infection was diagnosed in this study. **Conclusion:** In this Latin-American study, the most frequent organism found in spondylodiscitis remains *Staphylococcus Aureus*, the only risk factor associated with inadequate treatment response was the association of vertebral body infection > 50%. Medical co-morbidities, mycobacterium infectious disease nor previous spine surgery was of statistical value for inadequate treatment response in this study.

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P139: Outcome of surgical treatment of TB spine: a multi-center experience

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Introduction: Spinal tuberculosis accounts over 31% of all spine infections. This clinical entity is socioeconomic related, occurring more often in developing countries, although an increase in incidence has been documented in developed countries. About 10% of all tuberculosis cases present with musculoskeletal involvement and 50% of these involve the spine (Pott's disease). The thoracic and lumbar spine are most commonly involved (90% of cases). Delay in establishing diagnosis and management cause spinal cord compression and spinal deformity. **Material and Methods:** This is a prospective study, was performed in Bangabandhu Sheikh Mujib Medical University and different private clinics in Dhaka from July 2006 to July 2021, included total 618 patients, among them 319 were male & 299 were female, ranging of age was 17 -76 years. Neurological deficits were graded using the American Spinal Association (ASIA) Impairment Scale of motor and sensory impairment, which ranges from A (no motor or sensory function) to E (normal functioning). Thoracotomy along with anterolateral decompression, autogenous bone graft with cage and fixation by screws and rods were done in 70 cases. Posterior decompression, posterior interbody and posterolateral fusion by bone graft with or without case and stabilization by pedicle screws and rods were done in 507 cases and anterior decompression, fusion and stabilization done in cervical 42 cases. Appropriate anti TB drugs were given to all patients for 18-24 months. Follow up period was 3 months to 12 years. **Results:** Infection eradication and spine fusion was achieved in all patients. The clinical and imaging criteria for bone fusion were met after an average of 11 months postoperatively (range 8-24 months). There was no apparent relationship between time to fusion and the type of bone graft used. Among all patient revision surgery were done in 4 cases, superficial wound infection were encountered in 12 cases. Neurological improvement occurred in all patents except one case. There was no mortality. **Conclusion:** Surgical treatment combined with chemotherapy is a safe and effective approach to treat spinal tuberculosis infection. Severe cases with large abscesses and extensive vertebral column involvement, aggressive treatment with direct aspiration and debridement, anterior reconstruction and posterior instrumentation can result in a rapid recovery and acceptable rate of complications.

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PI40: Next generation sequencing (NGS) to determine microbiome of herniated intervertebral disc - Is disc still a sterile tissue?

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Introduction: Background Context: There is apparent causality between chronic infection of the intervertebral disc and its degenerative process. Although disc is considered a sterile tissue, collected samples of uninfected patients sent to culture testing resulted positive. Purpose: The purpose of this study was to analyze the microbiome of the intervertebral disc by using and validating the Next Generation Sequencing (NGS) molecular test, controlled with tissue culture and clinical presentation of patients. **Material and Methods:** Study Design/Setting: Prospective study of consecutive patients in a hospital. Patient Sample: Patients with lumbar disc herniation undergoing open microdiscectomy aging 18 to 65 years. Outcome Measures: NGS, Tissue culture. Methods: Subjects undergoing open decompression surgery for lumbar disc herniation were consecutively included and clinically followed for one year. Three samples of the excised herniated disc fragment were sent to tissue culture and another sample of the disc was sent to NGS test for microbiome analysis. Control samples of the ligamentum flavum and deep muscle were collected and sent to culture. **Results:** A total of 17 patients were included. All patients presented negative cultures of the removed disc samples, as well as negative cultures of muscle and yellow ligament. None of the patients evolved to clinical infection one year after surgery, nor presented significant alteration of laboratory markers. NGS mapped a mean of 14,645 (range 6,540 to 27,176) DNA sequences for each disc sample of each patient. There were a total of 45 different bacteria genera with different amount of DNA sequences detected. There was a mean of 8 (range 3-17) different bacteria in each sample of intervertebral disc. Three bacteria were present in all disc samples (*Herbaspirillum*, *Ralstonia*, and *Burkholderia*). Although there was a considerable mean number of bacteria mapped in each disc sample, the amount of sequences related to bacteria were low. *Cutibacterium acnes* was not found in any disc microbiome analysis. **Conclusion:** NGS has been proven to adequately determine bacterial DNA presence within the intervertebral disc. *C. acnes* was not isolated in culture neither in microbiome analysis of patients with lumbar disc herniation. We cannot confirm disc sterility since, even if it does not cause infection, there is bacterial or remnant DNA in herniated discs.

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PI41: Long term outcomes of extraosseous fixation in dorsal spine and hybrid fixation in dorsolumbar pediatric spine tuberculosis

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Introduction: Spinal tuberculosis is an endemic disease in developing countries. Pediatric age group is an important victim of this destructive disease. Children have issues of small size vertebrae and its instrumentation. Tuberculosis being a chronic infective condition, it leads to issues of porosis, destruction and poor hold of implant. We are presenting a long term outcome (> 5 years) of extraosseous (surface) fixation in the form of sublaminar wire and Hartshill rectangle/rod in dorsal spine tuberculosis and hybrid fixation in the form of proximal sublaminar wire and distal pedicular screw fixation in dorsolumbar spine tuberculosis. Lamina of vertebra is mainly cortical and fixation encircling the lamina provides sufficient anchorage to the encircling sublaminar wire and Hartshill rectangle/rod, this was the reason to use this construct in pediatric dorsal spine tuberculosis. **Materials and Methods:** In this retrospective study from a tertiary care centre, we studied the records of 30 consecutive pediatric patients suffering from dorsal and dorsolumbar spine tuberculosis. Out of 30 patients, 24 were admitted without any previous surgical intervention while 6 were treated previously for dorsal spine tuberculosis surgically in different hospitals and had come with implant failure. In all these 6 patients pedicular screw and rod system was used. Out of 30 patients, 28 had neurological deficit while 2 were operated in view of significant destruction of anterior column with kyphosis of more than 60 degrees. All 30 patients had wet lesions. The age ranged from 3 to 12 years. There were 18 boys and 12 girls. We used sublaminar wire and Hartshill rectangle/rod for dorsal spine fixation. In lesions involving D10 and below we used sublaminar wires at proximal levels and pedicular screw at distal levels thus making a hybrid construct. This was done to save the motion segment of lumbar spine. In all the cases anterior reconstruction was done with bone graft (rib, fibula, iliac crest). **Results:** Out of 28 patients who had neurological deficit all recovered neurologically within 8 weeks. Out of 30 patients one patient had breakage of sublaminar wire at 6 months follow up. There was buckling of anterior graft. This was revised and showed full consolidation in 10 months time. The loss of kyphosis correction was less than 10 degrees. We did not observe any case of crankshaft phenomenon or any rotational deformity in follow up. **Conclusion:** Sublaminar wire and Hartshill rectangle / rod for dorsal spine fixation and Hybrid fixation for dorsolumbar junction provide a long lasting outcome in spinal reconstruction for paediatric spine tuberculosis.

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PI42: Surge in spinal epidural abscess during COVID-19 pandemic - a series of twelve cases

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Introduction: To report the peculiarity of spinal epidural abscess in COVID-19 patients, as we have observed an unusually high number of these patients following the outbreak of Corona Virus Pandemic. **Materials and Methods:** We reviewed the clinical documentation of twelve consecutive COVID-19 patients with primary spinal epidural abscess that we surgically managed over a 3-month period. These cases were analyzed for what concerns both the viral infection and the spinal abscess. **Results:** The abscesses were primary in all cases indicating that no evident infective source was found. A primary abscess represents the rarest form of spinal epidural abscess, which is usually secondary to invasive procedures or spread from adjacent infective sites, such as spondylodiscitis, generally occurring in patients with diabetes, obesity, cancer, or other chronic diseases. In all cases, there was mild lymphopenia but the spinal abscess occurred regardless of the severity of the viral disease, immunologic state, or presence of bacteremia. Obesity was the only risk factor and was reported in three patients. The preferred localizations were cervical and thoracic, whereas classic abscess generally occur at the lumbar level. No patient had a history of pyogenic infection, even though previous asymptomatic bacterial contaminations were reported in five cases. **Conclusion:** To our knowledge, cases of spinal epidural abscess in COVID-19 patients have not been reported to date. We hypothesize that, in our patients, the spinal infection could have depended on the coexistence of an initially asymptomatic bacterial contamination. The well-known COVID-19-related endothelitis might have created the conditions for retrograde bacterial invasion to the correspondent spinal epidural space. Furthermore, spinal epidural abscess carries a significantly high morbidity and mortality. It is difficult to diagnose, especially in compromised COVID-19 patients but should be kept in mind as early diagnosis and treatment are crucial.

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PI43: Surgical outcome of transpedicular decompression with or without global reconstruction in thoracic/thoracolumbar Potts spine: a 7 year institutional review

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Introduction: There is lack of adequate literature on the outcomes of transpedicular decompression with and without global reconstruction in Potts spine. Use of PEEK cages in Potts spine has also not been established. This study was performed to the radiological and clinical outcomes of transpedicular decompression in spinal TB with and without anterior reconstruction with PEEK and Mesh cages. **Material and Methods:** An institutional retrospective analysis of hospital records and imaging database from January 2014 to January 2020 was performed for patients who underwent surgery for Potts spine and patients who satisfied the eligibility criteria. **Results:** 230 patients included in the study had a mean (\pm SD) age of 47.7 (\pm 18.1) years (109 males, 121 females). Significant improvement in VAS, ODI and Cobbs angle has been observed in the patients ($P < .001$). Patients who underwent anterior reconstruction had a greater correction in Cobbs angle postoperatively ($p = .042$) but also greater blood loss ($p = .04$). However, during the follow up, significant loss of correction was observed in the cohort who underwent anterior reconstruction compared to the other cohort ($p = .026$). No significant difference in clinical or radiological outcomes have been observed between those underwent anterior reconstruction using Mesh/PEEK cages. **Conclusion:** Transpedicular decompression has good clinical and radiological outcomes in the surgical management of Potts spine. Use of anterior reconstruction in addition can result in excess blood loss but the clinical outcomes are equivalent and radiological outcomes are better. The type of material used (mesh/PEEK) for anterior reconstruction does not have an effect on the clinical and radiological outcomes.

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PI44: Perioperative allogeneic blood transfusion: effect on the incidence of surgical site infection in adult Nigerian patients undergoing posterior spinal surgery

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Background: Postoperative spinal surgical site infection is a potentially frightful complication of posterior spinal surgery, unfortunately, it is quite a common complication. Posterior spinal surgeries could cause significant blood loss requiring blood transfusion. Though blood transfusion is an important common practice used in optimizing patient's clinical condition when indicated, there is skepticism that it could be a risk factor for surgical site infection which is a dreaded complication of spinal surgery. Transfusion related immunomodulation have been postulated to be the cause in

Caucasians. There are a few studies in Western society that tried to determine association of surgical site infection and allogeneic blood transfusion. However, there are paucity of such studies in Nigeria, this informed the choice of the current study. **Objective:** To determine the incidence of postoperative surgical site infection and whether there is any association between perioperative allogeneic blood transfusion and postoperative surgical site infection in patients undergoing elective posterior spinal surgery in Nigeria. **Methodology:** It was a prospective observational cohort study carried out in Memfys Hospital Enugu. Consenting patients who were 18 years and above admitted for open posterior spinal surgery were recruited into the study and were grouped into two groups of "Transfused" (those who had perioperative blood transfusion) and "Not Transfused" (those who did not have blood transfusion). Both groups were assessed for occurrence of postoperative SSI based on CDC criteria for diagnosis of SSI. Patients were followed up for 30 days (in cases of no implant use) and 90 days (in cases of implant use) for evidence of SSI. Data were collated and analyzed using Statistical Package for Social Sciences (SPSS) version 23. **Result:** A total of 54 patients were recruited for this study, 27 subjects (50%) received blood transfusion and the other half did not receive blood transfusion. The overall mean age of the patients was 55.83 ± 12.85 years. Lumbar spine was the most frequent region operated (46.2%), followed by cervical region (38.8%). There was no significant association between the region of surgery and blood transfusion ($p = .635$). The most frequent number of units of blood transfused per patient was two units among the Transfused patients. The overall incidence of SSI was 9.3%. The rate of SSI in the group that received blood transfusion (Transfused group) was 5.5% and the rate was 3.7% for those patients that did not receive blood transfusion (Not transfused). The occurrence of postoperative SSI in patients undergoing spinal surgery was not influenced by perioperative allogeneic blood transfusion ($p = .639$). In addition, there was no association between volume of blood transfused and surgical site infection ($p = .843$) in patients who developed SSI. **Conclusion:** Surgical site infection is common following elective posterior spinal surgery. Perioperative allogeneic blood transfusion has no association with surgical site infection. The volume of blood transfused does not increase the risk of occurrence of surgical site infection in patients undergoing posterior spinal surgery. This could be due to racial differences in transfusion related immunomodulation.

Keywords

Surgical site infection, allogeneic blood transfusion, posterior spinal surgery.

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PI45: Efficacy of transpedicular decompression and posterior fixation in tubercular spondylodiscitis

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Introduction: Spinal tuberculosis is one of the major health issues of developing countries as it is associated with significant morbidity and mortality, if not treated timely. Spinal tuberculosis can **Results** into permanent neurological deficit, however timely decompression can improve the prognosis and functional outcome. We evaluated the efficacy of Transpedicular decompression with posterior fixation and functional recovery in patients of spinal tuberculosis with neurological deficit. **Material and Methods:** 42 patients (23 males and 13 female) with diagnosed spinal tuberculosis, average age 47.5 ± 3.4 years, presented with neurological deficits, were recruited in our study. All patients were managed by Transpedicular decompression, debridement and posterior instrumented fusion. All patients were followed up clinically, radiologically, hematological and neurologically. Patients were followed up initially at six weekly intervals for 4 months than at three monthly intervals to access long term complications. Neurological recovery is accessed in terms of Frankel grading. Functional outcome was accessed in terms of Visual Analog score (VAS) and Oswestry Disability Index score (ODI score). **Results:** All patients were followed for a minimum of 32 months. There was significant improvement in VAS score from pre-operatively 9.4 to 1.7 at final follow-up ($P < .001$). There was significant change in kyphotic angle between pre and post-operatively ($P < .05$). There was also significant improvement in ODI score at final follow up from 56.5 to 22 ($P < .05$). At final follow-up, out of 42 patients, 33 patients improved to grade E, 6 patients improved to grade D and 3 patients remains in Grade A. Two patient developed loosening of implant and deep infection, required removal of implant. **Conclusion:** We observed Transpedicular decompression is safe, effective and viable approach for management of spinal tuberculosis as it allows adequate decompression of neural cord while pedicular instrumentation permits stable spinal fixation and subsequent rapid rehabilitation.

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PI46: Anterior cervical debridement and fusion for cervical pyogenic spondylodiscitis: use of anterior cervical plating or not?

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Introduction: Due to concerns about bacterial seeding on the foreign material after instrumentations in pyogenic infections, the safety and efficacy of anterior cervical plating for cervical pyogenic spondylodiscitis (CPS) are still undetermined and

controversial. Little information is available about the safety and efficacy of anterior cervical plating to manage CPS. We sought to evaluate the safety and efficacy of anterior cervical plating in anterior cervical debridement and fusion (ACDF) for patients with CPS. **Material and Methods:** Twenty-three patients who underwent ACDF with ($n = 12$) or without ($n = 11$) plating for CPS were included. The mean age was 62.6 years. Medical records were reviewed and radiological parameters including segmental height, segmental angle, C2-C7 angle, and fusion status were analyzed. The mean follow-up period after surgery was 21.3 months. **Results:** After ACDF with plating, segmental height, segmental angle, and C2-C7 angle were significantly improved compared with preoperative conditions and remained well-maintained at the last follow-up. After ACDF without plating, three radiological parameters were also initially improved compared with preoperative condition, but significantly deteriorated to preoperative levels at the time of the last follow-up. The fusion rate was higher in the ACDF with plating group compared with the ACDF without plating group (9.9% vs. 63.6%; $P < .01$). One patient who received ACDF with plating and four patients who received ACDF without plating underwent revision surgery due to nonunion or bone graft dislodgement. No recurrence of pyogenic spondylodiscitis occurred in either group. **Conclusion:** ACDF with plating showed better surgical outcomes compared with ACDF without plating for CPS. We recommend the use of anterior cervical plating, which can provide biomechanical stability, for better healing of CPS. To our knowledge, this is the largest surgical case series of CPS.

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PI47: Cryptococcal osteomyelitis of the thoracic spine in an immunocompetent patient

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Introduction: Vertebral cryptococcosis is very rare. It defines immunodepression. It occurs infrequently in immunocompetent patients. Bone involvement is extremely rare, reported in 10% of cases as part of a systemic infection. **Material and Methods:** We report an unusual case of 53 years old woman, diabetic, who has spondylitis T8 T9 complicated with spinal cord compression and incomplete paraplegia. The diagnosis was made on the basis of radiological and parasitological findings after CT-guided needle aspiration biopsy. The patient was treated by intravenous amphotericin B. The operation was performed with a posterior approach: First, posterior pedicle screw fixation was performed from th6 to T11. Then, we did

thoracic debridement th8 th9, and obtained intra-operative purulent tissue specimens for pathological examination and microbial culture. We performed corpectomy of 8th and 9th vertebral body. Anterior vertebral reconstruction was made with a Pyramesh titanium cage. **Results:** The early post operative outcome was good. On the right, the roots from L2 to S1 were rated 1. On the left, the roots L2 L3 were rated 1 and the roots from L4 to S1 were rated 3. At the 3-months follow-up, the neurological examination was normal. Unfortunately, the patient died 6 months later in the infectious disease department by a Covid-19 infection. **Conclusion:** Cryptococcus is a parasitic disease which mainly affects immunocompromised patients. It can infrequently be seen in immunocompetent patients. This can cause a delay in diagnosis. Treatment is medical and surgical in severe vertebral cryptococcus. Through this case, we want to present you this rare and severe disease. The prognosis depends especially on the precocity of diagnosis and treatment.

Medical Economics

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PI48: Characteristics of spine surgery performed at ambulatory surgical centers

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Introduction: The use of ambulatory surgical centers (ASCs) as site of care for outpatient spinal surgeries has grown in popularity over recent years for commercially insured patients. The aim of this study was to investigate trends in patient, surgeon, and billing characteristics of spinal surgeries performed in USA ASCs. **Material and Methods:** This was a retrospective cohort study of a large, claims database of patients with commercial insurance. Patients ≤ 65 years undergoing single-level ACDF, laminectomy, and microdiscectomy for degenerative pathologies at ambulatory surgical centers from 2013 – 2019 were identified. Patients with trauma, infection, or oncologic diagnoses were excluded. Study outcomes included patient age and sex, surgeon specialty, intraoperative neuromonitoring (IONM) utilization, out-of-network (OON) payment status, professional vs. facility fees, and net payment amounts for select services. Net payments were adjusted to 2019 dollars with the Bureau of Labor Statistics Consumer Price Index (CPI). Statistical significance was considered as $P < .05$. **Results:** In total, 4,565 patients undergoing single-level ACDF, 8,321 undergoing laminectomy, and 13,704 undergoing microdiscectomy at ASCs were identified. The mean age increased from 46.6 to 48.1. Over the study period, there was a shift in majority of spinal surgeries in the ASCs performed by neurosurgeons in

2013 to majority being performed by orthopaedic spine surgeons by 2019. Overall, IONM was utilized in 11.5% cases. The use of IONM increased significantly over the study period for ACDF and microdiscectomy. The highest proportion of OON billing was from the neurologist associated with neuromonitoring (63.1% of all neurology bills were OON claims). **Conclusion:** Over the past decade, there have been significant shifts in patient, surgeon and billing characteristics for spinal surgeries performed in the ASC setting. Among commercially-insured patients undergoing spinal surgery at ASCs, the age of patients and the proportion of surgeries with orthopaedic surgeons (vs. neurosurgeons) significantly increased from 2013 – 2019. Utilization of IONM increased significantly for ACDF and microdiscectomy over the same period. Additionally, a surprisingly high proportion of neurologists' fees were OON, potentially contributing to surprise billing. An understanding of these trends is important for population health planning as spinal surgery continues to be increasingly performed at the outpatient setting.

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PI49: Out-of-pocket costs in spine surgery among privately-insured patients < 65 years-old

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Introduction: Out-of-pocket (OOP) costs have a significant impact on healthcare consumption. Relatively little is known regarding OOP costs for inpatient spine surgery. Understanding these relationships is essential for determining the financial barriers that could limit accessibility to spine care for many patients. **Material and Methods:** This study utilized a private commercial insurance database of patients < 65 years-old from 2014 – 2019. Patients undergoing single-level anterior cervical discectomy and fusion (ACDF) and single-level posterior lumbar fusion (PLF) were identified, and those with traumatic, infectious, or malignant etiologies were excluded. Only patients with non-capitated insurance plans and continuous coverage from 180 days pre- to 30 days post-operatively were included. OOP costs were calculated as the sum of deductible payments, co-payments, and co-insurance. Monetary data were adjusted to 2019 dollars using the Consumer Price Index. General linear regression, Wilcoxon-Mann-Whitney, and Kruskal-Wallis tests were utilized, as appropriate. **Results:** In total, 10,225 single-level ACDF and 28,841 single-level PLF patients were analyzed. The vast majority of patients for each procedure had preferred provider organization (PPO) insurance (ACDF 7.3%, PLF 66.9%), followed by consumer-driven health plan (CDHP) insurance (ACDF 9.8%, PLF 12.3%). The mean OOP costs by

procedure were: ACDF \$3,180 (SD 2,495) and PLF \$3,166 (SD 2,529). Total OOP costs increased significantly from 2014 – 2019 for both procedures ($P < .0001$). The ratio of OOP costs to total net payments by insurance remained constant from 2014 – 2019 for ACDF and PLF (both $p > .2$).

Conclusion: Among commercially-insured patients that underwent spine surgery, OOP costs significantly increased while the ratio of OOP costs to net payments remained constant from 2014 to 2019. Patients with HDHPs had the highest OOP costs. Our findings suggests that, although bearing increasing OOP costs, patients undergoing spine surgeries have been paying a constant proportion of their overall cost of care. This differs from reports in other surgical specialties where patients are taking on an increasingly greater proportion of their overall healthcare costs. Our findings may also help spine surgeons provide OOP cost estimates of common spine operations to their patients and comply with future mandates enforcing price transparency.

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P150: Economic performance of oblique lateral lumbar interbody fusion (OLLIF) with a focus on hospital throughput efficiency

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Introduction: The standard treatment for lower back pain, interbody fusion, in an invasive procedure that requires stripping the muscles and soft tissue (TLIF). This leads to increased blood loss and a long recovery time. However, during the TLIF procedure, muscles are detached and denervated which may cause significant morbidity. To address these issues, minimally invasive (MI) TLIF was developed. While MI TLIF has been shown to decrease blood loss and complication rates relative to open TLIF, surgery times and long-term outcomes have been reported to be similar. Oblique posterior lateral lumbar fusion (OLLIF) is a surgical procedure designed for a minimally invasive spinal fusion. The OLLIF procedure allows for fusion of the lumbar spine through a single 10-15 mm incision, with faster surgery times and easier approach than any previous technique. This procedure is normally performed for patients that require a spinal fusion but do not want the recovery time required in a traditional spinal fusion surgery. **Material and Methods:** Anesthesia/surgery times and blood loss were recorded for all patients by clinic staff and entered into the EMR database immediately after surgery. Because no suction is used in OLLIF procedures, blood loss for the OLLIF group was measured by weighing sponges and subtracting dry weight. To monetize the cost per minute for an operating room (OR) per case and for an average hospital day, a published reference for this amount was

identified in the medical literature and adjusted by using consumer price index for medical costs. These values were reported both in aggregate and stratified based on the number of levels they had addressed at the time of their surgery (one, two, three or four). Mann-Whitney U-tests were utilized to test the null hypothesis that the OLLIF and TLIF groups have the same or identical mean distributions for age, BMI, blood loss, and the uncensored time duration variables. All data analyses were performed using SPSS (IBM SPSS Statistics for Windows, Version 22.. Armonk, NY: IBM Corp.). **Results:** Overall, across all surgeries studied, LOS for OLLIF surgeries was 58.5% of that seen with TLIF surgeries (3.1 vs. 5.3 days). The trend of shorter LOS for OLLIF surgeries remained consistent when surgeries were stratified and matched for the same number of levels involved (2.6 vs. 4.2 for one level, 3.2 vs. 5.8 for two levels, 3.2 vs. 4.3 for three levels, and 4.6 vs. 6.7 for four levels). Overall, when LOS was converted to inpatient operating costs of the hospital, the difference in cost of surgical admission was \$6,701 for OLLIF vs. \$11,583 for TLIF. **Conclusion:** The cost reductions and faster recovery times associated with the OLLIF procedure make it an appealing alternative to the traditional open fusions available for patient and insurance providers. The reduction in the use of these key hospital resources suggests that hospitals that are constrained by OR or hospital bed availability may be able to achieve greater throughput efficiency by increasing the overall percentage of patients receiving the OLLIF surgery.

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P151: Disparities in elective spine surgery for Medicaid beneficiaries: a systematic review

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Introduction: With the Medicaid expansion being one of the major provisions of the Affordable Care Act, the number of patients under Medicaid is higher than ever. Nonetheless, Medicaid beneficiaries have been shown to be disadvantaged in healthcare access and outcomes, particularly within surgical specialties. Understanding and mitigating these inequities is critical for the ability of spine surgeons to provide better care for their patients. We sought to synthesize the literature investigating the disparities that Medicaid patients sustain with regards to two types of elective spine surgery, lumbar fusion (LF) and anterior cervical discectomy and fusion (ACDF). **Material and Methods:** Our review was constructed in accordance with Preferred Reporting Items and Meta-analyses (PRISMA) guidelines and protocol. We systematically searched PubMed, Embase, Scopus, CINAHL, and Web of Science databases. We

included studies comparing Medicaid beneficiaries to other payer categories with regards to rates of LF and ACDF, costs/reimbursement, and health outcomes. Two independent reviewers performed title and abstract screening followed by full-text review. In both cases, a third reviewer served as an arbitrator in cases of disagreement. Additionally, references cited by included articles were also screened for inclusion. The two primary reviewers utilized the methodological index for non-randomized studies (MINORS) criteria to evaluate the quality of included studies. **Results:** A total of 573 articles were assessed. Twenty-five articles were included in the analysis. All articles were relatively recent with year of publication ranging from 2016 to 2021. MINORS scores ranged from 18 to 22, indicating moderate to good quality of all studies. We found that the overwhelming majority of research detected significant disadvantages associated with Medicaid insurance. Medicaid was strongly associated with decreased access to LF and ACDF, lower reimbursement rates, and worse health outcomes compared to other insurance types. These findings were replicated in large database studies, multicenter studies, and single institution studies. Worse health outcomes included prolonged length of stay, lower satisfaction and outcome scores, higher pain scores, and higher odds of readmission, emergency department visits, surgical site infections, prolonged opioid use, and reintubation. **Conclusion:** In adult patients undergoing elective spine surgery, Medicaid insurance is associated with wide disparities with regards to access to care and health outcomes. The decreased access to healthcare and the lower reimbursement rates we found highlight the reluctance of healthcare systems to increase Medicaid coverage. Additionally, the worse health outcomes indicate the need for efforts focused on identifying causes and interventions for disparities in this vulnerable population. With the increasing importance of spine surgery for the ageing population, our findings warrant close examination of the roots of inequities in spine surgery to produce interventions that can ameliorate them.

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P152: Increasing number of vertebral segment correction does not correlate with relative value units in pediatric spinal deformity

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Introduction: Physician reimbursement is based on relative value units (RVU). There is limited data on the application of RVU's to the pediatric spine population, especially from large databases in comparison to smaller, single-institution reports. The purpose of this study was to investigate and compare relative value units (RVUs)/min between posterior segmental instrumentation

(PSI) of ≤ 6 , 7-12, & ≥ 13 vertebral segments in pediatric spinal deformity surgery and perform an annual cost difference analysis. **Material and Methods:** We performed a retrospective cohort study involving pediatric patients who underwent surgical correction of spinal deformity between 2013 and 2019 and were registered in the NSQIP-Pediatric database for posterior segmental instrumentation of ≤ 6 , 7-12, ≥ 13 vertebral segments using the procedural CPT codes of 22800, 22802, & 22804 respectively. A total of 27,652 patients registered in the American College of Surgeons National Quality Improvement (NSQIP) Pediatric Database who underwent posterior arthrodesis for spinal deformity were included. Outcome measures included mean operative times, RVUs, RVUs/min, annual cost differences among posterior segmental instrumentation of ≤ 6 , 7-12, ≥ 13 vertebral segments. The RVU-to-dollar conversion factor was provided by the U.S. Centers for Medicare & Medicaid Services (CMS), and RVU dollar valuations were calculated. Annual cost difference was based on a standard 10 hour work day with 160 operative days per year (365 total yearly days minus 14 days of vacation, 5 federal holidays, & the remaining one-third of time for non-operative days). **Results:** For PSI of ≤ 6 segments, the average age was 11 years old, 63.1% female, BMI 2.1, and 12.2% ASA 1. For 7-12 segments, the average age was 14 years old, 74.8% female, BMI 22.6, and 14.2% ASA 1. For ≥ 13 segments, the average age was 14 years old, 62.8% female, BMI 21.8, and 1.2% ASA. The RVU per minute for posterior segmental instrumentation of ≤ 6 , 7-12, and ≥ 13 segments were .096, from a mean operative time of 24.65 minutes, .137, from a mean operative time of 264.14 minutes, & .129, from a mean operative time of 33.75 minutes, respectively. Based on mean operative times and a standard ten hour work day, the amount per day was determined to be \$2,496 for ≤ 6 segments, \$2,606.91 for 7-12 segments, and \$1,528.28 for ≥ 13 segments based on three ≤ 6 segments, two 7-12 segments, and one ≥ 13 segment instrumentation cases per day. The annual cost differences between posterior instrumentation for ≤ 6 segments less than 7-12 segments was +\$17,634, 7-12 segments less than ≥ 13 segments was +\$154,946, & ≤ 6 segments less than ≥ 13 segments was +\$172,581. **Conclusion:** Despite increasing complexity and mean operative times for increasing vertebral segments addressed in the surgical correction of pediatric spinal deformity, this current study found that the increase in RVUs were not proportional to the increase in operative time or number of segments corrected. Discrepancies in RVU proportion were previously demonstrated in the adult spinal deformity population, and this study further supports an adjustment or redistribution of relative value units for these procedures to offset the disproportionate rates and complexity associated with these cases.

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P153: Racial disparities in spine surgery: a systematic review

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Study Design: Systematic Review. **Objectives:** To synthesize previous studies evaluating racial disparities in spine surgery. **Summary of Background Data:** Racial disparities in access, outcomes, and quality of healthcare have been increasingly substantiated by research over the last few decades. Inequities based on race and ethnicity can be found across multiple surgical subspecialties. Despite increased efforts to mitigate racial bias, disparities persist, including in the field of spine surgery. **Methods:** We queried PubMed, Embase, Cochrane Library, and Web of Science for literature on racial disparities in spine surgery. Our review was constructed in accordance with Preferred Reporting Items and Meta-analyses (PRISMA) guidelines and protocol. The main outcome measures were the occurrence of racial disparities in post-operative outcomes, mortality, surgical management, readmissions, and length of stay. **Results:** A total of 1,753 publications were assessed. Twenty-two articles met inclusion criteria. Seventeen studies compared Caucasians (CAs) and African Americans (AAs) groups; fourteen studies reported adverse outcomes for AAs. When compared to CAs, AA patients had higher odds of post-operative complications including mortality, cerebrospinal fluid leak, nervous system complications, bleeding, infection, in-hospital complications, adverse discharge disposition, and delay in diagnosis. Further, AAs were found to have increased odds of readmission and longer length of stay. Finally, AAs were found to have higher odds of nonoperative treatment for spinal cord injury, were more likely to undergo posterior approach in the treatment of cervical spondylotic myelopathy, and were less likely to receive cervical disc arthroplasty compared to CAs for similar indications. **Conclusions:** This systematic review of spine literature found that when compared to CA patients, AA patients had worse health outcomes. Further investigation of root causes of these racial disparities in spine surgery is warranted.

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P154: matter, Words matter. Grading the quality culture of surgeons using AI on a perioperative communication platform

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Introduction: Healthcare systems are in a constant struggle to increase the quality of care to their patients. Principles like blameless culture, constructive feedback and teamwork are key to maintain a culture that promotes quality. However, there is no formal method to evaluate the quality culture of the providers. In

this study we suggest a novel score to grade the quality culture of a surgical team based on the communication between providers. We then grade the team according to communication data captured in a perioperative collaboration platform and compare a manual grading to a machine learning grading algorithm. **Methods:** We introduce the Quality Culture Score, a metric based on the quality of communication in a team. We weighted the frequency and sentiment of communication between neurosurgical faculty and residents captured in a perioperative communication platform. Three independent reviewers manually rated the positivity of pre- and post-operative text exchange in 680 neurosurgery cases on a scale of 0 to 3, with 0 representing negative sentiment, 1 neutral, 2 positive, and 3 very positive, and measured inter-rater reliability. We developed a machine learning algorithm to rate the sentiment using natural language processing. Sentences were divided into one or two word chunks. Rarer words influenced the sentiment scores more than common words. We then trained the algorithm on 80% of the data and evaluated on 20% by comparing it to the manual scores as a gold standard. **Results:** We used F1-score to measure the accuracy of our machine learning algorithm. The score is a measure of precision (positive predictive value) and recall (sensitivity). All reported values had p value $< .001$. Our algorithm had an overall sensitivity of .68 (SD .02), positive predictive value of .70 (SD .02), with F1-score .68 (SD .01). The algorithm performed with higher sensitivity for negative sentiment scores (.90, SD .03, $P < .001$) vs. very positive sentiment scores (.51, SD .02, $P < .001$). Similarly, the positive predictive value of our custom word algorithm was highest for negative sentiment scores (.94, SD .01, $P < .001$). Overall, the accuracy was highest for low sentiment scores (F1 .92, SD .02, $P < .001$), and lower for very positive scores (F1 .51, SD .05, $P < .001$). **Conclusion:** Quality of care, beyond standardized processes and ideas, is above all determined by the quality culture of an institution, a team and/or an individual provider. We present a novel method to evaluate the quality culture of surgeons based on the sentiment in the communication between residents and faculty, as captured by a perioperative communication platform. We harness AI technology to enable automation of this evaluation. We believe that if continued in this direction, by capturing and automatically analyzing this communication, we can not only evaluate the culture, but improve it, and therefore improve the quality of care for patients.

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P155: Early postoperative analgesia with epidural bupivacaine and fentanyl versus intravenous paracetamol and tramadol in posterior spinal surgery for lumbar degenerative spine disease in a resource poor setting

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Background: Postoperative pain is a distressing and disabling feature following posterior lumbar spinal surgery. Lumbar spine degenerative disease is a common disease condition in humans and is seen more with ageing. Adequacy of perioperative pain management remains challenging despite varying regimen of postoperative analgesia. More than two-thirds of people undergoing surgery suffer significant postoperative pain. Poor pain control could negatively affect the surgical outcome particularly in posterior lumbar spine surgery. Therefore, adequate postoperative pain management is essential in the care of spinal surgical patient. Unfortunately, there is lack of standard postoperative pain management protocol after posterior lumbar spine surgery in many centers. Choice of medications and methods of administration of the drugs frequently depends on availability, the surgical teams' decision and cost implication especially in a resource poor setting. In the Southeast Nigeria, IV paracetamol with tramadol regimen and epidural bupivacaine + fentanyl are both easily available. Different centers may use different modifications of the modalities but there is paucity of data to compare the efficacy as well as patient's satisfaction using the different analgesic regimen so as to guide in making inform decision by the surgeons. **Objective:** This study aims to compare the efficacy and the degree of patient's satisfaction of analgesia of postoperative intravenous paracetamol and tramadol versus epidural bupivacaine with fentanyl following posterior lumbar spinal surgery for lumbar degenerative disease. **Methods:** This was a single-center, 2-arm, prospective randomized study that compared the efficacy of the postoperative pain control among patients in the two groups (epidural bupivacaine + fentanyl and systemic intravenous analgesic with tramadol + paracetamol). Postoperative pain VAS score was obtained at 12 hours, 24 hours and 48 hours. Patient level of satisfaction was also obtained and compared between both analgesic regimens. The study was carried out among adult patients undergoing elective lumbar spine surgery for lumbar degenerative disease at Memfys Hospital Enugu. **Results:** 21 patients were randomized into Group A (intravenous tramadol and paracetamol) and 20 patients were randomized into Group B (epidural fentanyl with bupivacaine). Both postoperative analgesic regimens were effective in pain control and patients were satisfied with the pain control. The result showed no difference between the groups on the following measures: efficacy of the postoperative analgesic regimens ($p = .789$), overall patient-satisfaction ($p = .664$) with postoperative pain control and side effects of the analgesic regimens. The 48-hour postoperative analgesia cost ratio of a patient in Group A to a patient in Group B was 1.8:1. **Conclusion:** Both postoperative analgesic regimens (intravenous tramadol with paracetamol and epidural fentanyl with bupivacaine) are equally efficacious and none is superiority to the other. Both postoperative analgesic regimens also provided good patient satisfaction equally. Therefore, patients and surgeons could select either postoperative analgesic regimen for posterior

lumbar spine surgery as both regimens are equally comparable in efficacy, patient satisfaction and safety, however, epidural (fentanyl + bupivacaine) analgesia is more cost effective.

Keywords

paracetamol + tramadol, bupivacaine + fentanyl, postoperative analgesia, lumbar degenerative spine disease, lumbar surgery

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PI56: Optimizing spine surgery instrument trays to immediately increase efficiency and reduce costs in the operating room

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Objectives: Surgical tray configurations are rarely audited, which **Results** in an often overlooked source of perioperative inefficiency and unnecessary costs. The challenge in determining the ideal contents of a tray lies in the balance between clinical needs, costs, ease of batching, prevention of adverse clinical events and minimization of wear-and-tear. In our study, we developed a novel hybrid approach (HA) based on surveys and cost analyses to reduce the number of instruments on the Laminectomy Tray (LT) and the Basic Neurosurgery Tray (BNT). We compared the reduction in the number of instruments as well as cost savings from our approach to two approaches previously described in the literature: clinician-review (CR) and mathematical optimization (MO). **Methods:** Three approaches were tested: MO, CR, and HA. A MO was performed via the mathematical analysis of 25 observations of the use of a LT and BNT tray. For the CR and HA approaches, we interviewed 5 neurosurgeons and 3 orthopedic surgeons who performed a total of 5437 spine cases, requiring the use of the LT and BNT, from April 1st, 2017 to February 15th, 2021, at Sunnybrook Health Sciences Centre. In the CR approach, surgeons suggested which surgical instruments should be removed. The HA approach was performed via a structured survey of surgeon's estimated instrument usage, followed by a cost-based inflation point analysis. **Results:** The MO, CR and HA resulted in a total instrument reduction of 38%, 41% and 35%, respectively. Similarly, the total cost savings per annum were \$44,417.60, \$50,211.20, and \$46,348.80, respectively. **Conclusions:** While hospitals continue to examine perioperative services for potential inefficiencies, surgical inventory will be increasingly scrutinized. Despite MO being the most accurate methodology to do so, our Results suggest that savings were similar across all three methods. CR and HA are significantly less laborious and thus are viable alternatives.

Minimally Invasive Surgery

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P157: Modified Delphi research on building Chinese experts' consensus on lateral lumbar interbody fusion

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Introduction: The objective of this study was to introduce the modified Delphi study on establishing the consensus of Chinese experts on the application of lateral lumbar interbody fusion (LLIF). **Material and Methods:** We searched several Chinese and English databases about LLIF technology application of related literature, and we referred to the clinical data and specifications of the application of LLIF in China. A draft was made containing summary, preoperative evaluation, application at the lumbar spinal stenosis, lumbar disc herniation, lumbar spondylolisthesis, adult degenerative scoliosis, postoperative adjacent segmental degeneration, and revision surgery; contraindications, complications, and postoperative follow-up evaluation of LLIF including 11 aspects and 119 questions. Members of Chinese Study Group for Lateral Lumbar Spine Surgery was selected to collect expert feedback using the modified Delphi method, and the contents in the draft were screened and modified. Three expert evaluations were organized, and the percentage of expert approval was set as $\geq 70\%$. **Results:** A total of 77 experts formed an expert group, and the number of questionnaires collected was 63 (81.8%), 59 (75.3%) and 62 (8.5%) in the three rounds, after which consensus was reached on 73.9.0% of the issues. **Conclusion:** The expert consensus developed by using the modified Delphi investigation method is strongly representative, which provides a reference for the clinical standard development and popularization of LLIF.

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P158: Expert consensus on clinical application of lateral lumbar interbody fusion: Results from a modified Delphi study

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Introduction: The objective of this study was to establish expert consensus on the application of lateral lumbar interbody fusion (LLIF) by using the modified Delphi study. **Material and Methods:** From June 2019 to March 2020, Members of the Chinese Study Group for Lateral Lumbar

Spine Surgery were selected to collect expert feedback using the modified Delphi method where 65 spine surgeons from all over China agreed to participate. Four rounds were performed: one face-to-face meeting and three subsequent survey rounds. The consensus was achieved with $\geq 7.0\%$ agreement for each question. The recommendation of grade A was defined as $\geq 9.0\%$ of the agreement for each question. The recommendation of grade B was defined as 8.0-89.9% of the agreement for each question. The recommendation of grade C was defined as 7.0-79.9% of the agreement for each question. **Results:** A total of 65 experts formed a panelist group, and the number of questionnaires collected was 63, 59, and 62 in the three rounds. In total, 5 sections, 71 questions, and 382 items achieved consensus after the Delphi rounds including summary; preoperative evaluation; application at the lumbar spinal stenosis, lumbar disc herniation, lumbar spondylolisthesis, adult degenerative scoliosis, postoperative adjacent segmental degeneration, and revision surgery; complications; and postoperative follow-up evaluation of LLIF. **Conclusion:** The modified Delphi method was utilized to ascertain an expert consensus from the Chinese Study Group for Lateral Lumbar Spine Surgery to inform clinical decision-making in the application of LLIF. The salient grade A recommendations of the survey are enumerated.

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P159: Why operate a 360 degrees percutaneous lumbar arthrodesis? Analysis of 35 cases

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Introduction: Spinal fusion consists of the fusion of two or more vertebrae. It is a surgical option for many spinal diseases. These include spinal instability, isthmic or degenerative spondylolisthesis, facet arthropathy, postoperative instability, recurrence of a herniated disc, and other segmental instabilities of the spine. Today, 360° fusion is accepted as the best form of spinal fusion. It consists of the use of transpedicular screws with bars and an interbody cage with a bone graft. Percutaneous fusion through the muscle prevents lesions in the posterior paravertebral muscles. That protects the supra and underlying levels of the merger. The integrity of the adjacent faceted articular anatomy is also protected. **Material and Methods:** We analyzed the mean postsurgical quality of the paravertebral muscles. We include multifidus, longissimus, iliocostal, quadratus lumbar, and dorsal muscles. And the quality and integrity of the faceted joints. **Results:** We included 35 cases of percutaneous arthrodesis. We compared

thirty-five other patients with conventional approaches. All of them are performed by the same medical team. **Conclusion:** The effectiveness of both techniques is similar. The multifid muscles fibrosis is less evident in the percutaneous technique. There is no clinical significance between them.

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PI60: Indications and contraindications for endoscopic video discectomy. Analysis of 160 cases

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Introduction: With technological advances, we can do surgeries with a minimal incision in the skin. We can visualize the structures and tissues through endoscopic video vision. In this way, the size of the accesses and the surgical times are reduced. Bleeding rate, infection rate, and operating room usage time also decrease. All this brings a benefit to the post-operative comfort of patients. The enthusiasm of surgeons leads to an over-indication. That affects the rates of good Results. **Material and Methods:** In this work, we analyze 160 cases operated by the same medical team. The data collected were sex, age, pre-surgical symptoms, time of evolution, intensity, and levels affected. They were related to the evolution of 3, 6, and 12 months. Moreover, patients who were reoperated with arthrodesis. **Results:** The Results show a significant improvement of the above symptoms. **Conclusion:** It is a recommended technique. It has a low rate of complications, good clinical Results, and long-term permanence the result.

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PI61: Spondylolisthesis with idiopathic sarcopenia and MIS TLIF: case study and literature review

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Introduction: Sarcopenia is a muscle-wasting disorder common among older individuals. The disease has been associated with adverse perioperative and postoperative outcomes following spinal surgery. The combination of this muscle-wasting disease and spondylolisthesis, in addition to how we approached the case surgically, makes this case unique and

provides a method to treat this ignored patient population more effectively. **Material and Methods:** In this case study, we examine a patient with sarcopenia who needed transforaminal lumbar interbody fusion surgery for his grade 1 L4-5 spondylolisthesis. He is a 76-year-old man who consulted a neurosurgeon for back pain and left lower extremity paresthesia. Magnetic Resonance Imaging (MRI) showed degenerative disc disease with bilateral facet effusion in multiple levels of the lumbar spine as well as broad disc bulge in L5-S1. In addition, a muscular biopsy in the lumbar spine revealed an absence of muscle. Minimally invasive surgery for transforaminal lumbar interbody fusion (MIS TLIF) was performed as the most optimal way for this condition. **Results:** The patient experienced a massive decline in his VAS score to 0/10 in a short period and had a relatively transient wound healing process. Anterior Posterior x-ray of the lumbar spine shows dextroscoliosis; L4/5 TLIF instrumentation with posterior migration stable Postoperatively, the patient was provided guidance regarding his nutrition and exercise to maximize the treatment. **Conclusion:** This case illustrates the necessity of the Minimal Invasive Surgery (MIS) approach to minimize complications and tissue trauma of patients with sarcopenia and spondylolisthesis undergoing lumbar spinal surgery.

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PI62: Remodeling of epidural fluid hematoma after uniportal lumbar endoscopic unilateral laminotomy with bilateral decompression: comparative clinical and radiological outcomes with minimum two years follow up

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Introduction: There is limited literature comparing the effect of uniportal lumbar endoscopic unilateral laminotomy with bilateral decompression complicated with postoperative hematoma to those without. **Material and Methods:** Preoperative, postoperative one day, six months and one year postoperative MRI evaluation was performed for patients with single level uniportal lumbar endoscopic unilateral laminotomy for bilateral decompression. Clinical visual analog scale, Oswestry Disability Index, McNab's criteria evaluation measured, preoperative, six months postoperative and final follow up with minimal follow up of 2 yrs. **Results:** 126 patients with single level single level uniportal lumbar endoscopic unilateral laminotomy for bilateral decompression were recruited with minimum follow up of 26 months. 34 hematoma (27.0%) was found on postoperative day one MRI. 31 (91.1%) of the them are asymptomatic. There was

significantly narrower spinal canal area in lower endplate at postoperative day one, 6 months and one year in the hematoma cohort (122.94 ± 3.17 , 117.76 ± 31.56 , 118.12 ± 34.04) mm² compared to non-hematoma (149.88 ± 42.31 , 138.28 ± 41.02 , 139.66 ± 41.47) mm², respectively, $P < .05$. There was significantly less postoperative spinal canal area improvement at postoperative day 1 and 6 months at upper end plate in hematoma cohort (39.69 ± 15.72 , 26.89 ± 16.58) compared to non-hematoma cohort (48.92 ± 21.36 , 35.1 ± 2.44), respectively, $P < .05$ as well as 1 in lower end plate on postoperative day in Hemoatoma (51.18 ± 24.69) compared to non-hematoma cohort (63.91 ± 27.92), $P < .05$. No significant difference in terms of improvement in spinal canal area at postoperative 1 year in both cohorts. Hematoma cohort had statistically significant more pain at one week postoperative visual analog scale ($3.32 \pm .68$) and Oswestry Disability Index (32.65 ± 5.56) compared to non-hematoma cohort of ($2.99 \pm .50$) and (3.02 ± 4.84) respectively, $P < .05$. No significant difference at final follow up VAS, ODI and MRI spinal canal area at 6 months and one year. **Conclusion:** Epidural fluid hematoma is a common early postoperative MRI finding with endoscopic decompression. There is a short duration of symptoms. Further expansion of the spinal canal area after fluid hematoma remodeled is a common end point. Conservative treatment is the treatment of choice for patients without neurological deficit.

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PI63: Cement augmented fenestrated screw vertebroplasty along with short segment fixation in osteoporotic thoracolumbar vertebral compression fracture: a hybrid MIS procedure

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Introduction: Osteoporotic Vertebral compression fracture occurs in approximately 20% of individuals over 70 years of age. A significant majority of fractures approx 60% to 75% occur around the thoracolumbar region. The fractures can result in persistent pain, inability to perform daily activities, and a marked decrease in the quality of life. Reduction of pain and stabilization of vertebrae and prevention of deformity are the goals of treatment in thoracolumbar vertebral compression fracture. **Material and Methods:** The purpose of this technical note is to demonstrate the usefulness of minimal invasive cement augmented screw vertebroplasty along with short segment fixation at junctional vertebral compression fracture and its intraoperative effectiveness in preventing devastating complications. **Results:** At junctional level through cement

augmented screw vertebroplasty we could achieve several parameters like anterior reconstruction through cement, stabilizing posterior tension band via short segment fixation, correction of local kyphotic deformity and prophylaxis for prevention of future adjacent segment Fractures in osteoporosis. **Conclusion:** The procedure of cement augmented screw vertebroplasty with short segment fixation as a hybrid procedure through minimal invasive spine approach can really achieve milestones particularly at junctional level VCF's and this technique as far as safety concerns, reduces venous leakage of cement significantly, and risk of complications can be nullified.

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PI64: Effect of pre-operative parameters on outcomes of lumbar microdiscectomy: a retrospective analysis

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Introduction: Lumbar Microdiscectomy is the most commonly performed spine surgery procedure with over 300,000 operations performed annually in the USA alone. Persistent pain or disability after lumbar spine surgery is experienced by between one in four and in one in eight patients, respectively. Recent studies have found that many predictive factors play a role in postsurgical outcomes. An up-to-date identification of these reliable predictors for postoperative clinical outcomes following this surgery would be invaluable to surgeons when deciding whether surgery is the appropriate course of treatment, at what point of time surgery should be advised and to counsel the patients and relatives for the same. **Material and Methods:** This retrospective cohort study involves 209 patients who had lumbar Herniated Discs and were operated for Lumbar Tubular Microdiscectomies at P.D. Hinduja Hospital and Research Centre, Mahim, Mumbai between the study Period of 2015 and 2018. We considered the following pre-operative variables: diabetes mellitus, hypertension, duration of symptoms, epidural injections taken, smoking, alcohol, BMI, age. Inclusion criteria: Patients of 18 yrs and above with lumbar disc herniation undergoing tubular microdiscectomies. Exclusion criteria: Follow-up period of less than 1 year, Signs of pre-existing spinal deformity, Patients undergoing microdiscectomy as a revision surgery. **Results:** On analyzing the Visual Analog Score (VAS leg and VAS back) across various age groups, gender, BMI, addiction, co-morbidities, pre-operative epidural steroid injection and physiotherapy, level of disc herniation it was found that there was no statistically

significant difference across these categories. But the difference in Oswestry Disability Index ODI score at all-time points showed that better outcome was seen in younger age group i.e. 18-30 years, male gender, non-smokers, disc herniations at L3-L4 level and patients with symptom duration less than 6 months. These **Results** were seen at all post operative time points. **Conclusion:** The findings of the present study will help the surgeon to properly counsel the patient and relatives with regards to the factors mentioned above mainly the time point at which conservative management should be ceased and surgical intervention should take over. Also, patients in the younger age group of 18-30 benefit more from micro-discectomies and should be guided towards the same. This will also allow the surgeon set more realistic expectations, to improve the outcomes and help in appropriate surgical decision making.

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PI 65: Physiologic decompression of lumbar spine stenosis through anatomic restoration using trans-Kambin oblique lateral posterior lumbar interbody fusion (OLLIF)

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Introduction: Lumbar spinal stenosis (LSS) is one of the most common indications for spinal surgery. Traditionally, decompression is achieved by removing bony and ligamentous structures through open surgery. However, recent studies have shown that symptomatic relief can be accomplished in many patients by increasing intervertebral and interpedicular height using fusion alone. In this study, we evaluate whether trans-Kambin oblique lateral lumbar interbody fusion (OLLIF) can effectively and safely relieve symptoms of LSS when an indication for fusion is present. **Material and Methods:** This is a retrospective single surgeon cohort study of 187 patients with LSS who underwent 189 OLLIF procedures between 2012 and August 2, 2019. Inclusion criteria for this study were age > 18 years with symptoms of LSS, including pain, sensory, and motor deficits, and an additional indication for fusion, which included spondylolisthesis, degenerative disk disease, disk herniation, or scoliosis. Exclusion criteria were the bony obstruction of the approach, osteogenic spinal canal stenosis, large facet hypertrophy, and listhesis grade II or greater. The primary outcome was a change in the Oswestry Disability Index (ODI) one year after surgery. Secondary outcomes were the resolution of radiculopathy at the first follow-up visit and one year after surgery, complication rates, surgery time, blood loss, and hospital stay. **Results:** ODI improved from 52% pre-op to 37% at the one-year follow-up. At the first follow-up, radiculopathy had resolved in 39% of patients, and 72% of

patients experienced improvement of 50% or greater. One year after surgery, radiculopathy had resolved in 52% of patients and 74% experienced improvement of 50% or greater. Single-level surgeries required 56.4 ± 21.5 minutes, with a mean hospital stay of 1.6 ± 2.4 days. Nerve irritation occurred in 12% of patients at the first postoperative follow-up and persisted in 6.8% of patients one year after surgery. There was one case each of persistent weakness at one year, infection, and cage subsidence. **Conclusion:** Trans-Kambin OLLIF delivers anatomic restoration of intradiscal and interpedicular distance, which Results in physiologic decompression of lumbar spinal stenosis in patients undergoing lumbar fusion for degenerative or herniated disk disease, spondylolisthesis, or scoliosis. Amongst patients with LSS, OLLIF Results in significant improvement of radiculopathy and patient-reported disability in the majority of patients with low rates of long-term complications. Unlike other minimally invasive surgery (MIS) fusions, OLLIF can be safely used from T12-S1.

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PI 66: Effect of body mass index on perioperative outcomes in minimally invasive oblique lateral lumbar interbody fusion versus open fusions: a multivariate analysis

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Introduction: Obesity is an increasing public health concern associated with increased perioperative complications and expense in lumbar spine fusions. While open and mini-open fusions such as transforaminal lumbar interbody fusion (TLIF) and minimally invasive TLIF (MIS-TLIF) are more challenging in obese patients, new MIS procedures like oblique lateral lumbar interbody fusion (OLLIF) may improve perioperative outcomes in obese patients relative to TLIF and MIS-TLIF. The purpose of this study is to determine the effects of obesity on perioperative outcomes in OLLIF, MIS-TLIF, and TLIF. Study design: This is a retrospective cohort study. Patient sample: We included patients who underwent OLLIF, MIS-TLIF, or TLIF on three or fewer spinal levels at a single Minnesota hospital after conservative therapy had failed. Indications included in this study were degenerative disc disease, spondylolisthesis, spondylosis, herniation, stenosis, and scoliosis. Outcome measures: We measured demographic information, body mass index (BMI), surgery time, blood loss, and hospital stay. **Material and Methods:** We performed summary statistics to compare perioperative outcomes in MIS-TLIF, OLLIF, and TLIF. We performed multivariate regression to determine the effects of BMI on perioperative outcomes controlling for demographics and number of levels on which surgeries were operated. **Results:**

OLLIF significantly reduces surgery time, blood loss, and hospital stay compared to MIS-TLIF, and TLIF for all levels. MIS-TLIF and TLIF do not differ significantly except for a slight reduction in hospital stay for two-level procedures. On multivariate analysis, a one-point increase in BMI increased surgery time by $.56 \pm .47$ minutes ($p = .24$) in the OLLIF group, by 2.8 ± 1.43 minutes ($p = .06$) in the MIS-TLIF group, and by $1.7 \pm .43$ minutes ($P < .001$) in the TLIF group. BMI has positive effects on blood loss for TLIF ($P < .001$) but not for OLLIF ($p = .68$) or MIS-TLIF ($p = .67$). BMI does not have significant effects on length of hospital stay for any procedure. **Conclusion:** Obesity is associated with increased surgery time and blood loss in TLIF and with increased surgery time in MIS-TLIF. Increased surgery time may be associated with increased perioperative complications and cost. In OLLIF, BMI does not affect perioperative outcomes. Therefore, OLLIF may reduce the disparity in outcomes and cost between obese and non-obese patients.

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P167: Minimally invasive direct thoracic interbody fusion (MIS-DTIF): technical notes of a single surgeon study

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Introduction: Minimally invasive direct thoracic interbody fusion (MIS-DTIF) is a new single surgeon procedure for fusion of the thoracic vertebrae below the scapula (T6/7) to the thoracolumbar junction. In this proof of concept study, we describe the surgical technique for MIS-DTIF and report our experience and the perioperative outcomes of the first four patients who underwent this procedure. **Material and Methods:** In this study we attempt to establish the safety and efficacy of MIS-DTIF. We have performed MIS-DTIF on six spinal levels in four patients with degenerative disk disease or disk herniation. We recorded surgery time, blood loss, fluoroscopy time, complications, and patient-reported pain. Throughout the MIS-DTIF procedure, the surgeon is aided by biplanar fluoroscopic imaging and electrophysiological monitoring. The surgeon approaches the spine with a series of gentle tissue dilations and inserts a working tube that establishes a direct connection from the outside of the skin to the disk space. Through this working tube, the surgeon performs a discectomy and inserts an interbody graft or cage. The procedure is completed with minimally invasive (MI) posterior pedicle screw fixation. **Results:** For the single level patients the mean blood loss was 90 ml, surgery time 43 minutes, fluoroscopy time 293 seconds, and hospital stay two days. For the two-level surgeries, the mean blood loss was 27 ml, surgery time 61 minutes, fluoroscopy time 321 seconds, and hospital stay three days. We did not encounter any clinically

significant complications. Thirty days post-surgery, the patients reported a statistically significant reduction of 5.3 points on a 10-point sliding pain scale. **Conclusion:** MIS-DTIF with pedicle screw fixation is a safe and clinically effective procedure for fusions of the thoracic spine. The procedure is technically straightforward and overcomes many of the limitations of the current minimally invasive (MI) approaches to the thoracic spine. MIS-DTIF has the potential to improve patient outcomes and reduce costs relative to the current standard of care. We are currently expanding this study to a larger cohort and recording long term outcomes and costs.

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P168: Clinical outcomes of chemonucleolysis with condoliase versus microendoscopic lumbar discectomy in patients with lumbar disc herniation

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Introduction: Condoliase, which was launched as a new drug for chemonucleolysis in 2018, is a minimally invasive intermediate treatment for lumbar disc herniation (LDH) in Japan. Since condoliase has high substrate specificity for chondroitin sulfate and hyaluronic acid and lacks protease activity, it can be used safely compared to chymopapain. Currently, there are no serious complications associated with chemonucleolysis with condoliase. However, it is unclear whether this treatment will replace surgery because the indications and effects of condoliase remain unclear. We compared the Results of chemonucleolysis with condoliase and microendoscopic lumbar discectomy (MED) in patients with LDH. **Material and Methods:** The exclusion criteria for chemonucleolysis with condoliase were as follows: 1) muscle weakness with manual muscle testing scores ≤ 3 , 2) sequestration type of LDH, and 3) age < 20 years. Twenty-one patients who underwent chemonucleolysis with condoliase for LDH between April 2019 and March 2021 were included (condoliase group). During the same period, 45 patients who underwent MED according to the same criteria served as controls (MED group). The treatment was selected according to the patient's choice after he/she was informed of the risks and benefits of each treatment. MED was only performed as a surgical treatment for LDH. Treatment Results were compared on a 100-mm visual analog scale (VAS) 1 week and 3 months after treatment. The follow-up rate 3 months after treatment was 100% in both groups. **Results:** There were no intergroup differences in the age, sex, body mass index, and duration of symptoms before treatment. Before treatment, VAS scores for leg pain and the Oswestry Disability Index (ODI) were significantly higher in the MED group than in the condoliase group (VAS: 82.1 mm vs. 72.1 mm, $p = .04$; ODI: 49.2% vs.

35.5%, $P < .01$). There were no treatment-related complications in either group. No patients in the condoliase group underwent surgery during the follow-up period. In both groups, the VAS score for leg pain significantly decreased 1 week and 3 months after treatment. The amount of change in the VAS score was significantly larger in the MED group than in the condoliase group (condoliase vs. MED: -25.1 ± 25.4 vs. -65.6 ± 27.3 at 1 week, $P < .01$; -39.0 ± 28.3 vs. -71.1 ± 22.2 at 3 months, $P < .01$). The proportions of patients who had VAS scores corresponding to leg pain < 20 mm were 24% in the condoliase group and 76% in the MED group 1 week after treatment ($P < .01$) and 52.4% in the condoliase group and 82% in the MED group 3 months after treatment ($p = .02$). **Conclusion:** Condoliase works slowly and its therapeutic effect in the current indications varies widely: approximately half of the patients in this study presented with VAS scores corresponding to leg pain < 20 mm at 3 months. However, there were some cases with therapeutic effects from 1 week after initiation even in the condoliase group. If the indications could be more strictly determined, condoliase would be a treatment method comparable to surgery.

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PI69: Implant related complications and revision surgeries following minimally invasive antepsoas (ATP) long spinal fusion combined with percutaneous spinopelvic fixation

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Introduction: In long spinal fusion constructs, pelvic fixation is protective against lumbosacral junctional failures. Similarly, the placement of anterior column support at L5-S1 and L4-5 is considered preventive. This study retrospectively evaluates patients, who underwent long spinal fusion (4 or more vertebrae) using the minimally invasive antepsoas (MIS-ATP) approach combined with posterior percutaneous spinopelvic fixation, for mechanical complications. **Material and Methods:** After Institutional Review Board approval, we retrospectively reviewed 128 patients who underwent long spinopelvic fusions between 2008 and 2018 at a single institution. The collected demographic, clinical, and surgical information included: age, gender, smoking status, follow-up duration (years), preoperative diagnosis, number of fused levels (anterior and posterior), number of instrumented levels, and associated complications. The latter include surgical site infections, hardware complications (related to iliac screws,

pedicle screws, longitudinal rods), pseudarthrosis, adjacent segment disease, and revision surgery. **Results:** All 128 patients [Average age: 65.8 years, 38 (30%) Males, Average BMI: 31.5 (68 patients obese; 53.1%), mean follow-up: 2.5 years] included in the study underwent spinosacral fusions using the ATP approach combined with posterior percutaneous fixation. Of the studied patients, 54 (42.2%) never smoked, 43 (33.6%) were former smokers, and 31 patients (24.2%) were active smokers. The average number of instrumented levels was 8.6 per individual. The most common preoperative diagnosis was degenerative scoliosis (101 patients; 78.9%), 123 patients underwent a primary surgery, and 5 patients had revision ATP-PPF surgery for a prior failed back surgery. The most commonly fused levels were: T12-S1 Anterior / T10-S1 Posterior (54.6%). 41 patients (32%) experienced a total of 44 complications. Of these, 27 patients (21.1%) were smokers (active or former), 23 were obese (Odds Ratio: 1.2, $p = .6$), and 27 (21.1%) required revision surgeries. Three patients developed pseudarthrosis (2.3%). Of the 27 patients who required revision surgery, 20 were smokers (Odds Ratio: 2.5, $p = .06$). **Conclusion:** As an adjunct to the MIS-ATP technique in long spinopelvic fusions, percutaneous spinopelvic fixation proved to be safe and protective against lumbosacral junctional failures, loss of sagittal balance, and pseudarthrosis.

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PI70: Vascular and visceral complications associated with the minimally invasive antepsoas (MIS-ATP) approach for lumbar and lumbosacral fusion: a 13-year follow-up study

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Introduction: Recognized hazards to lumbosacral spinal fusion via anterior, lateral, and oblique approaches include injuries to adjacent vascular and visceral structures. This study aims to review the safety profile of the (MIS-ATP) approach which, through a single incision, allows a generous retroperitoneal access to the spine between T12-S1 with direct visualization of the major pre-spinal vasculature. This study looks into the vascular and visceral complications associated with the minimally invasive antepsoas (MIS-ATP) approach to lumbosacral fusion. **Material and Methods:** This study is a retrospective review of patients who underwent MIS-ATP fusion between January 2007 and January 202. All procedures were done by two fellowship trained orthopedic spine

surgeons and without the assistance of an access surgeon. A review of electronic medical records was conducted by independent clinical researchers. Variables collected included vascular, bowel, visceral and ureteral injuries identified during the surgery or up to one year postoperatively. **Results:** In 1376 patients (55.2% females, 44.8% males), 3079 total levels were fused with a mean of 2.24 levels per patient. 741 patients (53.8%) included the L5-S1 level. 3 patients (.22%) experienced minor vascular injuries involving segmental vessels. There were no ureteral injuries, no major vascular injuries, and no intraoperative direct bowel injuries encountered. However, 1 patient (.07%) experienced a delayed onset (24-48 hours postoperatively) of bowel ischemia due to a superior mesenteric artery embolism. Additionally, 7 patients (.51%) experienced prolonged post-operative ileus. **Conclusion:** The MIS-ATP lumbar fusion is safe and has lower rates of vascular and visceral injury as compared to other techniques. The generous pre-psoas surgical window allows unobstructed access to the spine between T12-S1 through a single anterolateral abdominal incision. Given our experience, the authors recommend ATP approach as a safer alternative to ALIF and LLIF when performing lumbar/lumbosacral fusion.

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P171: The antepsoas (ATP) surgical corridor for lumbar and lumbosacral arthrodesis: a radiographic, anatomic, and surgical investigation

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Introduction: Hazards to anterolateral lumbosacral spinal fusions include injuries to adjacent vascular and visceral structures. These complications are well reported for anterior (ALIF), lateral transpsoas (LLIF), and oblique (OLIF) techniques. Nonetheless, the safety profile of the MIS-ATP technique is not well understood. This study aims to review vascular and visceral complications associated with the (MIS-ATP) approach for lumbar/lumbosacral fusions. **Methods:** This study is a retrospective review of patients who underwent MIS-ATP fusion between January 2007 and January 2021. All procedures were done by two fellowship trained orthopedic spine surgeons and without the assistance of an access surgeon. A review of electronic medical records was conducted by independent clinical researchers. Variables collected included vascular, bowel, visceral and ureteral injuries identified during the surgery and up to one year postoperatively. **Results:** In 1376 patients (55.2% females, 44.8% males), 3079 total levels were fused with a mean of 2.24 levels per patient. 741

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P172: Awake percutaneous fixation for unstable fractures of the spine in high-risk patients - a retrospective study

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Introduction: Unstable fractures in sick or elderly patients are on the rise. These patients who are high risk for surgery present a challenge for surgeons and anesthesiologists. In patients with ASA 3-4 the risk is even higher due to the high rate of intraoperative complications. **Material and Methods:** All patients were ASA 3-4 who presented with unstable fractures of the spine, to a level one trauma center were assessed and underwent awake spinal percutaneous fixation, with mild sedation and local anesthesia. Demographics, radiology, and outcome were collected. **Results:** Nineteen patients were operated between the years 2019-2021. Average follow up was 12 months (range 8-24 months) 6 were female and 13 males. The average age was 77.7, the ASA score was 3-4 to all patients. There were 10 extension type injuries, 6 unstable burst injuries, 2 chance fracture and one teardrop fracture. All patients underwent unilateral fixation and just one patient underwent bilateral fixation, cement augmentation was performed in 16 of the patients. There was no neurological complication. There was one case of infection that presented 4 months after surgery. All patients were discharged ambulating. **Conclusion:** Awake fixation in extreme cases is safe and feasible, a dedicated team including an anesthesiologist and radiologist is needed to perform these cases safely and quickly.

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P173: Implications, benefits, and risks of hardware removal following percutaneous screw fixation for thoracolumbar fractures: a retrospective case series of 58 patients at a single institution

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Introduction: Thoracolumbar fractures are spinal conditions that accounts for considerable amount of morbidity and poses risks for severe mobility deficits. Management of thoracolumbar fractures are multifactorial and a topic of major debate. Although literature remains unclear if conservative versus operative treatment produces better outcomes in neurologically intact patients, surgery has more favorable radiographic **Results.** Among patients with thoracolumbar fracture undergoing percutaneous fixation, there is no consensus of whether hardware removal is beneficial long term. This study will assess the risks and benefits of hardware removal following percutaneous internal fixation in patients with thoracolumbar fracture undergoing spinal surgery. **Material and Methods:** Our single-center retrospective study analyzed all patients undergoing treatment for a traumatic TL spine fracture that did not require surgical decompression at a large level 1 trauma center from 2012 to 2017. Patients treated with percutaneous screw fixation were identified then further separated into those that had the hardware removed. Variables collected included patient demographics, medical comorbidities, prior history of spine surgery, use of non-steroidal anti-inflammatory drugs (NSAIDs), use of anticoagulation, mechanism of injury, AOSpine Thoracolumbar Injury Classification, pre/post-operative Cobb angles and level of the fracture. Statistical analysis was performed using Microsoft Excel (Bellevue, WA). Changes in Cobb angles were compared using paired t-tests. **Results:** Fifty-eight patients were included in the study, 43 males and 15 females. Of those included 35 had AO type A fracture, 19 had type B fractures and 6 had type C fractures. 29 patients underwent removal of their instrumentation, and 29 did not. There was no significant difference between the preoperative and post-operative Cobb angles in both groups ($P < .01$). **Conclusion:** In this study, removal of screws did not result in significant improvement of Cobb angles when compared to group with screws left in. Additionally, patients' status was not worse following screw removal. More work is needed to stratify implications and risks for removal.

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P174: Implementation of a three-dimensional (3D) robotic digital microscope (AEOS) in spine procedures

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Introduction: 3D-exoscopes have been introduced to overcome some shortcomings of operative microscopes. Prior clinical studies demonstrated high satisfaction with magnification and illumination combined with high level of ergonomics while independent working zoom function and depth of field were perceived as suboptimal. We investigated the clinical use in spine procedures. **Material and Methods:** We treated patients with various spine diseases in a neurosurgical department of a tertiary spine center according to current standard of care over four weeks period of time. Microsurgical procedures have been performed with Aesculap AEOS 3D microscope. Three neurosurgeons with different levels of experience and microsurgical skills were instructed and completed a questionnaire consisting of 43 items concerning intraoperative handling following the procedures. **Results:** 17 patients (35 % male/ 65 % female) with a median age of 70 years [CI 47-86] and median BMI of 25.8 kg/m² [range 21-33] with numerous spine indications (10 degenerative/4 tumor/3 infectious cases) with different level of complexity (35% low/35 % medium/ 30 % high according to the German Spine Society Score) were analyzed. In total, 6 decompression surgeries w/o discectomy, 3 ventral fusions, 4 corpectomies, 3 disc prosthesis and 1 tumor resection were performed in the cervical (35%), thoracic (24%) and lumbar (41 %) segments respectively. We experienced a moderate mean surgical time of 102 minutes [range 59-186] and median blood loss of 300 ml [100-3000 ml]. Setup conflicts were associated with adjustments of the monitor position or additional equipment (e.g. fluoroscopy in fusion surgery) ($p = .007$ and $p = .001$). Image resolution, image sharpness and 3D-depth perception were absolutely satisfactory for all surgeons in all procedures. 76.5% of the surgeons indicated that the control of the exoscopic arm was easy and 100% approved a better surgical corridor without blocking the working zone. No eyestrain or disturbance of the hand-eye coordination affected the surgeon's performance. However, higher complexity of procedures was associated with higher levels of frustration ($p = .045$) and anxiety ($p = .155$). **Conclusion:** The implementation of a 3D-exoscope in spine procedures especially in minimally invasive keyhole approaches appears to be highly beneficial. According to our experience we strongly recommend the use of this kind of system in such indications due to improved depth of field, illumination, magnification as well as ergonomics for the surgeon.

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PI75: Surgical complication incidence between MIS-BDUL and classic laminectomy for decompression in lumbar spinal stenosis: is minimally invasive spine surgery always superior?

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Introduction: Lumbar spine stenosis (LSS) remains one of the most presented spondylo-degenerative disorders to the spine clinics among the mid-age and elderly patients. Its management may involve conservative, alternative, open-surgical or minimally invasive surgical approaches. The invasiveness of an approach is inevitably associated with potential complications, particularly, open surgical techniques. Employing BDUL approach as a moderation of surgical invasiveness in LSS patients is anticipated to warrant limited spinal elements and tissue damage, reduced surgical complications and hospital costs compared to classic laminectomy. Value-based spine practice is rapidly becoming the epitome of care delivery in many developed and developing countries. The evaluation of complication outcomes from various studies of heterogeneous sources on the management of LSS patients with minimally invasive unilateral laminotomy or classic laminectomy can delineate safer surgical options based on the best given clinical evidence.

Material and Methods: A comprehensive literature review with meta-analysis was performed from January 2000 to September 2021. We investigated whether LSS patients treated with bilateral decompression via unilateral approach (MIS-BDUL) show overall better complication outcomes compared to those treated with conventional laminectomy (classic laminectomy). The selection criteria for included studies comprised: case series of ≥ 10 patients, complication outcomes and a ≥ 1 -year follow-up period. Outcomes compared between MIS-BDUL and classic laminectomy surgical approaches included: overall surgical complication incidence, intra-operative, immediate postoperative (defined as: < 2 weeks post-surgery),

and later postoperative (defined as: ≥ 2 weeks post-surgery) surgical complication incidence. The assessed surgical complications included: incidences of dural tear, cerebrospinal fluid (CSF) leak, epidural hematoma, wound dehiscence/exploration, superficial or deep wound infections, chronic low back pain/failed back syndrome, and re-operation after 2-week postoperative. Odds Ratios (ORs) and Confidence intervals (CIs) were computed for each studied variable. Significance was set at ($P < .05$). **Results:** Of the 372 LSS patients observed, 43.82% ($n = 163$) and 56.18% ($n = 209$) were MIS-BDUL and classic laminectomy, respectively. Compared to classic laminectomy approach, the overall surgical complication outcome was significantly lower in the MIS-BDUL approach, [OR = .49; 95% CI = (.28 to .85); I² = 8%, ($p = .01$)]. The incidence outcomes of dural tear, cerebrospinal fluid (CSF) leak, epidural hematoma, wound dehiscence/exploration, superficial or deep wound infections, chronic low back pain/failed back syndrome, re-operation after 2-week postoperative as well as the overall intraoperative, immediate postoperative, and later postoperative complication incidence were comparable between MIS-BDUL and classic laminectomy approaches. No other significant outcomes were observed between the two surgical approaches. **Conclusion:** Our study indicates that LSS patients treated with MIS-BDUL approach significantly show lesser overall surgical complication rates than those treated with classic laminectomy approach. Albeit the overall complication rates were favorably inclined towards MIS-BDUL approach, the intra-operative, immediate, and later postoperative complication rates were each, significantly comparable between MIS-BDUL and classic laminectomy approaches in LSS patients. These meta-**Results** evidently show that, regarding perioperative complication rates, both MIS-BDUL and classic laminectomy approaches are equally safe and with similar complication outcomes for the surgical management of symptomatic LSS patients. It is possible for highly experienced surgeons to perform classic laminectomy with minimal complication rates. More granular studies are encouraged to explore the subtle complication differences between classic laminectomy and MIS-BDUL.

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PI76: Significantly higher surgical site infection rates observed in MIS-TLIF compared to endo-TLIF in lumbar spinal stenosis patients

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Introduction: The current shift in healthcare focus from fee-for-service models towards value-based care paradigm models emphasizes the need to weigh currently employed surgical techniques in spine patients while reinforcing evaluation of the complication and quality outcomes of surgical patients. Minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) as a surgical technique for lumbar decompression and fusion in lumbar spondylotic degenerative disk disease or stenosing insults has rapidly gained popularity in the field since its inception by Foley et al., in 2002. In conjunction with the evolution of endoscopic (Endo) spine surgery which is also believed to be a less invasive procedure, performing MIS-TLIF or Endo-TLIF for LS-DDD patients is anticipated to delineate comparable clinical outcomes, particularly, technique efficacy and surgical complication rates. In this study, the authors purposed to determine if Endo-TLIF versus MIS-TLIF show paralleled rates of peri-operative complications. We anticipate that the findings obtained from this meta-review study may evidently expose the potential operative-related risk(s) associated with Endo-TLIF and MIS-TLIF surgical approaches in LSS patient management.

Material and Methods: A comprehensive literature review was performed from January 2000 to September 2021. The selection criteria for included studies comprised: case series of ≥ 10 patients, reported complication incidence and a ≥ 1 -year follow-up period. The main outcomes compared between the Endo-TLIF and MIS-TLIF surgical approaches included: overall surgical complication incidence, intra-operative, immediate postoperative (defined as: < 2 weeks post-surgery), and later postoperative (defined as: ≥ 2 weeks post-surgery) surgical complication incidence. The assessed surgical complications included: incidences of durotomy, epineurium/nerve injury, cerebrospinal fluid (CSF) leak, spinal epidural hematoma, superficial/deep wound infections/explorations, implant issues/hardware malpositioning, early hospital admission, and revision surgery requiring re-stabilization. Odds Ratios (ORs) and Confidence intervals (CIs) were computed for each studied variable. Significance was set at ($P < .05$). **Results:** A total of 654 LSS patients from 8 multi-institutional studies met the inclusion criteria. Of the 654 LSS patients, 46.48% ($n = 304$) and 53.52% ($n = 350$) were Endo-TLIF and MIS-TLIF, respectively. Among the subgroup entities of immediate postoperative complications defined at < 2 week following decompression and fusion, significantly lower incidence of superficial/deep wound infection/exploration; [OR = .15;

95% CI = (.03 to .84); $I^2 = 0\%$, ($P = .03$)] was observed in the Endo-TLIF approach. Overall surgical complication rates as well as the other subgroup analyzed complication incidences were comparable between Endo-TLIF and MIS-TLIF approaches. No significant findings were observed for incidences of durotomy, epineurium/nerve injury, cerebrospinal fluid (CSF) leak, spinal epidural hematoma, implant issues/hardware malpositioning, early hospital admission, and revision surgery requiring re-stabilization between Endo-TLIF and MIS-TLIF approaches, ($P > .05$). **Conclusion:** Except for surgical site infections/explorations, all compared complication rate outcomes between Endo-TLIF and MIS-TLIF approaches were not significantly different. Both Endo-TLIF and MIS-TLIF showed similar efficacy in the management of LSS patients. The MIS-TLIF approach is significantly associated with exposure to surgical site infections compared to the Endo-TLIF approach. Further studies are required to understand the preventative measures that can be put in place to mitigate the incidence of surgical-related infections in LSS patients treated with the MIS-TLIF approach.

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PI 77: Risk factor analysis for inferior clinical outcome and recurrence after full-endoscopic interlaminar discectomy (FEID) for lumbar disc herniations (LDH); a prospective observational study

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Introduction: Full endoscopic interlaminar discectomy (FEID) for lumbar disc herniation (LDH) has become popular in recent years. However, the major concerns for the beginners are inadequate neural decompression and early recurrence. Previous studies have proven the efficacy, but few have discussed the possible risk factors of poor outcome and recurrence. The objective of this study is to determine the possible risk factors for inferior clinical outcome and early recurrence of FEID for LDH in minimum 12 month follow-up. **Material and Methods:** This study is a prospective observational study from a single surgeon's experience as a beginner in endoscopic spinal surgery. From May 2019 to July 2020, FEID was performed in consecutive 72 patients for LDH. The operated level was L5-S1 in 41, L4-5 in 29 and L3-4 in 2 patients. Mean operation time was 66.4 minutes and mean hospital stay after the operation was 2.1 days. **Results:** The follow-up period was at least 12 month. The visual analog scale (VAS) for back and leg pain, and Oswestry disability index (ODI) showed significant improvement after operation. Excellent or good outcome by the modified MacNab's criteria was observed in 88.8% (64/72) of patients. Disc migration, late surgery, previous spine operation, recurrent herniation and urinary/bowel dysfunction were

associated with poor outcome. 8 patients were diagnosed with recurrent disc herniation (11.1%, 8/72) during follow-up period. Recurrence was more common in younger age, higher body mass index (BMI) and early operation. Broad-based (MSU classification 3) discs without calcification or spinal stenosis were also possible risk factors for recurrence. **Conclusion:** FEID is safe and effective alternative to conventional microscopic techniques for LDH even for a beginner in endoscopic spine surgery. We concluded that disc migration, late surgery, previous spine operation, recurrent herniation and urinary/bowel dysfunction were possibly associated with unsatisfactory surgical outcomes. Recurrence was more common in younger age, higher BMI and early operation.

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P178: Remodeling patterns of spinal canal after full endoscopic uniportal lumbar endoscopic unilateral laminotomy for bilateral decompression: one Year MRI and clinical follow up evaluation

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Introduction: There is limited literature on repetitive postoperative MRI and clinical evaluation after uniportal lumbar endoscopic unilateral laminotomy with bilateral decompression. **Material and Methods:** Clinical visual analog scale, Oswestry Disability Index, McNab's criteria evaluation and MRI evaluation for patients with single level Uniportal Lumbar Endoscopic Unilateral Laminotomy For Bilateral Decompression. MRI evaluation measured the axial cut spinal canal area of upper end plate, mid disc and lower end plate. 4 types of pattern of remodeling were identified: type A: continuous expanded spinal canal, type B: restenosis with delayed expansion, type C: progressive expansion and type D: sustained restenosis. **Results:** 126 patients with single level uniportal lumbar endoscopic unilateral laminotomy for bilateral decompression were recruited with minimum follow up of 26 months. 36 type A, 50 type B, 30 type C and 10 type D pattern of spinal canal remodeling were observed. All 4 types of patterns of remodeling had statistically significant improvement in VAS at final follow up compared to preoperative state with type A (5.59 ± 1.58), B (5.58 ± 1.71), C (5.58 ± 1.71) and D (5.27 ± 1.68), $P < .05$. There was statistical significant improvement in ODI at final follow up with type A (49.19 ± 1.51), B (5.00 ± 11.29), C (45.60 ± 1.58) and D (45.60 ± 1.58), $P < .05$. MRI evaluation showed there was significant different in increment of spinal canal area at upper endplate at postoperative day one and one year with type A (39.16 ± 22.73 ; 28.00 ± 42.57), B (47.42 ± 18.77 ; 42.38 ± 19.29), C ($51.45 \pm$

18.16 ; 49.49 ± 18.41) and D (49.10 ± 23.05 ; 38.18 ± 18.94), respectively, $P < .05$. Similar significant finding was found at mid-disc at postoperative day one, 6 months and one year with type A (55.16 ± 27.51 ; 37.23 ± 25.88 ; 44.86 ± 25.73), B (72.83 ± 23.87 ; 49.79 ± 21.93 ; 62.94 ± 24.43), C (66.85 ± 34.48 ; 54.92 ± 3.70 ; 64.33 ± 31.82) and D (71.65 ± 16.87 ; 41.55 ± 12.92 ; 49.83 ± 13.31) and lower endplate at postoperative day one and one year with type A (49.89 ± 34.50 ; 41.04 ± 28.56), B (63.63 ± 23.70 ; 54.72 ± 24.29), C (58.50 ± 24.27 ; 55.32 ± 22.49) and D (81.43 ± 16.81 ; 58.40 ± 18.05) at postoperative day one and one year respectively, $P < .05$. **Conclusion:** After full endoscopic lumbar decompression, despite achieving sufficient decompression on postoperative day one, varying severity of asymptomatic restenosis was found in postoperative six months without clinical significance. Further remodeling with varying degree of increment of spinal canal area occurred at postoperative one year with overall good clinical outcomes.

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P179: Surgical outcome of ultra long construct navigated minimally invasive spine surgery for extensive spinal metastasis

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Introduction: Minimal invasive spinal stabilization provides a good outcome as a palliative procedure in symptomatic spinal metastasis patients. There has been associated with a lower complication profile, shorter hospital stay, shorter operative time, less blood loss, and better functional outcomes when compared to open surgery. Patients with extensive spinal metastases (surgical classification of spinal tumors type 7) usually present with pain, instability, or neurological deficit and require palliative surgery. There were few reports on the treatment strategy in these groups of patients. We defined the ultra-long construct navigated minimally invasive spine surgery (UNMISS) with more than 10 levels operated spinal segment. We present the first case series of multiple spinal metastases patients who underwent UNMISS techniques at our tertiary referral center and their surgical outcomes. **Material and Methods:** Extensive spinal metastasis patients who recommended for the ultra-long construct navigated minimally invasive spine surgery between 2017 and 2022. We defined the UNMISS with the percutaneous spinal stabilization involving more than ten levels of vertebral bodies. **Results:** Fourteen patients were included to our study. Ten patients experienced neurological deficits of lower extremities which required decompression. The most extended construct in our case series involved T1 to iliac. All patients significantly improved in pain scores. The average blood loss was $59.71 \pm$

291.37 ml. The average operative time was 272.5 ± 73.42 minutes. Two patients had wound dehiscence, and one patient had worsened neurological status. No life-threatening complication was found in our study. **Conclusion:** The UNMISS should be considered as a choice of treatment in a patient with symptomatic extensive spinal metastasis. The primary goal of this technique is to stabilize the multiple levels of spinal metastasis and decompression of the neural element if needed. This technique is safe and provides a satisfying outcome

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PI80: Spondylolysis repair with modified Buck technique with minimally invasive approach, neuronavigated and neuromonitored in high-performance athletes: technical note, case report and literature review

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Introduction: Spondylolysis is a defect in the pars interarticularis of the vertebra, occurring frequently in high-performance young athletes. Although nonsurgical management is the mainstay of treatment, surgery is the option for patients with persistent symptoms despite multiple cycles of nonsurgical treatment. Performing a minimally invasive technique leads to reduce complications, post-surgery pain, hospitalization time and provide a quick recovery. The purpose of this study is to report the clinical Results of a series of three patients treated with a modification of the Buck technique with a minimally invasive approach. **Material and Methods:** 3 high-performance athletes between 17 and 18 years old managed non-surgically at least 6 months were operated with a modified Buck technique repair with a minimally invasive approach using cannulated compression screws, with neuronavigation and neuromonitorization. Patients were followed-up at least 6 months, taking a computed tomography to assess consolidation and fixation status. Once rehabilitation completed and in absence of pain, they returned to their respective sports. There were no complications reported. **Results:** All the patients presented bilateral spondylolysis, one case at L3 and two at L5. Previous conservative management was performed between 12 to 36 months. After surgery, consolidation was obtained at 4 months in all cases, returning to their sports activities prior to 6 months. **Conclusion:** The proposed technique shows the advantages of performing a minimally invasive surgery in young high-

performance athletes, ensuring consolidation and early return to sport activity without complications.

Navigation

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PI81: First experiences with NuVasive Pulse system for navigated placement of percutaneous pedicle screws in thoracolumbar spine - An analysis of 15 cases

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Introduction: Pedicle screws have been a standard procedure in spine surgery for decades. Application of intraoperative 3D imaging as well as the use of systems for navigated placement of transpedicular screws have become a clinical standard as via those techniques placement accuracy can be achieved. This report aims to present our first experiences with 3D C-arm-based (Cios Spin, Siemens Healthineers, Erlangen, Germany) navigation in percutaneous placement of pedicle screws in thoracolumbar spine using the novel Pulse system (NuVasive, San Diego, USA). The technique and workflow with the Pulse system as well as **Results** of the first 15 clinical cases are presented. **Material and Methods:** All patients who underwent percutaneous Pulse-navigated pedicle screw placement in the thoracolumbar spine between June and October 2021 in our institution were included. After an initial 3D scan for referencing, drilling is performed using a navigated drill guide, followed by the insertion of K-wires. The position is checked using 2D fluoroscopy and, if necessary, additional intraoperative 3D imaging. Subsequently, navigated screw placement is performed under live control of trajectory and insertion depth. Finally, screw position is checked by fluoroscopy and, at the surgeon's discretion, by intraoperative 3D imaging. The time needed for surgery, subjective satisfaction of the performing surgeon with the system, intraoperative radiation dose as well as intraoperative revisions of wire or screw position after performing intraoperative 3D imaging were assessed. Intraoperative and postoperative complications as well as technical problems during surgery were documented. **Results:** 15 patients with an average age of 70 years underwent percutaneous placement of a total of 114 transpedicular screws in thoracolumbar spine using Pulse navigation. The indication for surgery was an unstable vertebral body fracture in 12 cases and

spondylodiscitis in 3 cases. Screws were placed in the thoracic spine in 6 procedures, and in the thoracolumbar junction and lumbar spine in 4 cases each. A 3D scan was performed after wire placement in 3 cases and after screw placement in 6 cases. In two cases, 3D control was performed both after wire and screw placement, while in 4 cases no intraoperative 3D control was performed. In the second half of the surgeries performed (patients 9-15), intraoperative radiation exposure ($p = .08$) as well as the number of 3D scans performed intraoperatively ($p = .04$) tended to be lower than in the first eight surgeries. In one case each (2/114, 1.8%) after checking implant position in intraoperative 3D imaging, revision of a wire or screw was performed to achieve higher biomechanical stability. Neither intra-/postoperative complications nor technical problems occurred in any of the cases. **Conclusion:** The Pulse system has proven to be an easy-to-implement, intuitive and reliable tool for navigated pedicle screw placement in the thoracolumbar spine. Our first experiences show, in addition to an extremely low intraoperative revision rate, a steep learning curve as well as an increasing confidence in the system, which has already led to a reduction of the patient's intraoperative radiation exposure.

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P182: The prone transpsoas lateral lumbar interbody fusion using the fluoroscopy-based instrument tracking guidance for degenerative lumbar spine disease

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Introduction: Lateral Lumbar interbody fusion (LLIF) does have inherent limitations, such as the necessity to reposition the patient. To overcome this limitation, the trans psoas approach (PTP) for LLIF has been developed. To our knowledge, this is the first report of PTP with the assistance of the fluoroscopy-based instrument tracking system. We aimed to report the clinical and radiographic outcomes of a series of 15 patients who underwent this surgery. **Material and Methods:** A retrospective chart review of data was conducted for patients who underwent the PTP approach for degenerative lumbar spine disease. 15 consecutive patients met the inclusion criteria; a thorough analysis of clinical and radiographic outcomes was conducted. **Results:** The mean follow-up duration was 11.9 ± 7.9 months. The PTP approach significantly improved lumbar lordosis ($p = .03$) and pelvic incidence minus lumbar lordosis

($P < .005$). There was no significant difference found in pelvic tilt, sacral slope, or pelvic incidence. Clinically, patients improved significantly in Oswestry Disability Index ($p = .002$) and Short Form Physical Scores ($p = .01$). The estimated mean blood loss for patients who underwent the PTP procedure in our study was 137.7 ± 96.4 mL, mean operative time was 212.5 ± 77.1 minutes, and the patients had a mean hospital stay of 2.7 ± 1.4 days. There was one patient that had either superficial wound infection, transient paralytic ileus, transient pulmonary embolism, transient urinary retention, or another lumbar surgery. **Conclusion:** This study demonstrates that the PTP approach is safe with significant improvement in radiographic and clinical outcomes.

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P183: Navigated lateral lumbar interbody fusion (LLIF) leads to decreased radiation exposure compared to fluoroscopy

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Introduction: Reducing fluoroscopy time and radiation exposure in the operating room is beneficial for the patient and surgical team. Placement of an interbody device during lateral trans-psoas approach is traditionally carried out using anterior-posterior and lateral fluoroscopy. We sought to present our initial experience with the use of CT based spinal navigation for the LLIF procedure, and evaluates rates of intraoperative complications and radiation exposure. We believe 3-dimensional computed tomography (CT)-based spinal navigation of cage and pedicle screw/rod placement for LLIF procedure Results in decreased radiation exposure compared with fluoroscopically-guided LLIF. **Material and Methods:** 365 patients over 18 years of age that underwent LLIF with < 4 levels fused (mean age: 61.4 ± 1.8 , BMI: 29.7 ± 6.1 7 kg/m²,) were separated into two groups: Fluoroscopy-guided LLIF ($n = 337$), and Navigated LLIF ($n = 28$). Outcomes assessed were intra-operative and 90 day complications, as well as radiation exposure. **Results:** In terms of operative characteristics, estimated blood loss (EBL) ($38.6\text{ml} \pm 40.4$ vs $259.6\text{ml} \pm 151.7$, $P = .001$) and fluoroscopy dosage was significantly greater in the fluoroscopically-guided LLIF cohort ($66.8\text{mGy} \pm 78.7$ vs $41.7\text{mGy} \pm 5.9$, $P = .04$). There were no significant differences between fluoroscopic LLIFs and navigated LLIFs in overall intraoperative complication rate (2.4% Fluoro vs 3.6% Nav, $P = .70$), neuro-monitoring

changes (2.4% Fluoro vs 3.6% Nav, $P = .70$), or rate of durotomy (1.5% Fluoro vs 0% Nav, $P = .70$). The rate of post-operative complications (22.3% Fluoro vs 25% Nav), neurologic complications (3.9% Fluoro vs 3.6% Nav), surgical site infections (1.8% Fluoro vs 3.2% Nav), mechanical complications (1.2% vs 3.6%), and return to the operating room within 90-days (2.4% Fluoro vs 0% Nav) were not significantly different between the two groups. **Conclusion:** We report an average radiation exposure with Navigated LLIFs of 41.7 mGy, significantly lower than the 66.8 mGy in the fluoroscopically-guided LLIF group. The length of stay and perioperative complication rate was equivalent between the groups. These data support the use of CT-based navigation for placement of the cage and pedicle screws/rod construct for LLIF procedure.

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PI84: Intraoperative benefit and applicability of neuronavigation for lateral instrumentation of the thoracolumbar spine

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Introduction: Neuronavigation for pedicle screw placement in dorsal instrumentation is routinely performed in multiple centers. However, the potential of neuronavigation in spinal surgery reaches beyond. In this study, the use of neuronavigation for lateral instrumentation of the thoracolumbar spine was analyzed. **Material and Methods:** Patients scheduled for lateral instrumentation were prospectively enrolled. Case report forms acquiring patient data and surgeons' evaluation were acquired. For neuronavigation, a registration array was attached to the pelvis and an intraoperative computed tomography (ioCT) scan was acquired for registration and control of positioning. **Results:** Overall, 70 patients were enrolled with a median (range) of 1 (1-4) levels being instrumented. Perioperative blood loss was 410 ± 415 (20-2100) ml, duration of surgery after the initial ioCT-scan was 85 ± 38 (30-186) min. Intraoperative cage revision after control scan was performed in 10 cases. Final positioning of the cage regarding overhang of the cage in relation to the adjacent vertebrae was $.4 \pm .9$ (0-3) mm in the anterior-posterior view and $.4 \pm 1.0$ (0-5) mm in the sagittal view. Postoperative cage-revision was performed in two cases (cage malposition and progressive spondylodiscitis). For surgeons, the technique was comfortable to use and an intraoperative benefit regarding mental load was measurable. The use of conventional X-ray

was necessary in one case due to major inaccuracy based on a malpositioned reference array. **Conclusion:** Applying neuronavigation in lateral spinal instrumentation is useful enabling precise approaches and positioning of implants. This technique offers further potential, especially when combining dorsal and lateral instrumentation.

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PI85: Odontoid screw placement technique using two-dimensional navigation

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Introduction: Type 2 Odontoid fractures are routinely encountered in Neurosurgical practice. Anterior odontoid screw fixation (AOSF) improves the rate of union compared to bracing alone and preserves range of motion relative to posterior fusion. However, intraoperative image guidance remains challenging with a choice between cumbersome biplanar fluoroscopy or resource-intensive intra-operative CT imaging. This issue presents a barrier to AOSF. This study describes a hybrid two-dimensional navigation technique that reduces operative time and simplifies operative setup. **Material and Methods:** Technique: Once neck dissection is completed, anterior-posterior and lateral radiographs of the upper cervical spine are acquired and saved to the navigation unit. The navigated drill guide is placed at the entry point on the axis while the projected trajectory including the expected screw length and size is superimposed on the radiographs by the navigation unit. The drill is then advanced, and its progress is followed in real time by lateral fluoroscopy. Analysis: Seven patients were included in the series with five undergoing 2D navigated screw placement and two undergoing three-dimensional (3D) navigated screw placement. Postoperative CT imaging was collected for all patients, and screw placement accuracy was measured by two independent observers. Operative time and total room time in addition to radiation exposure were collected for all patients. **Results:** This technique was easily implemented in the operating room environment and permitted high-accuracy odontoid screw placement with reduced operative time as compared to 3D navigation. All screws were within the boundaries of the odontoid with a maximum distance from the midline of 1.6 mm. In addition, operative time was maintained at 72 minutes on average with 2D navigation as compared to 128 minutes for 3D navigation. **Conclusion:** 2D navigation combined with lateral fluoroscopy allows for accurate odontoid screw placement while maintaining efficient operative time and a simple OR setup.

Nonoperative Clinical Treatments

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P186: Prevalence and impact of cannabinoid use in patients with spinal disorders

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Introduction: One in four Americans suffer from chronic back pain, with 40% reporting trauma or surgery as its origin. Cannabis is becoming widely decriminalized or legalized for medical and recreational use. While there is literature on medical cannabis for pain management, little is focused on pain following spinal surgeries. This observational study aimed to address whether cannabinoid use provides meaningful pain relief and a decrease in pain medication consumption post-operatively. **Material and Methods:** Patients 18 years or older with a history of spine fusion at a large academic spine center since 2013 were asked to complete a questionnaire and were incentivized through raffle entry and follow-up calls. The survey included questions regarding demographics, level of pain, types of pain medication used for management of spine pain, recreational, personal, and medical use of marijuana and cannabis products, and whether marijuana or cannabis use reduces pain. Patients were asked for quality-of-life scores via PROMIS Pain Behavior, Pain Interference, and Physical Function. **Results:** A total of 7,371 patients were sent surveys, with 118 responding (1.6% response rate) from March to July 2021. Of the 118 patients surveyed, 61 patients identified themselves as having used cannabis and continue to use cannabis for pain. Of the respondents, 23.1% of patients reported using cannabis once or more daily, and 47% of patients reported using cannabis for pain more than once a month. Among spine patients, 55.5% reported a 50% or greater reduction in the use of prescription pain medications, specifically opioids, after using cannabis. PROMIS Scores for patients who underwent spine surgery indicate both cannabis users and nonusers experience more pain and more difficulties with physical function than the general population, as demonstrated by the T-Test Analysis of PROMIS Scores by Cannabis Users vs Nonusers. No statistical significance was found between users and nonusers. **Conclusion:** Among spine patients, it was subjectively perceived that cannabis use had reduced their pain medication use, however it was found that cannabis users did not have reduced pain levels based on PROMIS scores. There was no statistical difference in PROMIS Scores between users and nonusers, differing from the association with reported quantity of pain medication used. This continued research will be pioneering in giving providers and patients information regarding cannabinoid use in patients with spinal disorders and

will determine if cannabis can decrease narcotic pain medication prescription.

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P187: Impact of Gestalt therapy on spine surgeries

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Introduction: The progress of the Neurosciences allows to identify the functional relationship between the spine, the spinal cord, the autonomic nervous system and cortical and subcortical structures of the limbic system verifying the direct influence of the pathophysiological bases of psychosomatic medicine in the pathologies of the spine and spinal cord. Equally various disciplines of Umanistic Psychotherapy have been recognized as true scientific disciplines thus opening their increasingly wide use in various clinical fields. Gestalt therapy proposes that the organism is not a structure that can be divided into independent parts but is a totality in which a large number of processes converge. The objective of this study is to measure the impact of Gestalt therapy used as a therapeutic complement to pre- and postoperative management in patients undergoing spine surgeries. **Material and Methods:** We included 6 adult patients, both sexes, 35 to 68 years old, with non-traumatic pathologies of the spine undergoing surgery. Each patient with their closest relatives received a session of Psychotherapy before their surgery and a second session a week later. Subsequently, each patient receives 3 individual sessions of Gestalt Psychotherapy in the 3 months following their surgery. In each patient, a measurement instrument called "Lights and shadows of the consciousness of Dr. Ana María González Garza" was applied, which evaluates the biological, psycho-rational, personal, social and transpersonal dimension. This instrument was applied before each surgery and after all the Gestalt therapy sessions had been concluded. **Results:** Qualitative: all patients expressed an important sense of satisfaction, tranquility and minimal physical discomfort. They felt understood respected and contents both personally and as family, a great motivation of life was generated. Quantitative: the comparative analysis of the test showed a notable increase in the parameters of well-being in the biological and personal dimensions. Tendency to reduction in the psycho-rational dimension and tendency to expand consciousness in the social and transpersonal dimensions. **Conclusion:** In patients undergoing spine surgery, Gestalt psychotherapy is a very useful therapeutic tool that can induce significant and very favorable organic and psycho-emotional changes in the medium and long term.

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PI88: The benefit of electro muscle stimulation in patients suffering from acute paresis: a case series

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Introduction: Electro muscle stimulation (EMS) is often used in hemiparetic patients suffering from stroke to support neuroplasticity and muscle regeneration. Our case series aims to analyze the benefit of EMS in patients suffering from acute monoparesis after lumbar disc herniation or spinal canal stenosis. **Materials and Methods:** This is a retrospective evaluation from 07/2021 to 09/2021 of three patients suffering from acute monoparesis caused by lumbar disc herniation (2/3) and postoperative epidural bleeding (1/3). All patients were treated surgically with removal of the neurocompressive pathology. Postoperatively patients received EMS therapy during hospitalization and during the following three months. Patients characteristics, complications and muscular function status were analyzed. **Results:** We included 2 females and 1 male patient with median age of 69 years. While patient 1 experienced a left-sided proximal leg monoparesis (av. strength 2/5) after epidural bleeding with previous decompression surgery and kyphoplasty, patient 2 and 3 suffered of L4 (M. quadriceps strength 3/5) and L5 (M. tibialis anterior strength 3/5) compression nerve syndromes respectively due to disc herniation. Sensibility was affected in first 2/3 patients and all of them experienced radiculopathic pain. Gain of function was established 2 months after surgery with concomitant rehabilitation and EMS use for 30 minutes per day in all patients. While 2 patients reported mild remnants (strength 4+/5), the third patient was asymptomatic on follow up. All patients were highly satisfied with the EMS application. **Conclusion:** This case series confirms the uncomplicated use of EMS in patients suffering from acute paresis due to spinal neurocompression. We strongly recommend the use in the immediate postoperative setting and continuously through the rehab period.

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PI89: Ultrasound guided cluneal nerve block for low back pain; a novel technique

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Introduction: As spinal surgeon we come across a group of patients suffering from chronic low back pain radiating to the

superior gluteal region. They are usually tender around posterior superior iliac spine area. Their pain does not respond to conservative management including physiotherapy and analgesics. MRI scan of lumbar spine is usually normal with no significant pathology. This group of patient present a dilemma to the treating surgeon as they are in pain with no relief from simple measures and no underlying pathology. Over the last few years cluneal nerve has been identified as the source of pain in these patient. We present a novel technique of ultrasound guided Cluneal Nerve block and its outcomes in management of these patients. **Materials and Methods:** US guided cluneal nerve block was started last year as clinic procedure in Bone and Joint Centre at Hamad Medical Corporation. The patients were diagnosed on the basis of clinical examination and by the presence of normal MRI scan of lumbar spine. Cluneal nerve and its branches are identified under high resolution musculoskeletal ultrasound and a mixture of 3-5ml Levobupivacaine and 40mg depomedron is injected around the nerve. Pain score (visual analogue scale 0-10, where 0 being no pain and 10 being worst pain ever) is recorded before and 10 minutes after the procedure. Patients are followed up in clinic at 6 weeks, 3 months, 6 months and 9-12 months after injection to assess the pain relief and pain score is recorded at every visit. Any complication relevant to the procedure is also documented. We analysed the data of our first 24 patients to see the outcomes of this procedure in medium to long term. **Results:** All patients were in severe pain before the injection and would score 10/10 on visual analogue scale. Twenty three out of 24 (96%) patients reported no pain or nearly no pain (pain score less than 2) and complete relief of tenderness 10 minutes after injection. Twenty one patients (88%) remain pain free at 3 months follow up. Excellent pain relief (pain score 4 or less) was maintained in 83% patients at 6 months. About 50 % of the patients who were followed up at 9 months stated recurrence of pain and discomfort (with pain score more than 5) however, symptoms were not as severe as before injection. No procedure related complication was recorded. **Conclusion:** Cluneal nerve block can be safely performed as clinic procedure. It is very effective in a selective group of patients and provide excellent pain relief for over 6 months.

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PI90: Adverse events relating to prolonged hard collar immobilisation: a systematic review

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Introduction: Rigid cervical collars are commonly used in the management of cervical spine disorders. Although often short-term, for example in the case of acute trauma assessment, cervical immobilisation may continue for weeks or months to treat fractures non-operatively, or as an adjuvant to cervical spine surgery. Whilst prolonged immobilisation is recognised to cause complications, their frequency and nature are poorly characterised. Our objective was to evaluate systematically the complications of prolonged cervical immobilisation in a hard collar. **Material and Methods:** Our study design was a systematic review and meta-analysis. Following registration with PROSPERO, a systematic search of electronic databases (MEDLINE, EMBASE) was conducted. Two reviewers independently screened the search Results according to pre-determined search criteria. Data were extracted and tabulated. Joanna Briggs Institute (JBI) checklists were used for assessing the quality of included studies. **Results:** The search identified 773 articles. A total of 25 studies were selected for final inclusion. The Results largely comprised a mixture of case reports/series, cohort studies and reviews. The most commonly reported complications were pressure ulcers, dysphagia and increased intracranial pressure (ICP). A pressure ulcer pooled prevalence of 7% was calculated. There was no significant association between either age or duration of immobilisation and the prevalence of pressure ulceration. There were insufficient data for quantitative analysis of any other complication. **Conclusion:** There is significant morbidity from prolonged hard collar immobilisation, even amongst younger patients. Whilst based upon limited and low-quality evidence, these findings, combined with the low-quality evidence for the efficacy of hard collars, highlights a knowledge gap for future research.

1166

P191: Conservative treatment protocol for vertebral osteoporotic fracture in post menopausal females

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Introduction: Painful Spinal osteoporotic fractures pose significant morbidity to patients and a major cause of socio-economic burden to an individual and society. Vertebroplasty and Kyphoplasty are standard treatment care desired to restore vertebral height and alleviate pain; however, they are associated with significant complications. We evaluated the efficacy of conservative treatment of osteoporotic Vertebral Fractures in postmenopausal females. **Material and Methods:** A total of 94 postmenopausal osteoporotic females

(BMD spine $.76 \pm .09$ gm/cm²) with vertebral fractures, between age group 50- 75years, presented with a total of 106 vertebral fractures were enrolled. All patients were treated initially with bed rest, analgesics followed by hyper-extension bracing and a supervised physical therapy programme for strengthening back extensors. All patients were given weekly alendronate with calcium, and Vitamin D. Failure of treatment was defined as persistence of VAS score five or above at the end of two months of treatment. The adverse outcome was accessed in terms of the occurrence of another fracture or death. All patients were followed up clinically and radiologically. Functional outcome was evaluated in terms visual analog scale (VAS) and Oswestry Disability Index (ODI). **Results:** At the final follow up of one year, there was a significant improvement in VAS score ($P < .001$) from 9.4 to 2.6 and ODI ($P < .001$) from 57.8 to 25 from baseline. Thirteen patients failed to respond to conservative treatment. Eight patients suffer a further hip fracture, and three patients suffer wrist fracture. Six patients died because of other associated comorbidities. **Conclusion:** We observed improved quality of life with conservative treatment, and it is cost-effective, more ever free from operative complications. Conservative treatment is a viable and effective alternative treatment option for osteoporotic spinal fractures.

Novel Technologies

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P192: Analysis of the morphometric change in the uncinate process of the cervical spondylosis patients: A study of radiological anatomy

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Introduction: Purpose: Although there are many researches that focus on the relationship between the vertebral artery and uncinate process (UP), there were no publications concerning difference in the dimensions of the UP between the normal spine and degenerative spine, especially in Chinese patient. The purpose of this study is to determine the anatomic parameters that can be used as a guide for the procedure in intervertebral foramen decompression and for analysis of the morphometric change in the UP of the cervical spondylosis patients. **Material and Methods:** Forty patients from January 2016 to January 2019 were enrolled in this study. Three-dimensional computed tomography scans of the cervical spine were performed. The patients were subdivided into two groups which were nondegenerative cervical spine group (20 cases) and degenerative cervical spine group (20 cases). Six parameters concerning the height, width and angle of the UP

were measured. **Results:** In nondegenerative group, the average pedicle width was 3.63 mm - 5.91 mm from C3 to C7. The average width of safe UP resection will be 3.06 mm at C3, 3.12 mm at C4, 3.28 mm at C5, 2.74 mm at C6 and 2.01 mm at C7. The average safe depth will be 6.04 mm at C3, 6.52 mm at C4, 7.61 mm at C5, 6.07 mm at C6 and 5.09 mm at C7. There are statistical difference between degenerative group and nondegenerative group, especially in the parameter minimum height of UP, maximum height of UP, medial border's distance of UP and later border's distance of UP. **Conclusion:** In this retrospective study, our Results suggest that for the Chinese patients who suffered from cervical spondylosis could be performed intervertebral foraminotomy decompression by resecting part of the UP. The safe range within the spinal canal was up to 6.73 mm of width between inferior vertebral endplate and superior vertebral endplate in the intervertebral space and up to 5.09 mm of depth from medial border of the UP to the lateral side at C3 to C7 without interfering the spinal nerve root and vertebral artery. The translational potential of this article: Our study found the safe margin to perform intervertebral foramen decompression to the UP for the cervical spondylosis patients. This may help to improve safeness of the surgical procedure and provide data for future robotic surgery.

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P193: Clinical and radiological outcomes following the use of triangular sacro-iliac joint cages in addition to S2AI screws (bedrock technique) to enhance spinopelvic fixation

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Introduction: The pelvis is an important caudal anchor point for long construct spinal fusions. The use of S2 alar-iliac (S2AI) screws has been shown to have less complications than traditional iliac bolts and allows for easier rod insertion. However, as the sacro-iliac joint (SIJ) is not fused, there are still potential problems with toggling, loosening and breakage. About 12% of patients also complain of SIJ pain. The Bedrock technique involves adding triangular titanium implants across the SIJ from a medial to lateral trajectory above the S2AI screws. We aimed to assess the clinical and radiological outcomes of this technique. **Material and Methods:** Pre-operative EQ-5D 5L index, EQ-5D 5L VAS, Oswestry Disability Index (ODI) and Visual Analogue Scale (VAS) questionnaire scores were obtained in all patients who underwent this technique. Enhanced spinopelvic fixations using

the Bedrock technique were performed in a single tertiary specialist centre by two senior surgeons. All implants were inserted using computer navigation. We prospectively reviewed patient reported outcome measures (PROMS) at six and 12 months following surgery. CT scans were performed at 12 months to assess fusion rates. All patients had a minimum of 12 months follow-up and were assessed for SIJ pain. **Results:** Of our cohort of 15 patients, 10 had adult degenerative scoliosis, two had spondylolisthesis and positive sagittal balance and three had revision surgery for previous flat back fusions and metalwork failures. Follow-up ranged from 12 to 30 months. At 12 months, EQ-5D 5L index increased from .28 to .70, EQ-5D 5L VAS from 44.5 to 76.8, ODI decreased from 58.75 to 26.33, VAS leg decreased from 6.65 to 1.41 and VAS back decreased from 7.33 to 2.01. None of the patients complained of any SIJ pain. 15 of our patients had CT scans at exactly 12 months post-operatively. CT scans of all these patients revealed good evidence of fusion at 12 months with bone growing through the SIJ cages. There were no cases of distal implant failure or evidence of screw loosening. **Conclusion:** The clinical and radiological Results from our study reveal that the use of triangular SIJ cages in addition to S2AI screws (Bedrock technique) in long construct adult deformity surgery resulted in good outcomes with no mechanical failure of the spinopelvic fixation.

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P194: Modified Morscher technique for athletic pars repair: a case series and literature review

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Introduction: The lumbar spine is particularly susceptible to stress fracture of the pars interarticularis due to repetitive physical activity or acute traumatic injury as a result of uneven distribution of isthmic ossification formation. Previous studies have shown up to 95% patients achieve full recovery with an initial conservative treatment with nearly 85% of young athletes are reported to return to competition within 4 to 6 months, although some continue to have symptomatic lumbar back pain and are unable to return to sport. In this study, we present clinical outcomes of young adult patients treated for activity-induced lumbar spondylolysis using a modified Morscher technique with pedicle screws with underlying hooks (PSUH). We hypothesize this modified technique will lead to excellent fusion rates and few complications. **Material and Methods:** Between 2012 and 2017, 12 patients underwent pars repair surgery by a single surgeon at a level 1 trauma and tertiary referral center. Retrospective chart review was utilized to collect demographic data and

outcomes. Patients were indicated for surgical repair for significant lower back pain and failed conservative treatment. The primary outcomes were pain, assessed using visual analog score (VAS), and disability, determined using the Oswestry Disability Index (ODI). The patients were brought to the operating room and placed supine on the operating table. Fluoroscopy was utilized to confirm operative levels, and minimal midline dissection was performed with appropriate exposure of operative levels. Stereotactic navigation was utilized to perform takedown of spondylolysis pseudarthrosis by complete decortication with high-speed burr. **Results:** The study population and final data analysis contained five males and five females whose mean age at time of repair was 18.6 years (range 15 to 32 years). The primary outcome mean VAS score improved from 7.2 out of 10 preoperatively (95% CI: 5.4 - 9.0) to 2.4 out of 10 (95% CI: .6 - 4.2), representing an absolute reduction of 4.8 points. Among the 5 patients with complete pre- and post-operative ODI scores, the primary outcome ODI score decreased from 27.96% preoperatively (95% CI: 2.20 - 35.72) to 18.62% postoperatively (95% CI: .36 - 36.89). After at least 2 years of follow-up, all 10 patients described either full resolution or subjective marked improvement of their preoperative symptoms, with none experiencing symptom worsening. All 10 patients returned to sport on average by 8.3 months (range 1.5 to 17) after surgery. **Conclusion:** In this study, patients with pre-existing spondylolisthesis experienced a mean VAS reduction from 8 (95% CI: 6.0-9.96) to 1 (95% CI: 1-1). In addition, ODI score was reduced from 31.89% (95%CI: 2.35-43.43) to 11.45% (95% CI: 6.44-16.46). Though the sample size was smaller (5 out of the 10 total patients had listhesis, only 2 had complete pre- and post-operative data and were included in this sub-analysis), these are more robust changes than in the entire study population. This suggests that the PSUH method of surgical repair may have enhanced efficacy for pain and symptom relief in patients with underlying low-grade spondylolisthesis in addition to spondylolysis.

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P195: Current trends and future scope in 3D printing for surgical management of spine pathologies

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Introduction: 3D printing technology has increasing applications in spine surgery due to its many realized and potential benefits. This review aims to explore the current and future potential of 3D printing technology in various aspects of spine surgery. **Material and Methods:** A review of the literature was performed to expound on the application of 3D printing

technology in various aspects of spine surgery such as: (i) patient education & surgical training; (ii) patient-specific intervention; (iii) condition-specific intervention; and (iv) emerging applications. The MeSH terms used for the literature search included “3d printing”, “spine”, “orthopedics”, “patient”, “pathology”, “tumor”, “spinal neoplasms”, “osteoporosis”, “education”, “training”, “surgery”, “deformities”, “titanium”, “polymers”, “polyetheretherketone”, “carbon fiber”, “orthoses”, “porosity”, “elastic modulus”, “weight-bearing”, “infections”, “corrosion”, “radiotherapy”, “x-ray”, “magnetic resonance imaging”, “artifacts”, and “osseointegration”. In addition, the following free text words were also used: “additive manufacturing”, “anatomy”, “metastatic spine tumor surgery”, “spine surgery”, “implants”, “rigidity”, “bioactivity”, “computed tomography”, “chemotherapy” and “stress shielding”. Logical strings were created using the MeSH terms and free text words to search in PubMed and Google Scholar and retrieve the relevant articles. **Results:** The ability of 3D printing technology to geometrically mimic spinal anatomy enables the manufacturing of realistic anatomical models which can aid in patient education and surgical training. Current applications of 3D printing in spine surgery can be broadly categorized under patient-specific applications or condition-specific applications. 3D printed patient-specific applications centre around 3D printing’s ability to mimic/complement the geometry of anatomical structures. This gives rise to custom implants which improve the efficiency & clinical outcome of surgical intervention. Similarly, 3D printed surgical templates improve surgical accuracy and safety. Spinal pathologies such as osteoporosis and/or tumour involvement have an adverse effect on the spine’s biomechanical properties, thereby placing more stringent requirements on implants used. Condition specific applications serve to mitigate such adverse effects through design modifications and 3D printing’s ability to work with a wide range of materials to alter an implant’s biomechanical properties. **Conclusion:** The ideal implant should be both patient-specific and condition-specific to maximize the compatibility of the implant with the body and the effectiveness of instrumentation & adjuvant treatments. As the state of 3D printing technology advances, better resolution of printing, improved understanding of the effects of scaffolds & lattices, and the availability of more 3D printable implant materials would allow for more optimal patient-specific & condition-specific implants and emerging applications such as biodegradable implants and localized drug delivery system.

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P196: Pedicle screw classification and evaluation using deep learning

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Introduction: In spine surgery, the evaluation of pedicle screws from radiological images after screw insertion is an important and decisive step during and after the surgical procedure. Based on the intra- and postoperative verification of screws, decisions on acceptable screw position or replacement can be made. We explore the possibility of using Artificial Intelligence (AI) to classify screw positions from radiological images using a limited dataset, readily available convolutional neural networks (CNNs), and basic computer equipment. **Material and Methods:** Collection and pre-processing of pedicle screw images, construction of a dataset of single screw images categorized into either IN (screw situated completely within the cortex of the pedicle) or BREACH (screws penetrating the pedicle either medially or laterally). Applying the categorized dataset for training, validation, and testing through transfer learning using 19 pre-trained and readily available CNNs in MATLAB. Lastly, an evaluation of the performance, outcome, and accuracy of these CNNs in classifying pedicle screws were made and compared to each other. **Results:** The developed deep learning frameworks were capable of categorizing pedicle screws into “IN” and “BREACH”, with the best network achieving an 83.8% accuracy and with an overall average accuracy of 76.4%. **Conclusion:** The proposed method shows promising Results for further use and training of CNNs for the purpose of pedicle screw evaluation and classification in spine surgery. Such systems may provide an applicable intraoperative assessment tool as well as clinical decision support for surgeons.

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P197: The most familiar stranger, I want to know you more - Quantitative analysis of the effective area of lumbar puncture approach based on 3D data analysis (double the effective area of lumbar puncture)

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Introduction: Puncture failure is a common phenomenon in lumbar puncture, which may be caused by insufficient puncture area and small puncture tolerance range. This article describes a new approach to improve the success rate of lumbar puncture based on data analysis. **Material and Methods:** Based on CT data of 10 patients in supine position and bent position, the effective dural area of lumbar puncture method was analyzed on 3d data, and an improved lumbar puncture scheme was proposed. The scheme can improve

effectively the puncture area is nearly 2 times, reduce the damage probability 1 times the line by the root. Subsequently, a randomized controlled trial was conducted in which 10 patients received the modified method and 10 patients received the conventional method to evaluate the puncture success rate, VAS score for puncture pain, and complications.

Results: The single success rate of the modified lumbar puncture was 90%, compared with 70% for the traditional lumbar puncture. The VAS score of the modified method was $2.8 \pm .79$ and that of the traditional method was 4.40 ± 1.17 , the difference was statistically significant ($P < .05$). In terms of complications, the incidence of nerve root irritation was 10% by modified method and 20% by traditional method. Both modified and traditional method have the same headache rate of 10%. **Conclusion:** Improved lumbar puncture based on data analysis can achieve a larger puncture area, higher success rate and greater safety, while being simpler to perform and reducing postoperative pain scores.

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P198: Mid-term outcome of Ti-nanocoated PEEK cages: less revision operations than uncoated PEEK cages

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Introduction: Posterior lumbar interbody fusion is an accepted treatment for degenerative spinal disorders, e.g. chronic low back pain. Standard PLIF cages are made of Titanium or PEEK. Both materials have their specific advantages and disadvantages. For instance, PEEK has an elastic modulus similar to bone, offering mechanical compatibility. PEEK is also a radiolucent material, permitting easy assessment of radiological imaging. It is however an inert material, so osseointegration remains limited. Coating PEEK with Titanium should combine the best of both materials, and therefore lead to higher osseointegration, which is a significant predictor of positive long-term clinical outcomes. Besides the material, the topography of a cage is very important. Ideally, the interaction between the coating and the crucial components of the osseointegration process (bone cells and proteins) is optimized. We use nanocoated cages from Orthobion GmbH (Konstanz, Germany). The patented technology firstly has a micro topography with grooves to increase bone cell anchorage and adhesion. Secondly, a nano topography is applied to increase the surface area for proteins involved in the osseointegration process. The mechanical and biological stability of these cages have been confirmed in mechanical and animal studies. Furthermore, a one-year follow-up of a randomized controlled clinical study indicates that the Ti-nanocoated PEEK cages have significantly more definite fusion compared to uncoated PEEK cages (control), while

offering the same safety and clinical outcome. In this research, we want to compare the reoperation rates up to five years after the initial surgery between the two patient cohorts: Ti-nanocoated PEEK cages and uncoated PEEK cages. **Material and Methods:** Patients between 18 and 75 years old with chronic mechanical low back pain were recruited for the clinical study. A total of 70 patients was included: 34 patients in the Ti-nanocoated PEEK cage cohort and 36 patients in the uncoated PEEK cage cohort. Among these patients, we examined the rate of subsequent revision surgery during a five-year follow-up period. **Results:** The five-year reoperation rate for patients treated with the uncoated PEEK cages was 22.2% (8 patients). On the other hand, patients treated with the Ti-nanocoated PEEK cages had a significantly lower reoperation rate of 2.9% (1 patient; $p = .02$). Moreover, the average time period between the initial and the revision operation was 2,3 years for uncoated PEEK cages and 5,3 years for Ti-nanocoated PEEK cages. **Conclusion:** Reoperation rates are a useful tool to study the mid-term outcome of a surgery, as the clinical and radiographical deterioration leading to the revision are the ultimate evidence of the initial surgery failure. Previous studies have demonstrated that the Ti-nanocoated PEEK cages lead to a higher fusion rate, one year after the surgery, whereas there is not yet a noticeable difference in clinical outcome. This study shows that revision operation is significantly less likely for Ti-nanocoated PEEK cages than for the uncoated PEEK cages (in a five-year follow-up period). Therefore, we conclude that Ti-nanocoated PEEK cages lead to a superior radiological and clinical outcome compared to uncoated PEEK cages in the mid-term.

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P199: Clinical and radiographic outcomes of anterior lumbar interbody fusions using titanium cage with nano-surface technology

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Introduction: The titanium cage with nano-surface technology utilizes nanotechnology in order to elicit an endogenous biochemical and cellular response leading to improved fusion. To our knowledge, this is the only study to highlight the early clinical and radiographic experience of using the titanium cage with nano-surface technology in anterior lumbar interbody fusions (ALIFs). **Material and Methods:** A retrospective chart review of data for patients who underwent single or multilevel ALIFs using titanium cage with nano-surface

technology for degenerative lumbar spine disease was performed. Data was collected from 84 patients that met our inclusion and exclusion criteria. Their clinical and radiographic outcomes were assessed. **Results:** The mean follow up was 36.6 ± 14 months. At 6 months, solid fusion was seen in 97.6% of patients. At 12 months, solid fusion was seen in 98.8% of patients. Significant improvements were seen in patient reported outcome measures (PROMs) (visual analog scales [VAS] and Oswestry Disability index [ODI]) at 6 and 12 months compared to the preoperative scores ($P < .001$). One patient required a reoperation for broken pedicle screws two days after the ALIF surgery. None of the patients required readmission within 90-days of surgery. No patients experienced an infection. **Conclusion:** ALIFs using the titanium cage with nano-surface technology showed early signs of fusion at 6 months with most patients (98.8%) fusing at 12 months. There was significant improvement in PROMs at 6 and 12 months.

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P200: Correction of L5 tilt and fractional curve in vertebral body tethering versus fusion for adolescent idiopathic scoliosis in a large single center analysis

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Introduction: Untreated idiopathic scoliosis (IS) can lead to compensatory changes such as worsening of the fractional curve distal to the major curve and coronal L5 tilt. Progression of the fractional curve and L5 tilt have been associated with worse patient outcomes. While posterior spinal fusion (PSF) is the gold standard for treating IS, it carries significant limitations, including limited flexibility and growth in fused segments. Additionally, its risk of degenerative changes adjacent to the fused levels, as well as PSF's inability to caudally extend its construct, may lead to further progression of the distal fractional curve and L5 tilt. Vertebral body tethering (VBT) shows promising **Results** as a fusion-alternative in IS treatment. Avoidance of rigid fusion allows for routine selection of lower LIVs, allowing for excellent coronal imbalance correction. Given the novelty of this technique, limited evidence comparing VBT to PSF exists to date. This study compares fractional curve and L5 tilt correction in a large single-center cohort of IS patients undergoing VBT

versus fusion with LIV in the lumbar spine. **Material and Methods:** Retrospective analysis included IS correction surgeries with LIV in the lumbar spine from 2013 to 2020 from a single center with pre- and 3-month postop standing full body plain films available. Patients were grouped as VBT or fusion. Outcome measures included age, height, weight, BMI, Risser score, LIV and levels instrumented. Radiographic analysis included pre- and postop main, secondary, and fractional curve Cobb angles, and pre- and post L5 tilt. Measures were compared using independent samples t-tests, significance set at $P < .05$. Propensity matching (PSM) was completed for demographic differences. **Results:** 76 patients (34 VBT, 42 PSF) were included in the study. VBT cases were more frequently extended to L4 (61.8% v 11.9%, $P < .001$). There were no differences in preop L5 tilt or main, secondary or fractional curve angles. VBT had significantly smaller postop fractional curve (8.4 ± 7.9 v 14.2 ± 6.8 deg, $P = .001$) and postop L5 tilt (6.5 ± 4.8 v 9.7 ± 4.6 deg, $P = .004$). The VBT group had a significantly greater improvement in L5 tilt (-7.6 ± 4.5 v -4.4 ± 4.7 deg, $P = .004$). After PSM for Lenke classification, 44 patients (25 VBT, 19 fusion) remained. VBT patients continued to demonstrate significantly greater correction of L5 tilt (-7.6 ± 4.9 v -4.1 ± 4.5 deg, $P = .02$) and fractional curve (-16.5 ± 1.3 v -1.8 ± 7.7 deg, $P = .043$). The VBT group also showed significantly larger postop main curve (29.3 ± 1.7 v 21.5 ± 4.6 deg, $P = .006$). **Conclusion:** In this high-powered retrospective cohort study, it was shown that VBT allows for more caudal LIV selection and offers improved L5 tilt and fractional curve correction when compared to fusion for IS. These findings suggest that VBT is a reasonable alternative to PSF that may prevent some complications seen in PSF, including adjacent segment disease and loss of mobility.

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P201: Post-operative paresthesias in adolescent idiopathic scoliosis patients treated with thoracoabdominal vertebral body tethering

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Introduction: Vertebral body tethering (VBT) for idiopathic scoliosis (AIS) utilizes a retroperitoneal approach to achieve tether placement for thoracolumbar curves. Due to the retroperitoneal approach, paresthesia and/or numbness on the medial

aspect of the thigh can occur due to the anatomy of the psoas muscle. To date, no description of the frequency or risk factors for these sensory changes has been published. This study examined how intraoperative neurologic monitoring and clinical and surgical characteristics can be used to predict transient sensory changes in the thigh following anterior-to-the-psoas approach for VBT of AIS patients. **Material and Methods:** AIS patients who underwent anterior-to-the-psoas approach for VBT at a single academic medical center from 2020 through 2021 were retrospectively analyzed. Demographic and clinical characteristics were obtained. Intraoperative neurologic monitoring and clinical variables were assessed for all patients who underwent anterior-to-the-psoas approach for VBT. Differences in variables were assessed via T-test and chi-square, significance set at $P > .05$. **Results:** 30 patients were included in this case series. 15/30 (50%) experienced no postoperative paresthesias and 15/30 (50%) experienced transient numbness and/or tingling in the thigh. There were no differences in demographics between groups. 3 patients (10% total cases) experienced Iliopsoas (IP) irritation. 54.5% of patients with paresthesias had a change in Quadriceps MEP ($P = .043$). However, there were no significant differences in IP/Adductor MEPs or Saphenous SEPs between the groups. All sensory changes resolved without intervention. 57.1% resolved with ambulation, 28.6% resolved within 2 weeks, and the remaining 14.3% resolved after 2 weeks. The average time to symptom resolution was 6 days. There were no significant differences between patients who developed paresthesias and those who did not with regard to levels corrected (8.40 vs 8.67 , $P = .771$), operative time (473.20 vs 493.53 min, $P = .646$), estimated blood loss (303.33 vs 373.33 mL, $P = .247$), preoperative lumbar Cobb angle (43.76 vs 5.69° , $P = .0980$) or postoperative Cobb angle (2.79 vs 24.42° , $P = .454$). **Conclusion:** Anterior-to-the-psoas approaches as part of VBT corrections are safe and effective. An anterior-to-the-psoas approach decreases complication risks, which is further supported by the absence of post-op motor deficits for this entire study cohort. Despite a significant difference in Quadriceps MEP between those with and without sensory symptoms, no clinical presentation correlated to this difference. Other neuromonitoring and clinical characteristics were not predictive in this study. Sensory changes resolved without intervention within several weeks for all included patients.

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P202: Multirod instrumentation in cervical spine: a novel surgical concept

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Introduction: Background: Clinical scenarios like unstable fractures/ dislocations, ankylosing spondylitis, deformity correction, revision surgeries and spinal tumours often require complex spinal reconstructions and pose a surgical challenge especially in cervical spine. Adding a third rod in the cervical spine has superior biomechanical advantage in all planes of motion. Recent biomechanical study has shown the advantage of adding a third rod in the cervical spine has superior biomechanical advantage in all planes of motion. However, this technique has not been previously described in clinical scenarios in the cervical spine and ours is the first study to discuss its usage. In this case series we review application of more than 2 rods in cervical spine. We will also describe the technical steps for the same and propose an algorithm for its potential indications. **Material and Methods:** Prospective case series of 8 patients, using lateral mass and pedicle screws on the same side of spine allowed 2 longitudinal rods to be placed per side, with a total of three or four independent longitudinal rods per reconstruction. Understanding of the individual patient anatomy is vital to successful and accurate placement of pedicle screws in the dual construct (lateral mass and pedicle screw). Care must be taken to “visualize” the overall construct, before placement of the screws. This visualization will enable to critically plan the starting point and trajectory of each screw being placed in order to accommodate multiple rods. **Results:** Unstable pathologies in cervical spine with pan column destruction needing a construct with a higher biomechanical strength were analyzed. 8 patients with tumor-2, trauma-2, Anderson lesion-2, infection-1, C1-2 instability with dystonia-1. Were operated with lateral mass and cervical pedicle screws and Multirod construct. No instrument failure was noticed at > 1 year follow-up. One patient had dural tear with no further complications. We did not have any visceral, vascular or neural injury in this series. **Conclusion:** A multi rod construct offers a viable alternative in cervical spine stabilization especially when additional stability is needed. This being a stiff construct buys time for fusion and reduce chances of early rod fracture and pseudoarthrosis. We hope this study would act as a conceptual technique which may be used in certain indications.

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P203: Cervical alignment following vertebral body tethering for adolescent idiopathic scoliosis versus fusion

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Introduction: Vertebral body tethering (VBT) takes advantage of the Hueter-Volkman principle and modulates growth across intervertebral disc spaces with a tensioned tether secured at the lateral aspects of vertebral bodies. Cervical deformity in adolescent idiopathic scoliosis (AIS) patients is associated with lower health related quality of life. Posterior spinal fusion (PSF) constructs have been shown to improve cervical deformity; however, to date, these relationships have not been described in patients treated with VBT. This single-center retrospective cohort study compares cervical sagittal parameters in AIS patients either undergoing VBT or fusion. **Material and Methods:** Retrospective analysis of AIS correction surgeries with LIV in the lumbar spine from 2013 to 2020 with pre- and 3-month postop standing full body plain films available. Patients were grouped as VBT or fusion. Outcome measures: Age, height, weight, BMI, Risser score, LIV and levels instrumented. Radiographic analysis included pre- and postop C2 to C7 sagittal vertical axis (cSVA), cervical lordosis angle (CL), T1 slope and thoracic kyphosis (TK). Measures were compared using independent samples t-tests, with significance set at $P < .05$. PSM was completed for demographic differences. **Results:** 76 patients (34 VBT, 42 PSF) were included in the study. There were no significant differences in patient age, BMI, Risser or levels instrumented. VBT cases were more frequently extended to L4 (61.8% v 11.9%, $P < .001$). There were no preop differences in cSVA, CL, T1 slope and TK. VBT had a significantly greater improvement in cSVA than PSF (-3.3 ± 1.6 mm v -1.6 ± 6.5 mm, $p = .018$). Both groups displayed improvement in radiographic parameters of cervical and thoracic alignment including CL (-8.3 v -6.3 , $p = .437$), T1 slope (2.4 deg v 5.2 deg, $p = .156$) and TK (1.3 deg v 3.3 deg, $p = .450$). After PSM for Lenke classification, 42 patients remained (17 VBT, 25 PSF). The VBT group continued to demonstrate greater improvement in cSVA than the PSF group (-3.2 ± 9.5 mm v -3.1 ± 5.4 mm, $p = .021$). Both groups displayed similar radiographic improvements in cervical and thoracic alignment. **Conclusion:** This **Results** of this study showed that VBT and PSF both improve radiographic parameters of cervical lordosis, T1 slope and thoracic kyphosis in AIS patients, but with VBT demonstrating greater improvement in cSVA than PSF. VBT represents a viable alternative to PSF that may address compensatory cervical deformities in AIS patients.

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P204: Histological analysis of a biodegradable and biocompatible hydrogel for local bupivacaine delivery following spinal surgery in a sheep model

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Introduction: Effective postoperative analgesia is an active field of research. A focus shift towards localized treatments, minimizing the need for systemic analgesics such as opioids is taking place. Various sustained-release formulations of local anesthetics are in development, but most provide limited effect beyond 24 hours. Further, their liquid state allows drug diffusion away from the target site, limiting their applicability in spine surgery. Ideally, a local anesthetic sustained release formulation for use in spinal surgery should stay at the target site, should be biocompatible and -degradable and provide high local drug concentrations. To provide stationary and sustained analgesia following instrumented spinal surgery, we developed a robust yet deformable ring-shaped hydrogel encapsulating high doses of crystallized bupivacaine, designed for co-implantation with pedicle screws. This study assesses its compatibility and biodegradability. **Methods:** Eight sheep underwent spinal implantation of four or eight hydrogel rings mounted on pedicle screws and were sacrificed at 1, 2, 6, 9 and 12 months after surgery. Body weight and occurrence of adverse events were recorded during follow-up. Hydrogels were explanted, dried and weighted to quantify in vivo degradation. Tissue samples of the implantation site were obtained at termination and hematoxylin and eosin staining was performed for histological analysis. Foreign body reaction was scored on a qualitative basis. **Results:** Hydrogel ring implantation was successful in all 8 sheep and remained in place under the screw head after surgery. Hydrogels slowly degraded over the course of 12 months. Histological analysis of implant sites revealed a conventional foreign body response characterized by fibrous capsule formation and multinuclear giant cells, subsiding over the course of follow-up. Body weights remained stable for the duration of the experiment. No adverse events were recorded in any sheep during follow-up. **Conclusion:** Bupivacaine-releasing hydrogels designed for co-implantation with pedicle screws were well-tolerated in a sheep model for spinal surgery. Histological analysis revealed that hydrogels were biocompatible and underwent slow biodegradation within 12 months. The present hydrogel has the potential to provide localized and sustained analgesia following instrumented spinal surgery.

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P205: CT-guided measurements of cervical pedicle screws to improve the accuracy of robot-assisted cervical pedicle screws placement: a case series and systematic review

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Introduction: Robotically-assisted placement of cervical pedicle screws (CPS) has been shown to result in high breach rates. An accurate characterization of the dimensions of the pedicles in the cervical spine is critical in order to facilitate surgical planning of CPS implantation. The purpose of this study is to characterize the dimensions of cervical pedicles and trajectories. This will allow for design of properly sized robotic instruments for use in the cervical spine and for optimization of pre-operative planning in robotic-assisted CPS placement. **Material and Methods:** The study was a retrospective review of CT images of the sub-axial cervical spine. The primary endpoints addressed are the dimensions of the pedicle and surrounding anatomy. Specifically, we evaluated Pedicle Height (PH), Pedicle Width (PW), the Maximum Screw Length (MSL), Pedicle Transverse Angle (PTA), and Transverse Foramen Diameter (TFD). Secondary endpoints include differences in the pedicle dimensions based on gender, age, and obesity. Furthermore, we conducted a systematic literature search to compare our **Results** with different countries. **Results:** The overall mean PW and PH ranged from 4.68mm to 6.70 mm and 6.93 to 8.28 mm, respectively. The overall mean MSL ranged from 34.30 to 34.87mm. The overall mean PTA was approximately 52.2° from C3 to C6 and 4.4° at C7. The mean PW, PH, and MSL were greater in males than in females, and this difference was statistically significant at all levels ($p < .05$). Mean TFD was largest at C5 (7.37mm) and smallest at C7 (5.82mm). No differences were found in dimensions with respect to the age or weight of the patient. The literature search showed that our pedicle dimensions are larger than those published in Asia but consistent with those from studies conducted in the US, Europe, and South America. **Conclusion:** In this study, we found that pedicle size increases moving from C3-C7. Men have larger pedicle sizes with respect to PW, PH, and MSL. This data can be utilized to improve the accuracy of robotically-assisted CPS placement and to design robotic instrumentation appropriately sized for the cervical spine.

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P206: How are patients describing you online? A natural language processing driven sentiment analysis of online reviews on CSRS surgeons

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Introduction: Physician review websites have influence on a patient's selection of a provider, but written reviews are subjective. Sentiment analysis of writing through artificial intelligence can quantify surgeon reviews to provide actionable feedback. This study quantitatively analyzes the written reviews

of members of the Cervical Spine Research Society (CSRS) to report biases associated with demographic factors and frequently used words in reviews to help aid physician practices. **Material and Methods:** Online written and star-rating reviews of CSRS surgeons were obtained from healthgrades.com. A sentiment analysis package was used to obtain compound scores of each physician's reviews. The relationship between demographic variables and average sentiment score of written reviews were evaluated through t-tests. Positive and negative word and bigram frequency analysis was performed to indicate trends in the reviews' language. **Results:** 2239 CSRS surgeon's reviews were analyzed. Analysis showed a positive correlation between the sentiment scores and overall average star-rated reviews ($r^2 = .60$, $P < .01$). There was no difference in review sentiment by provider gender. However, the age of surgeons showed a significant difference as those < 55 had more positive reviews (mean = $+.50$) than surgeons \geq (mean = $+.37$) ($P < .01$). The most positive reviews focused both on pain and behavioral factors, whereas the most negative focused mainly on pain. **Conclusion:** The top-rated surgeons were described as considerate providers and effective at managing pain in their most frequently used words and bigrams. However, the worst-rated ones were mainly described as unable to relieve pain. Through quantitative analysis of physician reviews, pain is a clear factor contributing to both positive and negative reviews of surgeons, reinforcing the need for proper pain expectation management.

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P207: What are patients saying about you online? A natural language processing driven sentiment analysis of online reviews on scoliosis research society surgeons

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Introduction: Physician review websites have significant influence on a patient's selection of a provider, but written reviews are subjective. Sentiment analysis of writing through artificial intelligence can quantify surgeon reviews to provide actionable feedback. The objective of this study is to quantitatively analyze the written reviews of members of the Scoliosis Research Society (SRS) through sentiment analysis. **Material and Methods:** Online written reviews and star-rating reviews of SRS surgeons were obtained from healthgrades.com, and a sentiment analysis package was used to obtain compound scores of each physician's reviews. A t-test and ANOVA was performed to determine the relationship between demographic variables and average sentiment score of written reviews.

Positive and negative word and word-pair frequency analysis was performed to provide context to words used to describe surgeons. **Results:** 721 SRS surgeon's reviews were analyzed. Analysis showed a positive correlation between the sentiment scores and overall average star-rated reviews ($r^2 = .5$, $P < .01$). There was no difference in review sentiment by provider gender. However, the age of surgeons showed a significant difference as younger surgeons, on average, had more positive reviews ($P < .01$). **Conclusion:** The most frequently used word-pairs used to describe top-rated surgeons describe compassionate providers and efficiency in pain management. Conversely, those with the worst reviews are characterized as unable to relieve pain. Through quantitative analysis of physician reviews, pain is a clear factor contributing to both positive and negative reviews of surgeons, reinforcing the need to properly manage pain expectations.

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P208: International validation of natural language processing algorithms for automated detection of incidental durotomy: three independent cohorts from two continents

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Introduction: Natural language processing (NLP) is an emerging methodology for automated surveillance of adverse events in orthopaedic surgery. The purpose of this study was to validate NLP algorithms for automated detection of incidental durotomy in patients from Massachusetts, Maryland, and Australia. **Material and Methods:** Patients 18 years or older undergoing lumbar spine surgery in Massachusetts, Maryland, and Australia were included. The primary outcome was defined as intraoperative durotomy. Performance of the NLP algorithms was assessed by discrimination via area under receiver-operating curves (AUC). **Results:** Overall, 1,000 patients from Massachusetts, 1,279 patients from Maryland, and 944 patients from Australia were included. NLP algorithms developed on the Massachusetts cohort had excellent performance on the Maryland cohort (AUC = $.97$) but worse performance on the Australian cohort (AUC = $.77$). A hybrid NLP algorithm combining data from Australia and Massachusetts achieved excellent performance on independent testing data from Australia (AUC = $.97$) and Maryland (AUC = $.95$). **Conclusion:** Hybrid NLP algorithms retain excellent performance in individual countries relative to algorithms developed in the same country alone. Further multi-institutional, international collaborations can facilitate the creation of universal NLP algorithms that improve the quality and safety of orthopaedic surgery.

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P209: The application of stem cells in spinal surgery: is it feasible in clinical practice and what is the updated state of the art? A systematic review

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Introduction: In recent years, stem cells (SC) have become the focus of research for regenerative medicine and tissue engineering professionals. The application of SC in spinal pathology has focused on spinal fusion (SF), degenerative disc disease (DDD) and spinal cord injury (SCI), being considered as a promise of improvement with respect to current techniques. Despite the important research in basic sciences in vitro and in animal models, the literature is heterogeneous regarding the type of SC used, the use of carriers and adjuvants, the harvesting and amplification method, and there are few studies with a high level of evidence to demonstrate the efficacy of their use in spinal surgery in humans. The purpose of this systematic review is to analyze the current evidence for the use of SC in the treatment of spinal disorders: SF, DDD and SCI. **Material and Methods:** A systematic review of the literature was performed to find studies that addressed outcomes regarding the use of CS in spinal surgery. To identify studies regarding the use of SC in spinal surgery, PUBMED, WEB OF SCIENCE and SCOPUS were searched till June 2020 for English language studies of all levels of evidence following the PRISMA guidelines. **Results:** Upon 65 titles, 12 studies were included, 4 for SF (99 patients), 2 for DDD (34 patients) and 6 for SCI (79 patients). Only 2 were poor-quality case-control studies (SF and DDI) and the remaining studies were series of cases, according to a Level IV of evidence. **Conclusion:** Regarding the evidence of recent years, there are few clinical studies that support the clinical use of SC in spinal surgery. Based on the safety of the procedures, higher level of evidence studies are needed to advance into the investigation of the promising use of this therapeutic method.

Surgical Complications

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P210: Misplaced S1 screw causing L5 radiculopathy, rare and unusual presentation: report of 2 cases

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Introduction: Lumbosacral fixation is the most preferred method in the treatment of all forms of lumbosacral instability. Multiple techniques have been described for sacral pedicle screw fixation posteriorly, including anterolateral, anteromedial, bicortical fixation and tricortical fixation through the S1 end-plate. Pedicle screw misplacement rate is varied in literature with reports as high as 30%, with majority being asymptomatic and potentially ‘benign’. Many spine surgeons are not optimally acquainted with anatomy anterior to sacrum. Screw malposition injuring these structures can lead to unwanted lethal consequences. We report unusual cases of acute radiculopathy due to misplaced bicortical sacral screw causing L5 nerve root impingement on anterior sacrum. **Material and Methods:** A 39/M patient complained of severe rest pain (VAS 9/10) post TLIF in region of L5 dermatome with sensory deficit along the right lateral leg and straight leg raise less than 30°. X-ray revealed S1 screw protruding beyond the second cortex with a straight trajectory. CT scan revealed a protrusion of 11.4mm beyond anterior cortex. A 61/M patient operated elsewhere with instrumented decompression and fusion with screws passed at L4, L5 and S1 level for lumbar canal stenosis, post-surgery patient developed new onset radicular symptoms in right lower limb. The use of diagnostic injections should absolutely be performed diagnostically and exhausted therapeutically, before proceeding with any type of surgical intervention. In case 1, as the patient developed radiculopathy in the immediate postoperative period a diagnostic and therapeutic nerve root block was done. Though the patient was relieved of pain substantially but was not able to stand and ambulate due to severe L5 radiculopathy. Post revision of the screw trajectory the next day, patient had a significant amount of reduction in pain in the L5 nerve root distribution. In the second case there was significant pain relief with a selective nerve root block hence surgical intervention was not considered. **Results:** Patient 1 was taken for re-surgery and the trajectory and length of screw was revised. Sciatic pain completely disappeared immediately after surgery. Patient 2 was managed conservatively in the form of L5 selective nerve root block. Pain and numbness improved. **Conclusion:** Bicortical purchase of S1 screw though improves pull out strength, is associated with a risk of neurovascular complications. Surgeons should be alerted to the misplacement of S1 pedicle screws to avoid involvement not only anterior to the anteromedial neurovascular tissue, but also anterolateral to the arrangement of the L5 nerve root. Proper physical examination, diagnostic test, with use of conservative management prior to surgical intervention is crucial.

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P211: Major adverse effects associated with goal-directed fluid therapy in major spine surgery: a case series

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Introduction: Significant peri-operative blood loss is a common side effect of orthopedic surgery, especially for major spine surgery. Current intra-operative fluid administration is based on personal interpretation of static hemodynamic variables. Goal-directed fluid therapy (GDFT) is the individualization of fluid therapy based on the assessment of hemodynamic measures such as preload and fluid responsiveness. This article presents our experience using GDFT in major spine surgery, the benefits, and risks associated with this technique. **Material and Methods:** We looked at 8 patients undergoing major spine surgery (5 vertebral levels or more) and their outcomes following GDFT. After the induction of anesthesia, patients were divided into a control group (Group-C) (n = 8) which were compared to the study group (Group GDFT-EDM) (n = 2) who had an esophageal doppler (ED) probe inserted into the esophagus by the anesthetist allowing the patient to receive a maintenance infusion of ringer lactate through intravenous infusion at a rate of 1.5 ml/Kg/hr, with intra-operative IV boluses of colloids based on ED estimation of the stroke volume (SV), and a maximum administration of 33 ml/Kg (of ideal body weight) of hydroxyethyl starch. Patient 30-day complications, hemodynamic status, hospital length of stay and opioid use were recorded. **Results:** Of the two patients in the GDFT-EDM group, one minor and one major adverse event occurred which prompted early termination of our study. The minor complication was a urinary tract infection. The major complication was a right posterior cerebral artery stroke which resulted in loss of vision, acute kidney injury, partial seizure, troponemia, and thrombocytopenia. In the control group, the minor complication was delirium with psychotic features which self-resolved and the major complication was a pulmonary embolism. One patient in the GDFT-EDM group experienced hypotension immediately after the surgery and the day after. None of the patients in the control group suffered hypotension in the first six days following the surgery. The average length of hospital stay for patients in the GDFT-EDM group was 23.5 days, compared to 8.5 days for Group C (p = .34). **Conclusion:** This study might provide early evidence that GDFT may not be a safe option for patients with extensive co-morbidities who are undergoing major spine surgery. Further research is required to fully understand the effects of GDFT in major spine.

Keywords

spine surgery, goal-directed fluid therapy, orthopedic surgery, adverse effect, case series

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P212: Using machine-learning models to predict risk of venous thromboembolism (VTE) following spine surgery

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Introduction: Venous Thromboembolism (VTE) is a potentially high-risk complication for patients undergoing spine surgery. Although guidelines for assessing VTE risk in this population have been established, development of new techniques that target different aspects of the medical history may prove to be of further utility. The goal of this study was to develop a predictive machine-learning (ML) model to identify non-traditional risk factors for predicting VTE in patients undergoing spine surgery. **Material and Methods:** A cohort of 63 patients was identified who had undergone spine surgery at a single center from 2015-2021. 31 patients had a confirmed VTE while 32 had no VTE. 113 attributes were defined and collected through chart review. Attribute categories included (e.g. sex, BMI, insurance, etc), medications, labs (e.g. CBC, BMP, coagulation panels), past medical history, operative history (e.g. anesthesia time, estimated blood loss, complications, etc), and postoperative history (e.g. VTE diagnosis). The Waikato Environment for Knowledge Analysis (WEKA) software was used in creating and evaluating the machine-learning (ML) models. Six classifier models were tested with 10-fold cross validation: ZeroR, OneR, Logistic, SimpleLogistic, J48 (C4.5) and RandomForest with VTE as the predicting output. Models were statistically analyzed against each other using t-tests in WEKA. **Results:** Comparing the predictive ML models to the control model (ZeroR), all predictive models were significantly better than the control model at predicting VTE risk, based on the 113 attributes ($P < .001$). The RandomForest model had the highest accuracy of 88.89% with a positive predictive value (PPV) of 93.75%. The SimpleLogistic algorithm had an accuracy of 84.13%. This model defined risk attributes to include calcium and phosphate lab values, history of cardiac comorbidity, history of previous VTE, anesthesia time, SSRI use, antibiotic use, and antihistamine use. The J48 model had an accuracy of 8.95% and it defined hemoglobin lab values, anesthesia time, beta blocker

use, DA agonist use, history of cancer, and Medicare use as potential VTE risk factors. **Conclusion:** The usefulness of pre-operative ML modeling for predicting VTE risk in patients undergoing spine surgery is robust. Thus far, VTE risk predictive models have identified risk factors to include anesthesia time, insurance type, history of previous VTE or cancer as well as use of various medications (e.g. SSRIs, antibiotics.) Future directions include building models from a larger cohort size as well as further validation studies on unseen test sets. Further development of these tools may provide high diagnostic value and may guide chemoprophylaxis treatment in this setting of high-risk patients.

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P213: Causes, patterns, and outcomes of non-traumatic spinal cord injury

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Introduction: Non-traumatic spinal cord injury (NTSCI), refers to damage to the spinal cord that resulted from a cause aside from trauma. It is a condition with immense functional implications for the individuals involved. The incidence of NTSCI is difficult to estimate due to its heterogeneous cluster of a wide spectrum etiologies with varying pathophysiology. The most described NTSCI causes are degenerative disc disease and spinal canal stenosis, tumours, vascular diseases and inflammatory conditions. In order to avoid delay in diagnosis and time-critical treatment, knowledge of each is important. We aim to fill the gap of knowledge through assessing the causes, patterns, and outcomes of non-traumatic spinal cord injuries. **Material and Methods:** This is a retrospective cohort study of all the patients who had a NTSCI between 2016-202. Also, patients older than 18 and treated surgically were included in our study. Demographic and clinical data were collected. American spinal injury association (ASIA) impairment scales have been assessed preoperatively and at the last follow-up. **Results:** One hundred and sixty-four patients were included in our study. The mean age of our population was 61 years old, of which, ninety-six were females (58%) and sixty-eight were males (41%), with an average BMI of 3. Comorbidities were observed in 81.71% of patients; the most frequent comorbidities were hypertension, diabetes, and dyslipidemia; 51.22%, 49.39%, and 34.76%, respectively. Upon admission, back pain (n = 86; 52.44%), numbness (68; 41.46%), and inability to walk (n = 39; 24%) were the highest recorded clinical presentations. Furthermore, spinal stenosis and spondylolisthesis (n = 86; 52.22%) followed by degenerative conditions such as (degenerative

spondylotic cervical myelopathy, degenerative thoracic myelopathy and disc herniation) (n = 52; 31.7%) were the most observed pathologies. Tumors (n = 17; 1.37%), spondylodiscitis and scoliosis/kyphosis were the least observed among the patients with (n = 7; 4.27%) and (n = 2; 1.22%). Lumbar spine injuries accounted for (n = 81; 49%) whereas cervical spine injuries accounted for (n = 58; 35.37%) and thoracic spine injuries for (n = 25; 15.24%). The most performed surgical procedures were Thoracic and lumbar Laminectomy/fusion and Anterior Cervical Discectomy and Fusion (ACDF) with; 5.61% (n = 82) and 23.78% (n = 39) respectively. The average length of stay period was 23.2 days and the mean follow-up duration was 15 months. Postoperatively, inpatient rehabilitation was required for 48% (n = 59) of patients. The calculated ASIA impairment scale at the last follow-up showed improvement for 66% (n = 85) of patients. **Conclusion:** Surgically treated NTSCI could result in good neurological recovery with low complications rate.

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P214: High rates of pulmonary cement embolism after cement augmented pedicle screw fixation: a 12-year single-center experience

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Introduction: With the global trend of increased life expectancy because of remarkable improvements in health care quality, osteoporotic fractures and degenerative spine diseases have been gaining increasing attention. Cement-augmented pedicle screw fixation has been established as the mainstay treatment for patients with poor bone quality. The aim of the present study was to determine the number of patients with cement leakage and pulmonary cement embolism (PCE) rates as detected on thoracic computer tomography (CT) scans, and to assess the potential risk factors for PCE. **Material and Methods:** This study included patients undergoing cement-augmented pedicle screw placement in our institution from May 2008 to December 202. Data regarding baseline characteristics, complications, and cement leakage rates were collected. A CT scan was performed in patients with cement leakage on radiograph or upon surgeon's request as part of the diagnostic workup for PCE. Other indications for thoracic CT-scan were analyzed. **Results:** A total of 104 patients with a mean age of 72.8 years (SD 6.7) were included. Among 802 screws 573 were cement-augmented. Among 104 patients, 44 (42.3%) underwent thoracic CT scans to diagnose PCE; additionally, 67 (64.4%) demonstrated cement leakage, of whom 27 developed PCE, and four developed symptoms. Cement-

augmented thoracic screws were risk factor for the occurrence of PCE (odds ratio 1.5, 95% confidence interval 1.2–2.1; $p = .004$). **Conclusion:** This study showed a high prevalence of cement leakage after cement-augmented pedicle screw insertion, with a relatively frequent incidence of PCE, as tracked on thoracic CT scans. Cement-augmented thoracic screw placement was a unique risk factor for PCE.

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P215: How much blood loss is too much for a one-level open lumbar fusion?

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Introduction: Intraoperative blood loss remains an inevitable reality of spine surgery, especially during instrumentation and fusion operations. Despite the known association that higher estimated blood loss (EBL) may be associated with worsened outcomes, the exact repercussion of EBL on outcomes following spine surgery is relatively understudied. In a cohort of patients undergoing one-level posterolateral lumbar fusion, we sought to identify EBL thresholds to: (1) predict prolonged length of stay (LOS), (2) evaluate postoperative complications, and (3) characterize the relationship with patient-reported outcomes (PROs). **Material and Methods:** A single-center, retrospective cohort study using prospectively collected data was performed on patients undergoing elective one-level open posterolateral lumbar fusion with and without interbody fusion between 10/2010-04/2021. The primary exposure variable was EBL (mL). Primary outcomes included: (1) LOS, (2) 30-day complications, and (3) 3-month PRO instruments: Numeric Rating Scale (NRS)-Back pain, NRS-Leg pain, and Oswestry Disability Index (ODI). PROs were analyzed as continuous variables as well as dichotomized by minimum clinically difference (MCID), set at 30% improvement from baseline. For purposes of a Receiver Operating Characteristic (ROC) curve and Youden's index calculation, LOS was dichotomized as 1 day vs. ≥ 2 days. **Results:** Of the 2028 registry patients undergoing posterolateral lumbar fusion surgery, 1183 patients underwent one-level fusions, 763 (64.5%) with interbody fusion and 420 (35.5%) without. With interbody: In 763 patients, mean EBL was 439.4 ± 352.7 mL and mean LOS was 2.9 ± 2.4 days. A positive linear association

was found between EBL and LOS ($P < .001$) but not with PROs. EBL above 275 mL was associated with LOS beyond POD1 (AUC = .73 [95%CI .68-.78], $P < .001$), with no impact on overall complications or achieving MCID of PROs. The remaining 420 (35.5%) patients underwent one-level posterolateral lumbar fusion without interbody fusion. Without interbody: In 420 patients, mean EBL was 39.2 ± 35.5 mL and mean LOS was 3.1 ± 1.7 days. A positive linear association was found between EBL and LOS ($P < .001$) but not with PROs. EBL above 238 mL was associated with LOS beyond POD1 (AUC = .78 [95%CI .71-.85], $P < .001$), with no impact on overall complications or achieving MCID of PROs. **Conclusion:** In patients undergoing one-level posterolateral lumbar fusion, EBL volumes above 275 mL and 238 mL in patients with and without interbody fusion respectively were associated with increased LOS beyond POD1. However, no effect was found with regard to 30-day complications and 3-month PROs. Although EBL may not directly impact patients' outcomes, keen measures should be implemented to reduce EBL and shorten LOS.

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P216: How much blood loss is appropriate in patients undergoing 2-3 level posterior lumbar fusion?

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Introduction: While higher EBL is associated with reduced outcomes, we sought to examine EBL in patients who underwent two and three level posterior lumbar fusion and its relationship to (1) length of stay (LOS), (2) 30-day complications, and (3) patient-reported outcomes (PROs). **Material and Methods:** This single-center, retrospective cohort study included all patients who underwent two or three level open posterolateral lumbar fusion, with and without interbody placement, between 10/2010-04/2021. The EBL (mL) was used to assess correlation with LOS and three PRO instruments, Numeric Rating Scale (NRS)-Back/Leg, and Oswestry Disability Index (ODI). Binary outcomes were 30-day complications, dichotomized LOS, and achievement of minimum clinically difference (MCID), set at 30% increase from baseline. **Results:** A total of 577 patients underwent two level posterolateral lumbar fusion, with 178(32.0%) patients

underwent two-level posterolateral lumbar fusion with interbody placement. Two-level: Median EBL was 525mL (IQR: 337.5-1000) and 400mL (IQR:250-700) for with and without interbody placement respectively. EBL threshold was found to be 375mL for LOS beyond POD2 (AUC = .70, $P < .001$) for two level with interbody placement, and 425 mL for LOS beyond POD3 (AUC = .64, $P < .001$) for patients without interbody placement. EBL had no association with complications. The remaining 287 patients received three levels fusions, with 70(24.4%) having interbody placement. Three-level: Median EBL was 525 mL (IQR:337.5-1000) and 400 mL (IQR:250-700) for patients with and without interbody placement, respectively. EBL greater than 837.5mL (AUC = .75, $P < .001$) and 875 mL (AUC = .61, $P < .001$) were associated with LOS beyond POD5 for patients with and without interbody placement, respectively. Furthermore, EBL greater than 537.5mL (AUC = .64, $P < .001$) and 2075mL (AUC = .96, $P < .001$) were associated with greater 30-day complications in patients with and without interbody, respectively. **Conclusion:** In patients undergoing two and three level posterolateral lumbar fusion, EBL threshold were determined in patients with and without interbody fusion as a predictor of prolonged LOS. Although EBL may not directly impact patients' outcomes or increase complications in the short term, practices should be employed to minimize EBL and shorten patient's LOS.

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P217: How much blood loss in open multi-level lumbar fusion surgery affect outcomes?

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Introduction: Estimated blood loss (EBL), a renowned intraoperative variable that is affected by fusion levels, is associated with worsened outcomes following lumbar fusion surgery. However, the precise implication of EBL on multi-level lumbar fusion surgery is poorly investigated. In patients undergoing multi-level posterolateral lumbar fusion, we sought to identify EBL thresholds to: (1) estimate prolonged length of stay (LOS), 2) predict post-operative complications, and (3) assess the relationship with patient-reported outcomes

(PROs). **Material and Methods:** A retrospective cohort study was carried out using prospectively collected data on patients undergoing four-eight levels open posterolateral lumbar fusion between 10/2010-04/2021, at a single institution. The primary independent variable was EBL (mL). Outcome variables included LOS, 30-day complications, and 3-month PRO instruments: Numeric Rating Scale (NRS)-Back pain, NRS-Leg pain, and Oswestry Disability Index (ODI). PROs were dichotomized for Area Under the Curve (AUC) analysis by minimum clinically difference (MCID), set at 30% improvement from baseline. **Results:** A total of 366 patients underwent four-eight levels posterolateral lumbar fusion surgery fusions. Median EBL was 912.5 mL (IQR = 500-1600) and mean LOS was 5.2 ± 2.7 days. A positive linear association was determined between EBL and LOS ($P < .001$), but not with PROs. Patients with EBL above 775 mL were at increased risk of LOS beyond POD3 (AUC = .70 [.63-.76], $P < .001$), and EBL above 985 mL was associated with higher rate of complications (AUC = .62 [.53-.71], $P < .001$). There was no overall effect on achieving MCID of PROs. **Conclusion:** In patients undergoing multi-level posterolateral lumbar fusion, EBL volumes above 775 mL and 998 mL were associated with increased LOS beyond POD3 and higher complication rate, respectively. No significant effect was detected between EBL and PROs. Delicate surgical planning to reduce EBL should be implemented to shorten LOS and minimize complications.

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P218: What is an ideal target for blood loss in patients undergoing posterior cervical spine fusion?

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Introduction: Great estimated blood loss (EBL) in cervical spine surgery has been associated worsened outcomes and a protracted hospital course. In patients undergoing elective posterior cervical fusion, we sought to: (1) characterize how EBL impacts length of stay (LOS), complications, and patient-reported outcomes (PROs) and (2) identify the ideal threshold value of EBL for which these outcomes are negatively affected. **Material and Methods:** A retrospective cohort study

of prospectively collected data from a single-center between 10/2010-04/2021 was undertaken. Patients who underwent elective, posterior cervical fusion surgery were grouped as those who received one-three level fusions and four-seven level fusions. Recorded intraoperative EBL was the exposure variable of interest. Outcomes included LOS, complications, and 3-month PROs: Numeric Rating Scale (NRS)-Neck/Arm, and Neck Disability Index (NDI). Minimum clinically important difference (MCID) was set at 30% improvement from baseline. **Results:** One-three levels: In 299 patients, median EBL was 200 ml (IQR:100-350) and LOS was 3 days (IQR: 2-4). EBL threshold of 187.5 ml was associated with prolonged LOS beyond POD2 (AUC = .65[.59, .71], $P < .001$). EBL did not demonstrate any significant binary prediction for complications or achieving MCID. Four-seven levels: In 278 patients, median EBL was 270 (100-350) with median LOS 3 days (2-4). EBL threshold of 675 mL was found to predict LOS beyond POD6 (AUC = .65[.51, .79], $P < .001$). EBL did not demonstrate any significant binary prediction for complications or achieving MCID. **Conclusion:** In patients undergoing elective, posterior cervical spine fusions, EBL greater than 187.5 ml in one-three level fusion was found to be a significant predictor for increased LOS beyond POD2, while EBL greater than 675 ml was found to be a predictor for LOS beyond POD6 in four-seven level fusion. EBL did not demonstrate strong predictive value of complications or achievement of PROs. It is important to appropriately minimize EBL to reduce prolonged patient hospitalization after cervical spine fusion.

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P219: How common is acute pelvic fixation failure after adult spinal surgery? A single center study of 358 patients

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Introduction: Pelvic fixation is known to increase the mechanical stiffness of fusion constructs; however, fixation failure is known to still occur. Prior literature describes mid- to long-term failure rates. The incidence of acute failure within 6 months is less well described. We hypothesize that the incidence of acute pelvic fixation failure is low within this time period. **Material and**

Methods: Adult patients (≥ 18 years) having pelvic fixation (iliac, S2AI) with a minimum of 1 year f/u were retrospectively collected (2015-2020). Minimum total instrumented levels (TIL) = 3. Patients with prior pelvic fixation were excluded. PFF was defined as broken rod across the lumbo-sacral junction, broken pelvic screw, pseudarthrosis across the lumbo-sacral junction requiring revision to pelvic screws, loose pelvic screw, sacral/iliac fracture, set cap loosening or dislodgement. Patient, operative, screw, rod, rod pattern, and pre-/post-radiographic (LL, PI, PT, Major Cobb, Lumbosacral fractional curve, CVA, T1PA, C7SVA) parameters were collected. All rods across the lumbosacral junction were cobalt-chrome. All iliac and S2AI screws were closed-headed. **Results:** Of 358 patients, the mean age was 59.5 years and 64% were female. The mean TIL was 11.5 (min = 3, max = 24 levels), 14.2% with 3CO, and 71.2% with L5-S1 interbody fusion. The mean length/diameter of pelvic screws were 86.6/8.5mm. The mean no. of pelvic screws was 2.2 (S2AI only 65.6%, iliac only 2.9%, both 13.4%). The mean rod diameter 6.0mm and 78.5% had > 2 rods crossing the lumbopelvis junction. Accessory rods extended to either S1 (41.6%) or S2/ilium (58.4%). The mean preop PT (27.6), T1PA (21.1), C7SVA (6.1), CVA (3.2), and 62% with PI-LL > 1 . The failure rate within 6 months was .3% (N = 1) with a broken S2AI screw at the head-neck junction. This patient was a 76yoF with degenerative lumbar scoliosis and chronic left sacral zone 1 fracture non-union who underwent PSIF T10-Pelvis with bilateral S2AI screws (8.5x90mm), TLIF L4-S1, accessory rod LIV between S1 and ilium via domino connector, all 6.0 cobalt-chrome rods. Patient had persistent left buttock pain postop with radiographic breakage of left S2AI screw at 68 days postop. Revision included instrumentation removal L2-pelvis, and total of 4 pelvic screws (L: S2AIx2, Iliacx1; R S2AIx1). **Conclusion:** Our acute pelvic fixation failure rate was exceedingly low in adult spinal surgery. This low rate may be the result of multiple factors including the preference for multi-rod (> 2), closed-headed pelvic screw constructs.

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P220: What is the incidence, mechanism, and protective strategies for 2 year pelvic fixation failure after adult spinal deformity surgery with a minimum 6 level fusion

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Introduction: Prior literature suggests high rates of pelvic fixation failure (PFF) after adult spinal deformity (ASD) surgery. Protective factors for PFF after ASD is not well understood, and none propose an optimal rod strategy. We hypothesize that there exists potential modifiable risk factors for PFF. **Material and Methods:** ASD patients (≥ 18 years; min. 6 levels) and pelvic fixation (iliac, S2AI) with min. 2 year f/u were retrospectively collected (2015-2019). Patients with prior pelvic fixation were excluded. PFF was defined as a broken rod(s) across the lumbosacral junction, broken pelvic screw, pseudarthrosis across the lumbo-sacral junction requiring revision to pelvic screws, loose pelvic screw, sacral/iliac fracture, set cap loosening or dislodgement. Patient (age, sex, BMI, smoker, ASA, osteoporosis), operative (total instrumented levels[TIL], 3 column osteotomy[3CO], interbody fusion), screw (iliac, S2AI, length, diameter), rod (diameter, UIV, LIV, kickstand), rod pattern (# crossing lumbopelvic junction, LIV of accessory rod(s), lateral connectors, dual headed screws), and pre- and post-radiographic (LL, PI, PT, Major Cobb, Lumbosacral fractional curve, CVA, T1PA, C7SVA) parameters were collected. All rods across the lumbosacral junction were cobalt-chrome. All iliac and S2AI screw were closed-headed. **Results:** Of 253 patients (mean age = 58.9 years, mean TIL = 13.6, 3CO = 11.3%, L5-S1 interbody = 53.5%, mean length and diameter of pelvic screws were 86.9 mm and 8.6 mm), the 2 year failure rate was 4.3% (N = 11). The mechanism of failure included broken rod(s) across the lumbo-sacral junction (N = 4), pseudarthrosis across the lumbosacral junction requiring revision to pelvic screws (N = 3), broken pelvic screw (N = 1), loose pelvic screw (N = 1), sacral/iliac fracture (N = 1), set cap loosening/dislodgement (N = 1). A higher number of rods crossing the lumbopelvic junction (No Failure = 3.8 vs. Failure = 2.9, $p = .009$), and accessory rod(s) LIV to S2/ilium (No Failure = 54.2% vs. Failure = 18.2%, $p = .003$) were protective for failure. Multivariate logistic regression demonstrated that accessory rod LIV to S2/ilium vs. S1 (OR .2, $p = .004$) and number of rods crossing the lumbar to pelvis (OR .15, $p = .002$) were protective, while worse postoperative CVA (OR 1.5, $p = .028$) was an independent risk factor for failure. **Conclusion:** The 2 year failure rate is low relative to what is reported in literature, despite patients undergoing long fusion constructs for ASD. Number of rods crossing the lumbo-pelvic junction and accessory rod(s) LIV to S2/ilium relative to S1 alone likely increase construct stiffness. Residual postoperative coronal malalignment should be avoided to reduce pelvic fixation failure.

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P221: Incidence of major and minor vascular injuries during lateral lumbar access surgeries: a retrospective comparative study and systematic literature review

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Introduction: During lateral lumbar fusion, the trajectory of implant insertion approaches the great vessels anteriorly and the segmental arteries posteriorly, which carries the risk of vascular complications. We aimed to analyze vascular injuries for potential differences between oblique lateral interbody fusion (OLIF) and lateral lumbar interbody fusion (LLIF) procedures at our institution. This was coupled with a systematic literature review of vascular complications associated with lateral lumbar fusions. **Material and Methods:** A retrospective chart review was completed to identify consecutive patients who underwent lateral access fusions. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines were used for the systematic review with the search terms “vascular injury” and “lateral lumbar surgery.” **Results:** Of 260 procedures performed at our institution, 211 (81.2%) patients underwent an LLIF and 49 (18.8%) underwent an OLIF. There were no major vascular complications in either group in this comparative study, but there were four (1.5%) minor vascular injuries (2 LLIF, .95%; 2 OLIF, 4.1%). Patients who experienced vascular injury experienced a greater amount of blood loss than those who did not (227.5 ± 147.28 vs. 59.32 ± 68.30 ml) ($p = .11$). In our systematic review of 63 articles, major vascular injury occurred in 0-15.4% and minor vascular injury occurred in 0-6% of lateral lumbar fusions. **Conclusion:** The systematic review and comparative study demonstrate an increased rate of vascular injury in OLIF when compared to LLIF. However, vascular injuries in either procedure are rare, and this study aids previous literature to support the safety of both approaches.

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P222: Complications of subaxial cervical pedicle screws versus lateral mass screws: meta-analysis of 8636 screws

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Introduction: Lateral mass screw (LMS) fixation for the treatment of subaxial cervical spine instability or deformity has been traditionally associated with few neurovascular complications. However, cervical pedicle screw (CPS) fixation has recently increased in popularity, especially with navigation

assistance, because of the higher pullout strength of the pedicle screws. To their knowledge, the authors conducted the first meta-analysis comparing the complication rates during and/or after CPS and LMS placement for different pathologies causing cervical spine instability. **Material and Methods:** A systematic literature search of PubMed and Embase from inception to January 12, 2021 was performed to identify studies reporting CPS and/or LMS-related complications. Complications were categorized into intraoperative and early postoperative (within 30 days of surgery) and late postoperative (after 30 days from surgery) complications. All studies that met the prespecified inclusion criteria were pooled and cumulatively analyzed. **Results:** A total of 24 studies conducted during the time frame of the search and comprising 1,768 participants and 8,636 subaxially placed screws met the inclusion criteria. The CPS group experienced significantly more postoperative C5 palsy (odds ratio [OR] = 3.48, 95% confidence interval [CI] = 1.27-9.53). Otherwise, there were no significant differences between the LMS and CPS groups. **Conclusion:** There were no significant differences between the CPS and LMS groups in terms of neurovascular procedure-related complications other than significantly more C5 palsy in the CPS group.

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P223: Post-operative hematocrit is a predictor of postoperative complications in diabetic patients undergoing adult spinal deformity surgery

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Introduction: Previous orthopedic literature has shown that patients with diabetes mellitus (DM) are more likely to develop complications in the post-operative period. To date, however, no study has assessed the specific pre- and post-operative risk factors that may contribute to this association for diabetic patients undergoing adult spinal deformity surgery. **Material and Methods:** This study is a retrospective cohort review of diabetic patients undergoing adult spinal deformity surgery, with ≥ 5 levels fused at a single academic medical center. Patient's age, BMI, levels fused, pre- and post-operative hemoglobin (Hgb), hematocrit (HCT), and pre-operative HbA1C were collected. Primary outcomes were the development of post-operative complications. These included the development of neurologic complications, urinary complications, cardiac complications, pulmonary complications, venous thromboembolism (VTE), and surgical site infections (SSI). **Results:** 138 patients with DM met the

inclusion criteria and were included in the analysis. Of these, 5.7% of the total cohort developed a post-operative complication within 90 days of surgery. Patients who developed post-operative complications were noted to have significantly lower post-operative Hgb (9.82 ± 1.46 g/dL vs 1.72 ± 1.76 g/dL, $p = .002$), post-operative HCT ($28.8 \pm 3.92\%$ vs $32.60 \pm 4.61\%$, $P < .001$), and significantly greater number of levels fused (9.49 ± 3.74 vs 7.47 ± 3.16 , $p = .001$). Diabetic patients who developed a cardiac complications had significantly lower post-op Hgb (9.47 ± 1.50 g/dL vs 1.40 ± 1.66 g/dL, $p = .021$) and HCT ($27.87 \pm 3.16\%$ vs $31.15 \pm 4.72\%$, $p = .003$) compared with those who did not. Diabetic patients who developed urinary complications were noted to be older on average (72.56 ± 8.20 vs 64.43 ± 11.70 years, $p = .043$), while patients who developed VTE and pulmonary complications were noted to have significantly higher numbers of levels fused (VTE: 14.00 ± 3.61 vs 8.37 ± 3.51 , $p = .007$; PC: 1.82 ± 4.14 vs 8.29 ± 3.49 , $p = .025$). Finally, diabetic patients who developed a surgical site infection had significantly lower post-operative HCT ($26.74 \pm 3.27\%$ vs $3.86 \pm 4.64\%$, $p = .022$) than those who did not. Multivariate logistic regression analysis showed that postoperative HCT (OR: .765 [.613-1.098], $p = .001$) and number of levels fused (OR: 1.243 [1.084-1.425], $p = .002$) were predictive of development of any post-operative complication, when controlled for BMI, age, and post-op Hgb. Post-op HCT was an independent predictor of the development of cardiac complications (OR: .827 [.692-.989], $p = .037$) and SSI (OR: .709 [.528-.952], $p = .022$). **Conclusion:** Post-operative HCT is predictive of the development of post-operative complications in general, and more specifically the development of cardiac complications and surgical site infections. Along with blood-glucose and HbA1C, it should be closely monitored perioperatively in diabetic patients undergoing spinal deformity surgery.

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P224: The effect of chronic hyperlipidemia on the complication rates following lumbar fusion: a propensity score matching

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Introduction: Spinal fusion is widely used to treat a variety of degenerative and traumatic disorders of the lumbar spine. Certain complications are known to occur following spinal fusion; however, it has not been investigated how chronic hyperlipidemia affects perioperative complications. Therefore, the purpose of this study was to compare the perioperative complications of lumbar fusion in patients with and without chronic hyperlipidemia. **Material and Methods:** This

study was conducted using the MSpine division of the PearlDiver database. Patients with or without chronic hyperlipidemia who had lumbar spinal fusions between 2010 and the first quarter of 2019 were included in the study. The relevant Current Procedural Terminology (CPT) codes were used to identify patients with single- and multi-level lumbar spinal fusion surgeries. The International Classification of Diseases (ICD-9 and ICD-10) codes were used to identify patients with chronic hyperlipidemia. Then, we retrieved the perioperative surgical and medical complications using the appropriate ICD-9, ICD-10, and CPT codes. Propensity score matching analysis was conducted to control for the confounding factors, including age, gender, and Elixhauser Comorbidity Index (ECI). Chi-square test was applied to compare the incidence of complications among patients with and without hyperlipidemia. **Results:** A total of 65674 patients with hyperlipidemia (n = 18395) and without hyperlipidemia (n = 47279) underwent single-level lumbar fusions. Matching based on propensity scores resulted in 16930 patients in each group. Patients with hyperlipidemia compared to patients without hyperlipidemia had a higher incidence of wound complications [481 (2.8%) versus 357 (2.1%), $P < .001$], surgical site infection [370 (2.2%) versus 231 (1.4%), $P < .001$], failed back syndrome [1914 (11.3%) versus 1605 (9.5%), $P < .001$], hardware removal [1006 (5.9%) versus 761 (4.5%), $P < .001$], deep venous thrombosis/pulmonary embolism [264 (1.6%) versus 216 (1.3%), $p = .031$], myocardial infarction [81 (.5%) versus 23 (.1%), $P < .001$], cerebrovascular accident [86 (.5%) versus 39 (.2%), $P < .001$], renal failure [305 (1.8%) versus 197 (1.2%), $P < .001$], sepsis [103 (.6%) versus 51 (.3%), $P < .001$], urinary tract infection/incontinence [697 (4.1%) versus 436 (2.6%), $P < .001$]. A total of 48928 patients with hyperlipidemia (n = 15527) and without hyperlipidemia (n = 33401) underwent multi-level lumbar fusions. Matching based on propensity scores resulted in 14218 patients in each group. Patients with hyperlipidemia compared to patients without hyperlipidemia had a higher incidence of nerve root injury [33 (2%) versus 17 (.1%), $p = .034$], wound complications [624 (4.4%) versus 508 (3.6%), $P < .001$], surgical site infection [438 (3.1%) versus 307 (2.2%), $P < .001$], failed back syndrome [2024 (14.2%) versus 1642 (11.5%), $P < .001$], hardware removal [1146 (8.1%) versus 885 (6.2%), $P < .001$], revision [922 (6.5%) versus 1055 (7.4%), $p = .002$], myocardial infarction [120 (.8%) versus 41 (.3%), $P < .001$], renal failure [472 (3.3%) versus 313 (2.2%), $P < .001$], and urinary tract infection/incontinence [810 (5.7%) versus 618 (4.3%), $P < .001$]. **Conclusion:** Following single or multi-level lumbar fusions, patients with chronic hyperlipidemia have an increased risk of perioperative complications, including wound complications, surgical site infection, failed back syndrome, hardware removal, myocardial infarction, renal failure, and urinary tract infection/incontinence. In multi-level lumbar fusions, chronic hyperlipidemia is associated with a higher incidence of nerve root injury and revision rates.

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P225: C2 pelvic angle (C2PA) is a useful radiographic parameter that correlates with clinical outcomes of symptomatic proximal junctional kyphosis

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Introduction: The definition of PJK after spine deformity surgery is based on the PJA. Despite the growing amount literature on PJK, minimal correlation exists between PJK and clinical outcome scores. PJA poorly represents, and is difficult to measure, PJK for global spinal alignment after deformity surgery. C2PA is a novel radiographic angle that demonstrates the difference between global spinal alignment and alignment proximal to the spinal construct. **Material and Methods:** A radiographic review was performed on 98 deformity patients from July 2015-July 2018. The angle between the posterior superior sacrum, C2 centroid and upper instrumented vertebrae (UIV) centroid in the pre and postop setting (2 year or prior to return to OR) were measured and labeled as C2PA. The patients were divided into PJK and non-PJK groups based on a) PJK defined as PJA $> 20^\circ$ and b) PJK defined as C2PA $> 20^\circ$. Logistic regression and Chi-square analyses were performed to study the relationship between the postop PJA and C2PA with ODI/SRS scores. **Results:** Of the 98 patients, there were 20 patients with PJK when it was defined as PJA $> 20^\circ$. There were no statistically significant correlation between ODI and SRS scores in the Non-PJK and PJK group when it was defined as PJA. There were minimal differences between the ODI scores (8.0 vs 7.0, $p = .66$) and the SRS total scores (71.3 vs 7.6, $p = .85$) in the Non-PJK and PJK group when it was defined as PJA $> 20^\circ$. When PJK was defined as C2PA $> 20^\circ$, there were 31 patients with PJK. There were statistically significant differences between the Non-PJK and PJK group

for both ODI (8.0 vs 16.0, $p = .015$) and SRS total scores (97.0 vs 88.0, $p = .010$) when PJK was defined as $C2PA > 20^\circ$.

Conclusion: This is the first study demonstrating that C2PA is a superior radiographic representation of PJK, and directly correlates with patient reported outcomes (PROs). A C2PA $> 20^\circ$ is the critical angle that corresponds with clinical PJK.

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P226: Revisions for proximal adjacent segment disease following posterior cervical decompression and fusion

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Introduction: Symptomatic cervical spondylotic myelopathy (CSM) has become a leading indication for posterior cervical surgery. Cervical laminectomy and fusion is commonly used in patients with multiple stenotic segments, maintained cervical lordosis, and/or ossification of the posterior longitudinal ligament (OPLL). While distal junctional stenosis for fusions terminating about the cervicothoracic junction (CTJ) has been of particular interest in the literature due to transitional anatomy at the cervicothoracic junction, there is scant literature on proximal junctional stenosis. The purpose of the present study was to assess proximal junctional stenosis for posterior cervical decompression and fusion (PCDF) constructs. **Material and Methods:** A retrospective review of a prospectively collected database was performed with the University of Pittsburgh Institutional Review Board approval. All patients who underwent posterior cervical laminectomy and instrumented posterior spinal fusion (PSF) performed by two fellowship-trained spine surgeons at a single institution from August 2012 to August 2019 were included. All patients received lateral mass screws in the cervical spine and pedicle screws in the thoracic spine. Patients with less than one-year clinical follow-up, less than four vertebral levels fused, surgery performed for tumor, or fusion constructs with a distal junction terminating cranial to C7 or caudal to T2 were excluded. Patients with proximal junctional stenosis were identified and compared to the cohort. Chi-squared analysis, Fischer's exact test, and two-tailed unpaired t-tests were used to identify differences in demographics, co-morbidities, operation, and post-operative complications. $P < .05$ was considered statistically significant. **Results:** Two hundred and seven subjects (98 M, 109 F; age 64 ± 10 years) with a total of 6 proximal junctional stenosis cases (3% of all cases) were

identified. Mean follow-up was 2.6 years \pm 1.4 years. The most common levels of proximal termination were C2 and C3 where four proximal junctional stenosis cases requiring surgical revision were identified (2% of all cases). Three junctional stenosis occurred in constructs terminating at C3 and 1 junctional stenosis case occurred in a construct terminating at C2, other junctional stenosis cases were more distal. Subjects with constructs terminating at C3 were younger (60 ± 11 vs. 67 ± 9 ; $p = .002$), greater proportion female (57% vs. 34%; $X^2 5.28$, $p = .021$), and had lower age adjusted Charlson comorbidity indices (2.5 ± 2.5 vs. 3.8 ± 1.9 ; $p = .010$). There were no significant differences in BMI ($p = .290$), rate of proximal revision ($p = .546$), 90-day post-operative complication ($p = .897$), or re-admission ($p = .797$) between constructs terminating at C2 and C3. **Conclusion:** Proximal junctional stenosis in patients undergoing posterior cervical decompression and fusion with termination at the cervicothoracic junction occurs at nearly 3% in patients treated for cervical spondylotic myelopathy.

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P227: Incidence of complications associated with cervical spine surgery and post-operative physical therapy

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Introduction: Cervical spine surgery has shown to be relatively safe, however, complications can arise both intraoperatively and post-operatively. Incidence and complication type have been correlated with intraoperative factors and patient demographics; however, there is no published literature on the association of complications with post-operative physical therapy (PT). The aims of this study are to describe the incidence of complications associated with cervical spine surgery and post-operative PT, and to determine if the timing of initiation of post-operative PT alters the rates of post-operative complications after cervical spine surgery. **Material and Methods:** MOrtho, a subset the PearlDiver database, was used to identify patients who had undergone cervical spine surgery and post-operative PT from 2010-2019. Surgeries included Anterior Cervical Discectomy and Fusion (ACDF), Posterior Cervical Fusion (PCF), and Cervical Foraminotomy (CF). For each surgical group, patients were divided into three 12-week increments for post-operative PT (starting at post-operative weeks 2, 8, 12), and then matched based upon age, gender, and Charlson Comorbidity Index (CCI) score. The database was queried to determine complication rates for each of the surgical groups with post-operative PT. Complications included surgical

site infection (SSI), wound infection, root injury at 3 months, new onset cervicalgia at 6 months, and instrument failure, revision surgery, and spinal cord injury at 12 months. Chi-square analysis was performed, and adjusted odds ratios (OR), 95% confidence intervals (CI), and p-values reported. **Results:** 2,003 patients who had undergone cervical spine surgery at one or more levels and post-operative PT were identified after matching surgical groups for age, gender, and CCI (ACDF:990, PCF:873, and CF:140). Most frequent complication for all surgical groups was new onset cervicalgia (% 2-14 weeks, 8-20 weeks, 12-24 weeks): ACDF (15.05%, 12.92%, 7.88%), PCF (19.47%, 19.13%, 18.90%), CF (20%, 16.43%, 18.57%). The next most frequent complication for all surgical groups was revision: ADCF (7.8%, 8.3%, 8.0%), PCF (1.1%, 1.3%, 9.1%, CF (< 7.9%, 7.9% and 9.3%), followed by wound infection: ACDF (3.5%, 3.3%, 3.2%), PCF (7.0%, 7.9% and 8.7%), CF (< 7.9%, 7.9%, 7.9%). Less common complications included: ACDF: SSI (2.5%, 2.2%, 2.0%), SCI (1.5%, 1.7%, 1.1%), root injury (1.7%, 1.6%, 1.5%), and instrument failure (< 1.1%, < 1.1%, 1.1%); PCF: SSI (6.2%, 7.1% and 7.3%), instrument failure (5.0%, 4.4% and 4.4%), SCI (< 1.3%, < 1.3% < 1.3%) and root injury (< 1.3%, < 1.3% < 1.3%); CF: SCI (< 7.9%, < 7.9%, < 7.9%), root injury (< 7.9%, < 7.9%, < 7.9%), and SSI (< 7.9%, 0%, < 7.9%). Group differences were not statistically significant for any complication whether post-operative PT was started at 2, 8, or 12 weeks. **Conclusion:** Overall incidence of complications associated with cervical spine surgery and post-operative PT was low. There were no statistically significant differences in complication rates whether PT was initiated at 2, 8, or 12 weeks post-operatively. Post-operative PT has a relatively low risk for developing complications and suggests that early rehabilitation may be safe after select cervical spine surgeries. Future prospective studies should examine complication rates as they relate to patient outcomes, costs, and specific PT interventions to inform and guide effective post-operative management of cervical spine surgery.

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P228: C2 pelvic angle (C2PA) is a useful intraoperative radiographic parameter that correlates with the risk of developing proximal junctional kyphosis postoperatively

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Introduction: PJK is a postoperative complication of adult spinal deformity surgery that leads to poorer patient clinical outcomes. There is no literature on intraoperative assessment of sagittal alignment to prevent PJK. Intraoperative C2PA is a novel, radiographic parameter derived from the difference between global spinal alignment and the alignment proximal to the uninstrumented spine. The goal of this study is to demonstrate a positive relationship between the intraoperative C2PA and PJK. **Material and Methods:** We performed radiographic analysis on 60 deformity patients from 2015- 2018. Of the 60 patients, 25 were fused proximal to the pelvis. The angle between the posterior superior sacrum, C2 centroid and upper instrumented vertebrae (UIV) centroid in the pre, intra, and postop setting (immediate and 2 year or prior to return to OR) were measured and labeled as C2PA. PJK was defined as postop PJA > 15°. Logistic regression and Chi-square analyses evaluated the relationship between the postop PJA and intraop C2PA/PJA. **Results:** Of the 60 patients, 20 patients had PJK at the 2 yr postop or prior to return to OR films. The intraop C2PA for the non-PJK and PJK group were 12.5° and 21.2°, respectively ($P < .0001$). The intraop PJA for the non-PJK and PJK group were 5.6° and 7.4°, respectively ($p = .04$). The relative risk ratio of developing PJK for patients with intraop C2PA > 15° was 2.43, and no one with intraop C2PA < 15° developed PJK in the 2 yr follow up. **Conclusion:** This is the first intraoperative measurement that demonstrates a direct correlation with PJK. Intraoperative C2PA > 15° is a critical angle with 2.5 times the relative risk for developing PJK. No patient with intraoperative C2PA < 15° developed PJK.

915

P229: Postoperative spinal epidural hematoma after lumbar decompression surgery: one-year patient-reported outcome measures in 161 patients

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Introduction: In surgery for lumbar spinal stenosis (LSS), postoperative spinal epidural hematoma (PSEH) is considered a serious complication. Studies exploring outcome of reoperations after PSEH are scarce, have few patients, and often lack appropriate outcome measures. The purpose of this study was to evaluate the effect of PSEH on one-year patient-reported outcome measures (PROMs) in a large series of patients treated surgically for LSS. **Materials and Methods:** By using prospectively collected data between 2007 and 2017, retrieved from the National Swedish Spine Register (Swespine), we identified 219 surgically evacuated PSEH in a group of 35239 patients (.6%) with LSS that had undergone posterior decompression with or without fusion. PROMs before and one year after surgery were compared between 161 patients with PSEH and 28597 patients without PSEH that had all completed the one-year follow-up. Back and leg pain numerical rating scales (NRS), the Oswestry Disability Index (ODI), and the EQ-5D index were used for outcome assessment. Additionally, we assessed the proportion of patients achieving minimum important change (MIC) for each PROM. **Results:** Patients with PSEH had significantly worse preoperative back pain, disability, and health-related quality of life (HRQoL). There were no major differences in age, sex, smoking habits, and body mass index. One year after surgery, patients with and without PSEH were significantly improved in all PROMs. There were no significant differences in the improvement of NRS back pain, NRS leg pain, and ODI between the two groups. Patients without PSEH had a significantly larger improvement in EQ-5D index. When comparing the proportion of patients achieving MIC for each PROM there were no significant differences for any PROM. **Conclusion:** This study demonstrates that patients treated surgically for a PSEH have significantly improved PROMs for pain, disability, and HRQoL one year after surgery. Patients without a hematoma have significantly better improvement in HRQoL. However, the proportion of patients achieving minimum important change for pain, disability, and HRQoL is not significantly different among patients with or without a PSEH.

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P230: Single institution experience of 42 patients undergoing vertebral corpectomy and dorsal instrumentation

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Introduction: Vertebral corpectomy and dorsal instrumentation of the spine remains one of the most aggressive treatment modalities in the hands of the spine surgeons. Many different pathologies could lead to the development of biomechanical

instability, requiring a complex reconstruction of the segment. **Material and Methods:** This is a retrospective, single institution, multi-surgeon study of the patients undergoing a vertebral corpectomy and dorsal instrumentation between 2012 and 2021. As a total of 42 patients (25 males and 17 females), mean age-67. Patients with traumatic (18 patients), osteoporotic fractures (4), inflammatory processes (6), metastasis of the spine (9) and degenerative processes (6) were included. Only the patients who underwent a total vertebral body procedure and dorsal fixation were included. For the dorsal instrumentation a spinal navigation (O-Arm, Medtronic) was used. Epidemiological data, including bone related diseases, as well as neurological outcome were recorded. 18 patients became additional bone cement for additional ventral support to the expandable cage. **Results:** A total of 91 surgical interventions were carried out (including revision surgeries) till the completion of the circumferential reconstruction of the vertebral column. A total of 311 screws (transpedicular and massa lateralis) were placed. There was no statistical significance in the revision rate in the group of the patients with and without bone cement. There was no statistical significance in the neurological status at the admission and discharge of the patient. **Conclusions:** The circumferential reconstruction of the spinal column is a feasible method for the treatment of diverse pathologies. With the development of the new technologies (spinal navigation, adjuvant and neoadjuvant therapy) this procedure remains a treatment of choice, when the proper criteria are met.

1031

P231: Does the gender affect the rate of preoperative and early postoperative complications in microscopic tubular discectomy

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Introduction: Herniated lumbar disc is a major spine disease affecting young adults with a dominance on male gender. Most are treated non-operatively, and a smaller group needs surgical intervention. Many surgical approaches had been evolved to treat the lumbar disc herniation and minimally invasive procedures are the surgical intervention of favor now. **Material and Methods:** In this study we used the interlaminar tubular microdiscectomy to treat our patients and we studied the effect of gender on complications of the procedure. **Patent and method:** we studied 302 patients between 2016-2021 (174 males and 128 females) in compare the complication rate regarding to (operative time, blood loss, hospital stay, spondylodiscitis, wound infection, recurrent disc, dural tear,

facet violence, neuritis, vascular injury, hematoma, deep venous thrombosis, urinary retention, and postoperative muscle spasm). **Results:** The mean operative time in females was significantly higher as compared to males, i.e., 72.49 ± 14.03 and 63.21 ± 11.20 respectively ($P < .001$). Discussion and **Conclusion:** we found that there is no significance in gender for patients having tubular microdiscectomy regarding indications, level, approach, blood loss, hospital stay and postoperative complications, but surgical time was significantly affected by gender with females take longer time. **Conclusion:** The gender has an impact on the operative time, as in female group the operative time is higher, but the perioperative and early postoperative complications rate there is no big difference between male and female.

I043

P232: Lumbar endoscopic adhesiolysis for post-operation adhesion. How I do it

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Introduction: Post-operative epidural adhesion remains a clinical challenge for spine surgeons. The presentations of post-op epidural adhesion vary from dull localized pain to neuropathic pain along dermatome. There are some minimal invasive methods, such as caudal epidural injection, percutaneous epidural adhesiolysis, balloon assisted adhesiolysis, or epiduroscope assisted adhesiolysis to deal with adhesion. However, in severe fibrosis, safer and more direct and visible way for adhesiolysis is anticipated. We will share the protocol and outcome of using endoscope to deal with the most difficult to handle but common sequela after lumbar surgery. Intra-operation neuromonitoring is mandatory. We will share the monitor policy and application. **Material and Methods:** Patients with chronic low back pain with or without radiculopathy developed after previous lumbar surgery were collected. We tried a series of less invasive pain procedures, like caudal epidural block, oral medication, rehabilitation maneuver of flossing. However, there are still 5 patients show very little response to conservative treatment. We performed interlaminar approach (N = 4) or transforaminal approach (N = 1) for epidural adhesiolysis under general anesthesia. Intra-operation monitoring (IOM), applied in all four patients, with somatosensory evoke potential (SSEP), motor evoke potential (MEP), and free-run electromyography (EMG). Result: Four patients performed with interlaminar approach endoscopic adhesiolysis showed good result and satisfaction for at least 6 months after operation. The one underwent transforaminal approach showed only transient partial relief. Intra-operation monitoring (IOM) provides sensitive alarm when manipulating the structures and of great help in differentiating the fibrosis tissue from nerve. **Conclusion:** In more advanced fibrosis and adhesion

situations, it is difficult to lyse adhesive tissue only by a catheter or fluid. Endoscopic spine adhesiolysis with IOM provides a more confident and effective method.

I220

P233: Role of chilled yoghurt in improving swallowing and voice dysfunction in patients undergoing anterior cervical spine surgery

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Introduction: Anterior cervical spine surgery via the Smith-Robinson approach is the workhorse approach to the anterior cervical spine. Dysphagia and dysphonia are commonly reported complaints in the post-operative recovery of patients. In the first few weeks post-operatively, up to 70% and 50% of patients experience dysphagia and dysphonia respectively. These symptoms are likely caused by both swelling of the structures within the pharynx/larynx and also injury to the nerves which control these muscles, likely as a result of the manipulation/retraction of the structures of the neck in order to gain adequate exposure of the anterior cervical spine. Patients are generally quite bothered by these complaints in the early post-operative recovery period, but these symptoms usually resolve by 6 weeks. We hypothesized that a cooling, thickened liquid will be beneficial in improving dysphagia/dysphonia as the cooling nature would help in relieving pain/discomfort as well as some of the inflammation of the pharyngeal/laryngeal muscles and the thickened nature of the liquid would aid in swallowing and formation of a bolus of food. **Material and Methods:** This was a randomized blinded clinical study. We randomized all patients in our institution who underwent anterior cervical spine surgery into 2 groups – the intervention and control groups. Patients in the intervention group were given one serving of chilled yogurt 3 meals a day for the first 3 days post-operatively, while patients in the control group were not given any yogurt or any chilled food for the first 3 days. At several time-points (pre-operatively, immediately post-operative as well as at 4 weeks post-operative), patient-reported outcome measures of dysphagia (EAT-10 score) and dysphonia (Voice Handicap Index) were collected. This data was then analyzed. **Results:** The demographics of both groups were similar. Majority of patients had minimal swallowing or voice dysfunction pre-operatively, and most of them suffered from swallowing and voice dysfunction immediately post-operatively. There was a statistically significant improvement in dysphonia scores in the intervention group at 4 weeks post-operatively (mean improvement of 4 points, $P < .024$) but no statistically significant improvement in the dysphonia scores in the control group. There were no statistically significant improvements in the dysphagia scores. **Conclusion:** Chilled yogurt is a relatively simple and easy to

implement method of easing patient's post-operative pain after anterior cervical spine surgery. It may have some statistically significant effect in helping to reduce patient's dysphonia symptoms post-operatively. Further studies need to be done to investigate its role in aiding dysphagia. There is a need to develop more accurate patient reported outcome measures for assessing dysphagia and dysphonia.

1298

P234: Preoperative trends in CT bone density predict likelihood of proximal pathology in long segment spinal fusion

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Introduction: Proximal junctional kyphosis (PJK) and proximal junctional failure (PJF) are well known costly complications of long-segment spinal fusions. The link between low bone mineral density (BMD) and PJK/PJF has been established in the literature with recent efforts directed at circumventing expensive and logistically challenging preoperative DEXA imaging. Emerging alternatives such as CT densitometry offer numerous logistical and clinical advantages but are not well validated. Specifically, CT densitometry utilizes pre-existing imaging to establish not only anatomically relevant BMD, but also can be used to trend BMD in the preoperative period. This study demonstrates the novel prognostic value of CT densitometry in identifying patients prone to PJK/PJF. **Material and Methods:** IRB-approved single-institution retrospective review of spinal fusions from January 1st 2015 through April 30th 2021 was performed. All thoracolumbar fusions of five spinal segments or greater were included. Patients with fewer than six months of follow-up, infection or tumor affecting proximal segments, or fewer than two preoperative CT scans were excluded. Demographics, CT densitometry, DEXA (when available), and postoperative imaging were collected. Fellowship-trained spine surgeons performed all radiographic assessments. Regression analysis of demographic factors and Pearson correlation coefficient analysis of bone density and PJK/PJF was performed. **Results:** Of 608 patients meeting operative inclusion criteria, 121 had sufficient preoperative imaging and follow-up. PJK was observed in 32.2% of included patients and was significantly associated with low BMD at the UIV. When study subjects were subdivided into increasing, stable, or declining preoperative BMD cohorts, likelihood of PJK was significantly increased in the declining BMD cohort. **Conclusion:** This study demonstrates that preoperative trends in BMD of the UIV as established by CT densitometry correlate significantly with likelihood of postoperative PJK/PJF. It also bolsters the

emerging role of CT densitometry in evaluation of spinal BMD as a valuable part of preoperative workup.

1335

P235: Sacroiliac joint syndrome followed after fusion of lumbar spine - Is it a complication?

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Introduction: Recurrent pain with pseudoradicular irradiation into legs is a common complication after operative fusion of lumbar spine. The relapse of this pain symptomatic usually occurs after rehabilitation and returning to a normal life and work. By clinical experience, we noticed that lot of patients have pain particularly in the sacroiliac joint (SJS). Thus, the aim of our study was first to describe the pathophysiological relationship between SJS syndrome and lumbar fusion and secondly to identify predictors for recurrent pain syndrome. **Methods:** All patients who underwent a stabilization and fusion surgery on lumbar spine in author's institution between 2015 to 2020 were included in this retrospective study. We defined postoperative SJS syndrome as a recurrent pain syndrome in SJS more than 3 months after surgery with negative CT/MRI findings in spine. Furthermore, followed parameters were analyzed: sex, body mass index (BMI), age, level of lumbar fusion, mobility and pain before and after surgery and at follow-up. **Results:** In total, 375 patients were eligible for the analysis. Of them 24 patients (6.4%) had postoperative SJS syndrome, the median age was 72.3 years and BMI was higher than 30 in 17 patients (7.8%), higher than 25 in 6 patients (25.0%) and normal in 2 patients (8.3%). Predictors for postoperative SJS were female sex (OR 3.3, $P < .01$), BMI index (OR 1.0, $P < .05$) and older age (OR 1.1, $P < .05$). The mobility measured by walking distance was better after initial surgery in 80% of patients after 8 weeks, however it was reduced to 50% at follow-up. A conservative therapy with physiotherapy, infiltration of SIJ was successful by 21 patient (87.5%), 3 patients (8.8%) underwent a SIJ fusion. **Conclusion:** Higher age, female sex and higher BMI are risks factors to have a postoperative SIJ syndrome after lumbar fusion. Better mobility after fusion surgery might lead to overloading of SJS and could be one main reason for postoperative SJS syndrome.

Trauma—Cervical

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P236: Safety and utility of functional dynamic cervical spine radiograph (FDCSR) in identifying subaxial cervical injuries (SACI) which are stable by radiological and clinical criteria: a retrospective cohort study

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Introduction: Identifying instability in cervical spine injuries is essential to decide the type of intervention. Dynamic x-rays have been utilized in a few centres around the world to diagnose missed cervical spine injuries. However, the safety and utility of dynamic x-rays in deciding the stability of a fracture have not been established till date. At our centre, we routinely perform FDCSR in SACI even in cases with a fracture detectable on x-ray/CT scan to predict instability when there is a questionable stability of a fracture. **Material and Methods:** We hypothesized that FDCSR is useful and safe in selected patients with SACI with incomplete or no neurological deficit. A retrospective analysis of hospital records and imaging data base of a tertiary care referral center from 1st Jan 2014 to 31st Dec 2018 was performed. Our indications for doing FDCSR in SACI are as under: 1. In neurologically intact patients: Those with stable injuries (burst/compression fractures) on neutral radiographs ($< 11^\circ$ angulation relative to adjacent segment /3.5 mm horizontal translation). 2. In patients with neurological deficit: All fractures with neurological deficit are generally considered to be unstable. However, we perform dynamic radiographs in patients with neurological deficit in degenerative /congenital stenotic canal with no radiologically discernible bony injury on static radiographs (i.e. hyper extension injuries). Under supervision, the patient were asked to actively flex and extend the neck as much as possible. The patient is asked to abort the movement and report if there is a feeling of tingling/ numbness/ weakness in the limbs and if there is unbearable pain. Parameters assessed: The following parameters were assessed 1. Adequacy of radiographs 2. Assessment of instability, 3. Assessment of Neurological status via ASIA Impairment Scale (AIS) Outcome measures were 1. Safety: 1. Neurological status of patient pre and post FDCSR, 2. Pain/spasm during the procedure, 2. Utility: • Adequacy rate of FDCSR, • Instability rate in adequately performed FDCSR • Instability rate in inadequately performed FDCSR. **Results:** 960 patients presented with TCSCI (traumatic cervical spinal cord injury) during the timeframe of our study. 364 patients satisfied the eligibility criteria. The neurological status before FDCSR was AIS-B in 1.1% (n = 4), AIS-C in 8% (n = 29), AIS-D in 12.6% (n =) and no

neurological deficit in 78.3% (n = 285) patients. There was no worsening of neurological status in any patient during/following FDCSR. 262 x-rays were inadequate and 102 x-rays were adequate with adequacy rate of 28%. Among 102 patients with adequate x-rays, instability was seen in 1.2% (n = 10). Among 262 cases with inadequate FECSR, instability was seen in 7.25% (n = 19) patients. The overall instability rate in the study was 7.96% (n = 29). **Conclusion:** In selected patients, dynamic x-rays under supervision can be safely utilized in patients with sub axial cervical spine injury to identify instability. FDCSR are useful to detect instability in patients with subaxial cervical spine trauma when there is a question on the stability of cervical spine on x-ray/CT scan. They could reveal instability in apparently stable TCSCI even when adequate FDCSR could not be performed.

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P237: Spinal cord injuries in Rugby Union: mechanisms and trends

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Introduction: SCIs can cause permanent neurological defects in movement and sensation below the level of spinal injury, as well as neuropathic pain and spasm. Rugby Union is the world's most played contact sport and can produce SCIs in players. Monitoring changes in the causes of SCIs in Rugby Union is essential to understanding how to prevent their occurrence. There is a paucity of research on the modern English game and there remains disagreement on the causes of rugby SCIs. **Material and Methods:** Injured players were identified through the Injured Players Foundation (IPF) and invited to an interview via informed consent process to determine the circumstances surrounding the injury. Injured players radiological imaging confirmed the interview **Results. Results:** The incidence of all SCIs in England in rugby union from 2011-2019 was .14 injuries per 100,000 hours while complete SCIs had an incidence of .09 per 100,000 hours. The tackle produced the most SCIs (60%) followed by the ruck (20%), then the scrum (10%) and maul (10%). **Conclusion:** The modern English rugby game produces SCIs rarely. The tackle and ruck are the most common phases where these SCIs occur. Changes in the laws of the game have reduced the incidence of these catastrophic injuries.

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P238: Congenital basilar invagination and odontoid fracture: case report

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Introduction: Basilar invagination is a congenital or acquired craniocervical junction abnormality where the tip of the odontoid process projects above the foramen magnum to the posterior cranial fossa, which could be of two forms: (1) Primary: the congenital defect is frequently associated with syndromes and other vertebral abnormalities. Incidence unknown. (2) Secondary: attributed to development issues (causing softening of the bone tissue at this site and frequently presenting later in life), traumatic injuries, atlantoaxial facet joint instability, osteopenia, bone destruction, etc. The odontoid fractures are relatively common fractures of the C2 vertebral body, usually in high energy traumatic injuries in younger patients. These can be classified by D'Alonzo as avulsives (avulsion of the alar ligament, rare), through waist and fractures that extends into cancellous body of C2 and involves a variable portion of C1-C2 joint. **Material and Methods:** Male patient, 62 years old, who had and cerebrovascular ischemic event 3 years before with left hemiparesis as sequel. Patient fell while walking, hitting occipital region, presents behavioral disturbance, respiratory deficit, quadriplegia and quadriparesis but responds to verbal stimuli. Requires mechanical ventilation, after two weeks without improvement was taken to cervical x-ray and tomography and was diagnosed with basilar invagination, absence of C1, odontoid fracture Anderson D'Alonzo Type III and inferior cervical levels with ankylosing spondylitis. He underwent craneocervical fusion C0-C2-C4-C6 and enlargement of foramen magnum. **Results:** In postoperative patient recovers sensibility, muscular strength 3/5 in four extremities, osteotendinous reflexes 1/4, but still with mechanical ventilation. One week later had nosocomial pneumonia and decease. **Conclusion:** Due to the unknown incidence of this pathology, it is usually difficult to diagnose, which is why it is important to make these cases known and report them, in this way it will be possible to give more prompt attention to these cases and avoid associated complications, as in the case of this patient who presented nosocomial pneumonia secondary to prolonged mechanical ventilation (3 weeks).

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P239: Radiological features of type II odontoid fractures in the elderly after high- and low-energy trauma

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Introduction: Although type II odontoid fractures mainly occur due to low-energy trauma (LET), the number of odontoid type II fractures after high-energy trauma (HET) in the elderly is on the rise. However, there is a paucity of conclusive evidence on the relationship between trauma mechanism and cervical spine alignment in the elderly population. Consequently, we examined cervical alignment and osteoporotic and osteoarthritic patterns in elderly individuals (aged ≥ 65 years) with type II odontoid fractures. **Material and Methods:** We retrospectively assessed cervical spine alignment in 76 elderly individuals who experienced type II odontoid fractures after HET ($n = 36$) and LET ($n = 40$) between 2005 and 202. Osteoporotic and osteoarthritic changes on computed tomography and cervical alignment parameters on sagittal plane radiographs were examined. **Results:** Baseline characteristics and osteoarthritic patterns were not significantly different between the groups. Moderate and severe osteoporosis of the dens-body junction and osteoarthritis of the atlanto-odontoid joint were more prevalent in the LET than the HET group ($P < .005$). The anterior atlantodental interval was significantly smaller in the LET group than in the HET group (.7 [.7] mm vs. 1.2 [.8] mm; $p = .003$). The C0-C2 angle, C1-C2 lordosis, and C2-C7 sagittal vertical axis were significantly different (HET vs. LET: 33.2 [7.2] $^\circ$ vs. 41.6 [11.4] $^\circ$, $p = .005$; 28.1 [7.0] $^\circ$ vs. 34.0 [8.0] $^\circ$, $p = .002$; and 16.1 [11.1] mm vs. 27.1 [12.4] mm, $p = .008$; respectively). **Conclusion:** Significantly higher rates of osteoporotic and degenerative changes were observed after LET. Furthermore, previous cervical malalignment represents a risk factor for type II odontoid fractures after LET.

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P240: Spinal cord injuries in Rugby Union: novel findings and management

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Introduction: Spinal Cord Injuries can cause permanent deficits in movement and sensation. SCIs are most commonly sustained in road traffic accidents but also in sporting accidents which account for 11% of SCIs in the UK. Rugby Union is the most popular contact sport in the UK and occasionally produces SCIs. Regular monitoring of the management of SCIs is essential to optimising outcomes and innovating preventative interventions. **Material and Methods:** The Injured Players Foundation (IPF) of the Rugby Football Union (RFU) provided a list of all players who sustained a SCI from 2008-202. All players were invited to an online interview via informed consent process to gather information on how they were injured and treated. The injured players radiological

imaging was used to investigate the causes of the injuries. The management of these players was assessed through: adherence to Major Trauma Centers as the first treatment center, examination of surgical intervention and the immediate care given to players on the pitch (including ambulance arrival times). **Results:** Radiological data was obtained for 17/20 interviewed players. Imaging for 6 of these players was available and revealed pre-existing conditions that contributed to them sustaining a SCI. 4 conditions were degenerative age-related conditions while the remaining 2 were congenital. The management of players was overall satisfactory aside from the ambulance arrival times as 61% of players waited over 30 minutes before paramedics arrived. **Conclusion:** The novel finding of pre-existing spinal cord conditions confirmed with radiological imaging provides an opportunity for a preventative screening tool to identify players at an increased risk of sustaining a SCI. The management of injured players on the pitch could be improved by reducing the arrival time of ambulances.

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P241: The coronary split fracture of the lateral mass of the atlas - A new entity and its therapy

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Introduction: In 2009 Bransford et.al. firstly described an unstable Jefferson fracture variant - a unilateral C1-lateral mass sagittal split fracture. Later, in 2011 motion-preserving primary internal fixation of these fractures by C1-ringosteosynthesis was recommended by the same group of authors, because those fractures were identified to have a propensity for late deformity, requiring C0-C2 reconstruction and fusion. Only a few publications were focusing on this fracture variant, and three more reports 2013 (1 case), 2016 (1 case) and 2017 (2 cases) described more obliquely oriented sagittal split fractures, treated with the aid of unilateral lag screws. Another report 2017 treated 1 case with initially C0-C2 osteosynthesis and a unilateral C1 polyaxial screw used as a lag screw and later converted to C1-ringosteosynthesis. **Material and Methods:** A 53 yo construction worker was referred to our institution from abroad after a 3 m fall from a wall on the head. A CT scan had demonstrated a coronary fracture of the right massa lateralis of the atlas with a 3 mm anteroposterior gap. On the left side the fracture affected the anterior arch of the atlas. The patient had no neurologic deficit and the vertebral arteries were found intact. The patient was immobilized in a rigid collar, but radiologic control showed an increased anteroposterior fracture gap of the lateral mass. A closed and open reduction with simultaneous transoral manual

pressure, Distraction and posterior compression-lag-screw osteosynthesis at the mediocaudal border of the right lateral mass with a Herbertscrew was performed, augmented with a simultaneous typical posterior C1-ringosteosynthesis. Intraoperative stability testing C1-2 proved stability, the transverse atlantal ligament was intact. **Results:** The operation and the postoperative course was eventless. Postoperative controls showed good reduction and implant positioning. The patient was free of pain and had a good C1-C2 function together with bony fusion over the fracture gap 6 months postoperatively. **Conclusion:** The chosen therapy was able to preserve function in the important C1-C2 joints and achieve fusion over the (reduced) fracture gap with no relevant morbidity. Reduction and retention of the very rare coronary split fracture of the massa lateralis of the atlas is achievable with the aid of a compression-lag-screw and C1-Ringosteosynthesis.

673

P242: Lateral mass screw fixation in subaxial cervical spine injury

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Introduction: Subaxial cervical spine injury is one of the major causes of neurological impairment. Impact on working population is huge in developing countries due to higher incidence of trauma and suboptimal prevention strategies. Although it can be treated nonoperatively to some extent, it is well accepted that the goals of surgical treatment are prevention and maintenance of neurological function and stability with bony fusion (Rizzi et al, 2015). Reduction, arthrodesis and fixation is recommended as the method of choice. However, no consensus exists about the best approach, with preferences divided into anterior or posterior (Helton et al, 2007). Hence, it is assumed that posterior reduction and fixation using lateral mass screws might be one of the solutions for better outcome in subaxial injuries. The goal of the study was to address the efficacy of posterior lateral mass screw fixation with respect to fusion, alignment and clinical outcome. **Material and Methods:** It is prospective descriptive study to evaluate the outcome of posterior cervical lateral mass screw fixation in subaxial cervical spine injury. The outcome of 30 patients treated with lateral mass screw fixation between January 2018 and December 2019 at Yangon General Hospital was assessed and analyzed clinically and radiologically. The follow-up period was 10 months. **Results:** Among 30 patients, the most common age group was 40-49 years in 40%. 86.6% of the study population were male. The most common mechanism of injury was fall from height in 6%. The most common injured level were C4-5 and C5-6 levels in 46.7 %. In neurological assessment, 43.3% showed ASIA improvement. In neck pain assessment, mean preoperative NRS score was 7.2 which was

reduced to 1.1 at last follow-up. Screws of varying length were used depending on bone stock. Total of 120 screws were used in 30 patients. Of which, 4 screws were placed into C3 level, 32 in C4, 56 in C5 and 28 in C6 levels. Most frequently used screws were 16 mm in length (52/120,54.3%), with 3.5-mm diameter. Lower levels received a greater percentage of longer screws. 95 out of 120 screws showed bi-cortical purchase. No case showed worsening of kyphotic deformity compared to preoperative level although there is decreasing lordosis over the follow-up. Mean pre-operative kyphosis was improved from 17.7° to mean 4.2°. Good bony fusion was observed in 73% at 3 month and 93.3% at last follow-up. Hard ware failure was found in two cases. No significant neurologic or vascular injury was noted. **Conclusion:** Our study showed that posterior cervical surgery with lateral mass screw fixation is safe and effective technique in subaxial spine injury. The avoidance of neurovascular injury and minimal instrument failure rate proved that it is a safe and straight-forward procedure that requires shorter learning curve unlike pedicle screws. Other advantages include easiness to achieve reduction and surgeons' familiarity. The limiting factor was small study group and longer follow-up is required to confirm the satisfactory **Results** of our technique and to yield more accurate analysis and **Conclusion** with regards to clinical practice.

821

P243: Endoscopically-assisted odontoidectomy plus 360° C1-C2 navigated fusion as surgical management of traumatic posterior atlantoaxial dislocation without odontoid fracture

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Introduction: Complete posterior atlantoaxial dislocation (PAAD) without odontoid fracture is rare, with only 20 reported cases. Treatment strategy remains controversial, with skull traction and open reduction being the mainstream management options. We present the case of a traumatic PAAD in a young adult man, managed with an endoscopically-assisted odontoidectomy followed by a 360° C1-C2 navigated fusion. **Materials and Methods:** Case report of a patient with traumatic complete PAAD, who underwent endoscopically-assisted surgical

management. **Results:** A 21-year-old man presented to a rural institution after a motorcycle accident. On admission, the patient presented cervical pain. However, he did not display neurological deficit. After rapid progression to quadriplegia (right-side muscle strength 1/5, left-side 2/5), corresponding to a grade C injury on the ASIA scale, the patient was transferred to a trauma referral center. Spine CT scan revealed a complete posterior atlantoaxial dislocation, with the unfractured odontoid process located ventral to the anterior arch of C1. Significant spinal stenosis and spinal cord compression were also observed. Spinal MRI revealed cervical myelopathy. Closed reduction of the dislocation was contraindicated due to neurological deterioration and the possibility of increasing spinal cord injury. We decided to perform a 360° C1-C2 fusion divided into two interventions. First, we used an endoscopically-assisted anterior transcervical approach, which allowed complete exposure of the odontoid process. Odontoidectomy was then performed. We carried out reduction under direct endoscopic visualization, assisted by O-arm, and strict neurophysiological monitoring, which showed improvement after the procedure. During reduction maneuvers, severe rotational instability was observed, which prompted us to perform C1-C2 arthrodesis using transarticular screws. A posterior approach was also needed to complete fusion through tricortical iliac crest graft and C1-C2 wiring to accomplish greater flexo-extension and distraction stability, which was completed six days later. Both interventions were accomplished without complication. At immediate postoperative follow-up, the patient presented partial recovery of motor skills, with left-side strength of 3/5, and right-side strength of 2/5. **Conclusions:** Surgical fixation assisted by endoscopy provides a good and safe alternative for definitive treatment of posterior traumatic atlantoaxial dislocations and can help prevent re-dislocation and further instability of the spine.

1207

P244: Proposal of treatment strategy for pedicle fractures of the C2: an analysis of 49 cases

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Spine surgeons often confuse C2 pedicle fractures (PFs) with pars interarticularis fractures. In addition, little information is available about the characteristics and treatment strategies for C2 PFs. We sought to investigate the characteristics of C2 PFs and to propose an appropriate treatment strategy. A total of forty-nine patients with C2 PFs were included in this study. We divided these patients into unilateral and bilateral C2 PF groups. The incidence rates and characteristics of other associated C2 and C2-3 injuries, and other cervical injuries, were evaluated. In

addition, treatment methods and outcomes were analyzed. Twenty-two patients had unilateral C2 PFs and twenty-seven patients had bilateral C2 PFs. Among the cases of unilateral C2 PFs, all patients had one or more other C2 fractures, and twenty patients (9.9%) had one or two C2 body fractures. Meanwhile, among the cases of bilateral C2 PF, all patients had two or more other C2 fractures and one or two C2 body fractures. In unilateral C2 PFs, three patients with C2-3 anterior slip or adjacent cervical spine (C1-3) injury underwent surgery and nineteen patients (86.4%) were treated with conservative methods. In bilateral C2 PFs, three patients with C2-3 anterior slip or SCI at C2-3 underwent surgery and twenty-four patients (88.9%) were treated with conservative methods. Our **Results** showed that C2 PFs do not occur alone and are always accompanied by other associated C2 injuries. C2 PFs should, generally, be thought of as a more complex fracture type than hangman's fracture or dens fracture. Despite the complex fracture characteristics, most C2 PFs can be managed with conservative treatment. However, surgical treatments should be considered if the C2 PFs are accompanied by the C2-3 anterior slip and adjacent cervical spine injury

1209

P245: Surgical outcomes for tear drop fractures of the C2: clinical relevance to hangman's fracture and C2-3 discoligamentous injury

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Objective: To analyze characteristics of surgically managed tear drop (TD) fractures of the C2 axis associated with other injuries such as hangman's fracture and C2-3 discoligamentous injury as well as treatment outcomes. **Methods:** A total of 14 patients (eight men and six women) with TD fractures of the C2, who were surgically treated at four national trauma centers of tertiary university hospitals from January 2000 to December 2017, were included in this retrospective study. The mean age of the patients was 45.5 years (ranging from 19 to 74 years). The characteristics, surgical treatment methods (anterior fusion vs posterior fusion), and **Results** of 14 TD fractures of the C2 were analyzed retrospectively. And the clinical relevance between C2 TD fracture and hangman's fracture and C2-3 discoligamentous injury was investigated through the co-occurrence between injuries. The mean follow-up time after surgery was 22.6 months (ranging from 12 to 60 months). **Results:** Among 14 patients with TD fracture of the C2, four patients (28.6%) had anterior TD fracture and 10 patients (71.4%) had posterior TD fracture. All 10 posterior TD fracture patients had anterior C2-3 displacement. While two of four anterior TD fracture patients had posterior C2-3 displacement, the remaining two did

not. All 14 patients of TD fracture had at least two or more other associated C2 injuries as well as C2-3 discoligamentous injuries. About 92.9% (13/14) of the patients had typical or atypical hangman's fracture; 100% (10/10) of the posterior TD fracture patients had hangman's fracture, but 75% (3/4) of the anterior TD fracture had hangman's fracture. At admission, 13 patients were neurologically intact. However, the remaining patient had spinal cord injury with American Spinal Injury Association (ASIA) impairment scale B with C2-3 bilateral facet dislocation. All four anterior TD fracture patients underwent posterior C2-3 fusion. While four of 10 posterior TD fracture patients underwent C2-3 anterior fusion, the remaining six underwent posterior fusion. At last follow-up, 100% (14/14) of the patients achieved solid fusion, and visual analog scale for neck pain was significantly improved (5.9 vs 2.2, $P < .001$). One patient with ASIA impairment scale B had significantly improved to scale D. No major complications occurred. **Conclusion:** Our study showed that surgically managed TD fractures of the C2 showed a high incidence of other associated spine injuries including hangman's fracture and C2-3 discoligamentous injury. Therefore, special attention and careful radiologic evaluation are needed to investigate the presence of other associated spine injuries including hangman's fracture and C2-3 discoligamentous injury, which are likely to require surgery.

1283

P246: Anterior C1 C2 reduction and anterior fixation for irreducible C1 C2 fixation

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Aim and Objective: To study role of anterior release for irreducible C1C2 dislocation and feasibility of anterior C1C2 stabilization. **Material and Method:** 17 years old male presented with irreducible traumatic C1C2 dislocation with odontoid fracture. Patient presented after few months after trauma with gradually progressive myelopathy with inability to walk. we did anterior C1C2 release via retropharyngeal approach which was not sufficient to reduce dislocation. So we removed anterior C1 arch removal and odontoidectomy, after which we achieved reduction. We fixed C1C2 anteriorly using 2 plates with screws in C1 lateral mass and C2 vertebral body. **Result:** Duration of surgery was 3 hours with 200ml blood loss. Perioperative course was uneventful, and patient improved neurologically and was started walking without support on day 5 after surgery. Now patient is neurologically normal after 8 months of surgery with implant and reduction of C12 in position. **Conclusion:** Anterior stabilization of C1C2 dislocation is viable option. It helps to reduce 2

surgeries, one anterior release and posterior fixation. Chances of complication like vertebral artery injury or cord injury are less with anterior stabilization.

I309

P247: Delayed diagnostic and management of bilateral C4 C5 facet dislocation after abusive physiotherapy

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Introduction: Traumatic cervical injuries should be treated early. Unfortunately, sometimes we are facing neglected cervical spine injuries that have unusual cervical presentation with serious complications. Actually, there is no validated management protocol for these neglected cervical spine injuries. **Material and Methods:** We present the case of 44 years old man with neglected bilateral C4 C5 facet dislocations with neurological deficit, who was exactly diagnosed after 1 month after abusive physiotherapy. The patient underwent posterior than anterior approach after closed reduction failure. we started by a posterior reduction, lateral mass instrumentation, and fusion C4 C5, followed by a partial anterior C4 and C5 corpectomy, placement of an expandable cage, and anterior C4 to C5 plating. **Results:** We were able to restore a normal cervical lordosis. The cervical radiculopathy resolved within 02 weeks. At 18 months post-operative follow-up, his cervical posture was improved, no pain was reported and he regained a full mobility of the neck. **Conclusion:** Delayed diagnosis of cervical spine injuries makes treatment challenging. Early management is essential. It can be achieved through better knowledge of these injuries, better medical awareness, and better application of emergency protocols. Fortunately, operative intervention can achieve closed reduction, long-term stability and substantially improve the quality of life in these patients.

Trauma—Thoracolumbar

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P248: Percutaneous short fixation associated with kyphoplasty for burst fractures of the thoracolumbar spine: monoaxial versus polyaxial screws

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Introduction: Burst fractures of the thoracolumbar and lumbar fractures account for almost 50% of spine fractures. They require a surgical treatment most of the time to achieve good deformity correction and quick patient recovery. Percutaneous short fixation associated with kyphoplasty appears as an effective treatment. Several studies report mechanic advantages, and better fracture correction when using monoaxial screws over polyaxial screws. Monoaxial screws offer the possibility to better transmit the bending of the rods to the spine. The goal of our study was to compare the correction obtained with monoaxial and polyaxial screws in percutaneous short fixation associated with kyphoplasty. Our hypothesis was that the correction was better with monoaxial screws. **Material and Methods:** We included from October 2009 to 2020, all the patients who presented with a Magerl A3 or A4 fracture of the thoracolumbar or lumbar spine without neurologic deficit, treated by percutaneous short fixation and kyphoplasty. Minimum radiologic follow-up was 6 months. We measured vertebral kyphosis (VK), local kyphosis (LK), and calculated the traumatic regional angulation (TRA), and anterior vertebral compression ratio (AVCR). All measures were made by a single assessor on computer, before surgery, on early post-operative X-Rays, and at last follow-up. Last follow-up X-Rays were the last before device removal if so was performed. The main judgment criteria were VK, and LK. **Results:** 79 patients were included. Monoaxial screws were used in 43 patients, and polyaxial in 36 patients. The mean improvement of VK at last follow-up was 7°. At last follow-up there was no significant difference between both groups regarding KV: 6° and the LK: 3°. There was no difference either regarding TRA: 6° in both groups. AVCR was better in the monoaxial group: 84% versus 78% in the polyaxial group ($p = .027$). **Conclusion:** The Results of our study are good, and similar to those reported in the literature. Although some studies report better fracture correction and better mechanic stability with monoaxial screws, the radiographic correction in our study was the same in both groups. However, this is to our knowledge, the only study comparing both screws type in the case of percutaneous short fixation with kyphoplasty. Our interpretation is that the kyphoplasty, which provides a good anterior column support in our construct, minimizes the impact of the screw type. We did not find any difference regarding fracture radiologic correction between monoaxial and polyaxial screws in percutaneous short fixation associated with kyphoplasty in this study.

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P249: Applicability of the AO Spine PROST (patient reported outcome spine trauma) among SCI patients - healthcare professionals' perspective and development of version 2.0

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Introduction: The provision of appropriate surgery, medical care and rehabilitation can have significant effect on disability in people with spinal cord injury (SCI). To learn what surgical and rehabilitation treatments are most effective and to compare them in a reliable and valid fashion, it is important to standardize classification and outcome measurements. To meet these requirements, the AO Spine Knowledge Forum Trauma developed the Patient Reported Outcome Spine Trauma (AO Spine PROST). This tool was developed for people with spine trauma and minor or no neurological impairment. To the best of authors' knowledge, it is adopted worldwide with currently being translated into 15 languages. In the current study, the applicability of the AO Spine PROST for people with motor-complete SCI was examined from the perspective of the healthcare professionals. Also, recommendations were made for adjustments of the tool.

Material and Methods: A discussion meeting with SCI rehabilitation physicians in the Netherlands was performed, followed by an international online survey among healthcare professionals involved in the care of people with SCI. Participants rated the comprehensibility, relevance, acceptability, feasibility and completeness of the AO Spine PROST on a 1-5 point scale (5 most positive). Comments could be provided per question. The discussion meeting was audio taped, meaningful phrases transcribed, and analyzed thematically. The Results of the international survey was compared with the Results of the discussion meeting using descriptive statistics. The comprehensibility, relevance, acceptability, feasibility, and completeness of the tool were analyzed by calculating frequency tables using SPSS. **Results:** A total of 13 physicians attended the discussion meeting. The survey was completed by 196 participants. Comparable Results were obtained from the discussion meeting and the international survey. Comprehensibility (mean $4.1 \pm .8$), acceptability ($4.0 \pm .8$), relevance ($3.9 \pm .8$), completeness ($3.9 \pm .8$), and feasibility ($4.1 \pm .7$) were rated positively for use in people with motor-complete traumatic or non-traumatic SCI. A few participants questioned the relevance of items about the lower extremities (e.g. Walking) or indicated the lack of questions about respiration/breathing and complications. **Conclusion:** The AO Spine PROST was found to be applicable for people with motor-complete traumatic or non-traumatic SCI. This study formed the basis for recommendations in adapting the tool (version 2.0) in order to make it applicable to the entire spine trauma patient population, including patients with (severe) SCI. With this modified version, the AO Spine PROST is expected to be even more useful both in the clinics and for research purposes, contributing to the comparison of spine trauma outcomes in a valid and reliable fashion with the potential to reduce the ongoing controversies in spine trauma care.

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P250: Short-segment fixation of thoracolumbar fractures with burst elements using minimally invasive surgery - A novel technique

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Introduction: We describe our technique utilizing minimally-invasive surgery (MIS) short-segment pedicle screw fixation for thoracolumbar fractures with burst elements – utilizing a one-up one-down instrumentation with index vertebra fixation. We aim to highlight the two-year radiological & functional outcomes of 20 consecutive patients who underwent this technique. **Material and Methods:** A retrospective study comprising 20 patients with thoracolumbar fractures with burst elements who underwent fixation via our technique was conducted. Baseline characteristics and injury profiles of included patients were collected. Radiological parameters such as vertebral wedge angle, regional kyphosis angle, coronal Cobb angle, anterior and posterior vertebral body heights were recorded at preoperative, intraoperative, postoperative, and up to 2-year follow-up. Clinical outcome scores of VAS and ODI were also recorded at similar time-points. **Results:** Radiological outcomes reflect significant lordotic corrections of the vertebral wedge angles up to 2-year follow-up when compared to preoperative values (intraoperative: $p = .06$; postoperative: $p = .001$; 3-month: $p = .002$; 6-month: $p = .004$; 1-year: $p = .011$; 2-year: $p = .016$). Additionally, significant lordotic corrections of regional kyphosis angles (intraoperative: $p = .00$; postoperative: $p = .00$; 3-month: $p = .031$; 6-month: $p = .039$) and increases in anterior vertebral body heights (postoperative: $p = .001$; 3-month: $p = .010$; 6-month: $p = .020$) up to 6-month follow-up was found. Significant improvements in functional outcomes ODI and VAS compared to preoperative data were found, with median scores of 0 at 2-year follow-up. **Conclusion:** Our approach in treating thoracolumbar fractures with burst elements using MIS short-segment fixation and novel screw placement technique shows good biomechanical basis. This technique has achieved satisfactory radiological correction & high rates of fracture union whilst reducing approach-related morbidity & improving functional outcomes.

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P251: Long segment v/s short segment index vertebra fixation of thoracolumbar fractures

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Introduction: The thoracolumbar junction represents an area of spine transition from more rigid thoracic spine to the more mobile lumbar spine. This area is most commonly injured part of the spine. Treatment of thoracolumbar fractures is ever evolving. Modern instrumentation systems allow for a better prognostic outcome. The study was conducted to assess and analyze the clinical, peri-operative, functional and radiological parameters to compare outcomes of long segment fixation vs short segment fixation with instrumentation of index vertebra. **Material and Methods:** A retrospective study was done with 119 patients having fractures of thoracolumbar spine. Fractures were classified according to AO classification system. Patient were followed up for a minimum of 1 year. Angle of correction were measured on lateral roentgenogram using Cobb's method. Neurological grading was done using Frankel's grading system. Operative time, perioperative blood loss and time to mobilization were analyzed. **Results:** After one year, the loss of kyphosis was not significantly different between two groups (p value = .3974). The present study has also demonstrated no statistical difference in terms of neurological outcomes (p value = .201), patient mobilization (p value = .34) or duration of hospitalization (p value = .39). However, operative time (p value- .0001) and perioperative blood loss (p value- .0001) was significantly less in patients undergoing short segment fixation. **Conclusion:** In our experience, short segment fixation can be used for treating thoracolumbar fractures, as it is associated with less blood loss, decreased intraoperative time and not significant difference in relation to time to mobilization, duration of hospitalization, neurological recovery and loss of kyphosis.

550

P252: Neurological improvement after early versus late surgical decompression after traumatic thoracolumbar fractures: a comparative study

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Introduction: Thoracolumbar spine fractures can result in significant disability, and neurological deficit. Surgical treatment may minimize complications, Controversies exist regarding the timing of surgery. The aim of this study is to evaluate the neurological improvement in patients with traumatic thoracolumbar fracture with neurological deficit, after early versus late surgical decompression. **Material and Methods:** A prospective cohort study was conducted in 25 patients with thoracolumbar fracture, met our inclusion criteria

underwent surgical decompression and stabilization in Baghdad medical city complex and neuroscience hospital of Baghdad from August 2014 till December 2016, all patients evaluated according to ASIA impairment scale on admission and at (6) month of follow up. 12 patients underwent early surgical decompression (≤ 72 hrs.) and 13 patients underwent late surgical decompression mean time from injury to surgery was 12.5 ± 7.7 (4-28) days. **Results:** A total of 12 patients underwent early surgery, 13 patients underwent late surgery, overall AIS improvement of early group were (66.6%) and late group were (76.9%), The change in AIS from preoperative to post operative assessment was statically significant in patients who underwent early (p value .016) and late surgery (p value .032). All patients with partial neurological impairments had an improvement at least one grade (except for one early patient who remain in ASIA-B). All patients (six) with complete neurological impairments shows no improvement. Both groups show improvement in AIS and the difference in the neurological improvement between the 2 groups were statically non-significant (p value .073). **Conclusion:** Significant improvement gained in patients with thoracolumbar fractures with partial neurological deficit in both early and late surgically decompressed patients. No significant difference in the rate of neurological improvement between early and late group. Surgical decompression and fusion did not result in neurological recovery after complete neurological impairment in patients with thoracolumbar spine fractures.

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P253: Short segment fixation with intermediate screw versus conventional long segment fixation with out intermediate screw in treatment of unstable thoracolumbar burst fractures: a retrospective comparative study

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Introduction: Debate still exists about the optimal way for treatment of thoracolumbar burst fracture and the number of levels need to be fixed. Recently, adding a pedicular screw to the fractured segment (intermediate screw) shows a promising result. The aim of this study is to compare the outcome of short segment fixation with intermediate screw and long segment fixation without intermediate screw in the management of the unstable thoracolumbar burst fractures: retrospective comparative study. **Material and Methods:** A total of 17 patients with thoracolumbar burst fracture, thoracolumbar injury classification and severity (TLICS) of ≥ 4 , from October 2018 until the end of April 2019. Patients divided into two groups

according to the number of levels fixed and the use of intermediate screw. Group (A) 9 patients fixed with short segment and intermediate screw. Group (B) 8 patients fixed with long segment without using intermediate screw. Patients were evaluated and followed for local kyphotic angle (LKA) correction and maintenance, anterior vertebral body height (AVH) reduction and maintenance with evaluation of back pain and ambulation. **Results:** The mean patients age was 33.76 years. Mean follow-up duration in group (A) was 9.1 months while in group (B) was 1.8 months. Pain rating scale for back pain was significantly different between both groups in the postoperative period in favor of group (A), with no significant difference in back pain between the two groups in the follow-up period. Postoperative correction and maintenance of (LKA) was significantly different between the two groups compared to the preoperative measures (P value .019, .003 respectively) in favor of group A, postoperative correction and maintenance of (AVH) was not statically different between the two groups. Ambulation shows significant difference between the two groups in the postoperative period (p value .037) in favor of group A. **Conclusion:** Short segment fixation with intermediate screw of thoracolumbar burst fractures is a reliable method of fixation, associated with accepted correction of (LKA) and (AVH), less postoperative pain, early ambulation, and it can save more motion segments.

1118

P254: Single-stage posterior circumferential stabilization using double small cages for the treatment of thoracic and lumbar spine fracture

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Objective: Controversy remains regarding the optimal methods for resection of the vertebral body, reconstruction of the anterior column, and decompression of the spinal cord in patients who have severe vertebral body destruction of the thoracic or lumbar spine with associated neurologic impairment. We report an alternative technique for primary treatment and salvage involving single-stage corpectomy followed by reconstruction of the anterior column using double small mesh cages via the posterior-only approach. **Methods:** Plain radiographs and computed tomography scans, taken at different intervals, were used to measure local kyphosis, segmental height, and fusion grade. Pain was evaluated using visual analogue scale (VAS) and neurological symptoms were classified according to Frankel grade. **Results:** The mean kyphotic deformity improved by 14.47 ± 9.06 ($P < .001$) and the mean segmental height improved by 7.17 ± 6.11 mm ($P <$

$.001$) after surgery. Fusion was achieved at 84% of patients, within a median interval of 12 months. Kyphotic recurrence was observed in 2 patients (11%), segmental height loss (SHL) occurred in 1 patient (5%), and both kyphotic recurrence and SHL occurred in 1 patient (5%). None of the patients reported worsening pain or neurologic symptoms after surgery, and there were no surgery-related complications such as neural injury, cerebrospinal fluid leakage, cage dislocation, surgical site infection, or cardiopulmonary complications. **Conclusion:** Single-stage corpectomy followed by reconstruction of the anterior column using double small mesh cages via the posterior-only approach is a reliable and less invasive single-stage treatment and salvage option in selected cases.

1169

P255: Vertebral thoraco lumbar fractures: percutaneous versus open osteosynthesis

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Introduction: Thoraco-lumbar spine fractures are lesions which treatment has long relied on open osteosynthesis. The objectives of our work were to compare the functional and radiological Results of percutaneous versus open osteosynthesis of thoracolumbar vertebral fractures and to discuss the advantages of percutaneous osteosynthesis. **Material and Methods:** Through a retrospective comparative study over a period of 7 years, including 40 cases of vertebral fractures without neurological signs treated by percutaneous osteosynthesis, and 40 cases operated in the open, we evaluated: the visual analogue scale for pain, the score of Denis for the return to work, the operating time, the length of hospitalization, the quality of the scar, the frequency of postoperative complications, vertebral kyphosis, traumatic regional angulation, Beck index, load sharing score. **Results:** The average age was 44.56 years, with a sex ratio of 1.58. The circumstances of the occurrence were predominantly accidents on public roads (47.5%). 61 patients (76%) presented with an injury associated with the spinal trauma. Pain assessment scores (VAS and ODI score) were significantly lower for the group of patients treated by percutaneous internal fixation ($P < .001$). For the radiological Results, we did not find any significant difference between the two groups ($p > .05$). The group treated with percutaneous osteosynthesis was characterized by a significantly reduced operating time and hospital stay ($p \leq .044$), and by a significantly lower frequency for bleeding incidents ($p = .011$) and thromboembolic complications ($p = .001$). **Conclusion:** According to our study and the data in the literature, for radiological Results comparable to those obtained in open surgery, percutaneous osteosynthesis is associated with significantly less postoperative pain and fewer early complications (in particular

haemorrhagic and thromboembolic complications), significantly reduced operating time and hospital stay. The main disadvantages of percutaneous osteosynthesis are represented by its significantly more radiating nature for the surgeon than open surgery and the need for a substantial learning curve.

I251

P256: Compression fractures of thoracolumbar spine: Results of the orthopedic treatment

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Background: Compression fractures of the thoracolumbar spine are common. Surgical treatment is usually prescribed. It can reduce deformations. Orthopedic treatment still have a place in the management of these fractures despite the less significant corrections of kyphosis. The indication of the treatment depend not only on the fracture itself but also on the cost of each procedure especially as our current context imposes a policy of health economy. The aim of our study was to evaluate clinical and radiological Results of the orthopedic treatment of compression fractures of the thoracolumbar spine, its limits and its indications. **Methods:** This was a retrospective, descriptive study conducted over five years, on 45 cases of compression fractures of the thoracolumbar spine treated orthopedically with a minimum of 6 months follow-up. **Results:** The mean age was 43.8 years. The sex ratio was 1.05. Home accident was the most common etiology (53%). The most common injury mechanism was falling from a height (65%). Clinically, the mean Oswestry score was 14.3% (minimal disability). The work accident significantly increases functional impairment ($p = .022$) and lengthens rest duration ($p = .009$). 72.7% of active patients had regained their full-time work without professional reclassification (1 and 2 of Denis score). On the radiological level, all patients had consolidated after a 3-month delay. For unreduced fractures, wearing the brace did not allow the correction to be maintained since there was an overall loss at the last follow-up. For reduced fractures, significant correction initially obtained had persisted at an average of 19 months. Correction was better maintained at the thoraco-lumbar hinge. Traumatic regional angulation above 20° was accompanied by bad functional Results ($p = .043$), and this indicate a certain degree of radio-clinical correlation. **Conclusion:** Optimization of indications, systematic reduction of fractures and rigorous technique of fitting the brace are essential for the success of orthopedic treatment which remain a good procedure for the treatment of compression fractures of the thoracolumbar spine.

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P257: Injury of the thoracolumbar posterior ligamentous complex: a bibliometric literature review

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Introduction: This bibliometric review of literature on posterior ligamentous complex (PLC) injury in thoracolumbar (TL) trauma aims to guide future research. **Material and Methods:** We conducted a keyword-based search from January 2000 to September 2021 using the Scopus database. Relevant publications were analyzed for the year of publication, authorship, publishing journals, institution and country of origin, subject matter, and article type. In addition, content analysis of clinical articles was performed, analyzing for sample size, study design (retrospective vs. prospective), single vs. multicenter, and level of evidence. **Results:** 262 publications have been published in 61 journals by 537 authors, 162 institutions, and 29 countries. Thomas Jefferson University, the University of Calgary, and the University of Toronto have the largest number of publications related to PLC injury. The USA, Canada, and China were the most frequent contributors in terms of the number of publications. Spine was the most prolific and top-cited Journal, while Vaccaro A.R. was the most prolific author. The most cited publication was the Thoracolumbar Injury Classification and Severity Score (TLICS) classification by Vaccaro et al. in 2005. Most of the publications have been case studies, with diagnostic accuracy being the most frequently discussed topic. The sample size for a large portion of the case series was less than 5. The majority of case series were retrospective studies conducted at a single center. **Conclusion:** Our review provides an extensive list of the most historically significant spinal imaging articles, acknowledging the key contributions made to the advancement of this research area.

I314

P258: Kyphoplasty for the treatment of osteoporotic vertebral fracture: a clinical and radiological evaluation

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Background: Osteoporotic vertebral fractures are very common fragility fractures of the spine that affect up to 50% of people over 80 years old. Pain and spinal deformation cause loss of autonomy and predispose to a higher risk of morbidity and mortality. Kyphoplasty is a therapeutic alternative to treat these fractures. The aim of this work was to evaluate the clinical and radiological Results of the kyphoplasty on osteoporotic vertebral fractures. **Methods:** It was retrospective study, between 2015 and 2019. We included 22 patients treated with Kyphoplasty for osteoporotic vertebral fractures with no spinal cord injuries. A collective of clinical, functional and radiological data was done. **Results:** The last follow-up was 17 months. The mean age was 64 years with a female predominance (sex ratio 2.6). The thoracolumbar hinge was the most severed region. 21 patients have described pain reduction after surgery. The improvement in the Visual Analogue Scale was by 2.64/10 post-operatively ($P < .103$) and by 3.69/10 ($P < .103$) in the last follow-up. The Denis pain scale was less than two for 20 patients in the last follow-up. The functional evaluation had shown that 21 patients had minimal or moderate disability in the last follow-up. On the radiological side, the reduction of vertebral and regional kyphosis was respectively by 8.5° ($P < .103$) and 5.9° ($P < .103$). Beck's index went up from .63 to .8 post-operatively ($P < .05$). Complications were cement leakage in two patients without clinical symptoms. One surgical site infection was managed by medical treatment without any general complication. **Conclusion:** In our experience, kyphoplasty is a reliable technique for treating osteoporotic fractures. Its value lies in rapid pain reduction, early functional improvement and restoration of the spinal alignment.

Trauma—Other

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P259: Occupational therapy treatment time during inpatient spinal cord injury rehabilitation: a retrospective study in Riyadh

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Introduction: Occupational therapy (OT) is a part of rehabilitation process in which facilitates and enables individuals with spinal cord injuries (SCI) to be independent as possible in activity of daily living (ADLs). Little is known about OT treatment plan and the duration of the selected treatment intervention during SCI rehabilitation. This study aims to describe the duration of OT treatment that patient with SCI received during their in-patient rehabilitation stay. **Material**

and Methods: A chart review of spinal cord injury patients who attended in-patient rehabilitation at King Abdulaziz Medical City between 2016- 202. For each patient 's electronic medical file, the documented rehabilitation session, including the treatment duration and type of therapeutic intervention, have been extracted. Demographic, clinical data related to the type and level of spinal cord were also collected. We estimated the time that each patient received in all sessions and examined it with clinical factors. **Results:** A total of 50 eligible patients have been included in this analysis. The median age of the study population was 28, and the majority were male patients (82%). The most common reason for the SCI was a motor vehicle accident (94%), in which 56% required ICU admission. The most common specific therapeutic activity was education (100%), equipment prescription (96%), transfer training 86%, and toileting training (70%). The median of total time spent over the patient's stay was 1785 minutes, approximately 43.7 hours of occupational therapy rehabilitation. After categorizing the level of spinal cord injury, the median total of 33 hours of session received for SCI level between C1-C4 over the course of rehabilitation, and 25 hours of session received for patients with SCI level between C5-C8, 36 hours of session received for SCI level below T1 to T6, and 29 hours of session received for with SCI level below T6. **Conclusion:** Almost all patients with SCI received strengthening/ Range of Motion exercises and ADLs training over the course of OT rehabilitation, which consumed the most time over other interventions. Specifically, we found lower body dressing training was the most ADL consumed time. We also identified a significant variation in time spent among SCI for all OT interventions when examining both total time spent and a calculated number of minutes per session. Some of this variation could be explained by patient and injury characteristics.

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P260: Is the segment of spine injury in polytraumatized patients indicative for concomitant injury distribution and time of spine surgery? An analysis of 12,596 patients of the TraumaRegister DGU

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Introduction: There is a lack of studies, with larger case numbers, investigating the prevalence of spinal column injuries occurring in severely injured patients. For the care

strategy of these injuries, it is important to know the type, distribution and severity of concomitant injuries. Due to the severity of a concomitant injury, the immediate care of the spinal column injuries can be deferred. Data from the German TraumaRegister DGU (TR-DGU) of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie, DGU) was analyzed to show the incidence and distribution of injuries as well as the time of care (early within the first 48 hours and late after 48 hours) with focus on spine injuries. **Material and Methods:** A retrospective examination of 179,846 patients, who were registered in the TR-DGU during 2008 and 2017, was performed. Included were patients from European hospitals with an Injury Severity Score (ISS) ≥ 16 and an age ≥ 16 years. Furthermore, the collective was restricted to severe spinal injuries with an Abbreviated Injury Scale (AIS) of 3-6 points. All plexus injuries were excluded. In the resulting population, an evaluation of the different concomitant injuries with AIS of 2-6 points was then performed in relation to the height segments of the spine (cervical spine, thoracic spine, lumbar spine). **Results:** In the generated patient population, 12,596 patients showed a spine injury. 72.7% were male and 94.4% suffered blunt trauma. On average, the patients were 5.88 ± 2.2 years old. The most frequent accident mechanisms were car accidents (19.2%) and motorcycle accidents (12.7%). The overall mortality rate was 17%. When reviewing the height segments of the spinal column, 39.7% of spinal injuries occurred in the cervical spine, 37% in the thoracic and 3.7% in the lumbar spine. In the group of injuries with an AIS 3, almost 50% of the patients presented a more severe injury on another part of the body. Accompanying severe head injuries (AIS 5) occurred mainly in connection with cervical spine injuries (11.5%). An accumulation of severe thoracic injuries (AIS 5) was found with injuries of the thoracic spine (14.7%). Using the example of the moderate cervical spine injury (AIS 3), it was shown, that only 15.2% of the patients were treated early in the presence of more severe concomitant injuries with a higher AIS. However, if the cervical spine injury was leading, 35.1% of patients received early treatment. **Conclusion:** The critically injured patients included in the study often had a severe spinal injury. An anatomical connection of the concomitant injuries could be shown with regard to the height segment of the spinal column. The time of surgical treatment of the spine seems to depend on the severity of the concomitant injuries in the data presented. In everyday clinical practice, the concomitant injuries should be considered in a standardized manner when determining the time of spinal column treatment. All aspects should be evaluated in order to establish a priority orientated treatment plan.

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P261: Consequences of delayed surgical treatment of traumatic spinal cord injuries: tertiary center experience

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Introduction: Owing to its disabling consequences, spinal cord injury is devastating for both the patients and their health care providers. There are many causes of spinal cord injury, by far the most common of which being motor vehicle accidents (MVA). Unfortunately, in neglected injuries, many complications and poor outcomes could be encountered. This research aimed to assess the causes, consequences, and outcomes of neglected traumatic spinal cord injuries. **Material and Methods:** Out of 750 cases reviewed between February 2016 to February 2021, 18 cases matched our inclusion criteria which was any TSCI with neurological deficit requiring surgical intervention more than 14 days from the index trauma. The following variables were measured: patient's demographics, injury, management, delay, complication, and hospital course characteristics. ASIA scores were recorded at presentation and final follow up. **Results:** Out of 18 neglected TSCI patients, 72.2% were male. The patient's mean age at the time of injury was 36.8 years. 77.8% of the patients were from outside Riyadh, the capital of Saudi Arabia. The mechanism of injury was MVA in all patients. Delay in referral to a tertiary hospital was the main cause (88.9%). The mean duration of delay was 43 days. The commonest site of injury was thoracolumbar (55.5%). Improvement in ASIA score found in 2 patients. Bed sores and deep vein thrombosis were found in 55.5% and 27.8%, respectively. Postoperatively, 77% of the patients were admitted to the ICU. Most patients (12) were unable to join a specialized spinal cord injury rehabilitation center after the surgery. **Conclusion:** Early referral of all traumatic spinal cord injury patients is highly encouraged to prevent short and long term complications.

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P262: Adolescent atlantoaxial instability in Down Syndrome (DS)

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Introduction: Atlantoaxial instability is common and symptomatic atlantoaxial instability is uncommon in DS patients. Furthermore, craniocervical junction (CVJ) instability is present in 8% to 63%, atlantooccipital instability up to 44%, atlantoaxial instability in 10% to 30%, and symptomatic atlantoaxial instability present in 1 to 2% of patients due to C2 transverse ligament laxity (1). This study's objective was to point out for a cautious preoperative surgical planning in symptomatic atlantoaxial instability treatments in DS patients.

Material and Methods: This study includes a literature review regarding pre-operative atlantoaxial instability surgical planning in DS patients and a case report used for exemplification. **Results:** Surgical planning for symptomatic CVJ instability: 1. Computerized tomography (CT) imaging screening parameters for CVJ instability and numerical indexes for risk of myelopathy (2): 1.1 atlantodental interval (ADI) > 6 mm, 1.2 space available for cord (SAC) at C1 < 14 mm, 1.3 basionaxial interval (B/AI) > 12 mm 2. CVJ surgical indications in DS (3): pathological neurologic findings, occipital-C1-C2 instability, spinal cord signal changes on magnetic resonance imaging (MRI), atlantodental interval greater than 10 mm. 3. Pre/post-operative anesthetic planning anticipates difficult airway managements (4). 4. Surgical pre-operative planning includes vertebral screw and rod constructs techniques (5) and CVJ 3-dimensional angiotomography (6). Case report: A 13-year-old female adolescent was admitted into the Institutions pediatric emergency ward unable to walk after trip-fall to the ground event upon admission day. Medical background: clinical diagnosis of DS at birth, open heart surgical atrioventricular communication correction at 2 years/age, special care for mental impairment, previous one-year progressive walking impairment with urinary retention. Initial neurological exam: somnolent (14-point GCS), quadripareisis (ASIA 3), and urinary retention. Imaging: Sagittal CT CVJ images measured indexes identified spinal canal stenosis with spinal cord compression at the C1 level due to a dorsally dislocated unstable C2 vertebrae. An anomalous right sided C1 vertebral artery course was identified with a 3-dimensional angiotomography. MRI indicated spinal cord oedema/ischemia at the C1 level. At surgery, a fiber optic endoscopy was used for intubation in the general anesthetic process

followed by dorsal C1-C2 spinal cord decompression and occipital/C2 pars interarticularis craniocervical fixation. Due to C1 ligament laxity and a fractured unilateral C1 osteoporotic lateral mass verified during surgery, feasible lateral mass C1 screws insertions were impossible. After an uneventful post-operative recuperation, hospital discharge occurred 2 days after surgery. At outpatient 1 year follow up, unassisted walking capacity (ASIA D) was retained. Post-operative CT CJV images revealed CVJ stability, widening of the C1 measured space available for the spinal cord, and absent spinal cord compression. **Conclusion:** Preoperative surgical planning in symptomatic atlantoaxial instability treatments in DS patients includes selection of the most appropriate surgical atlantoaxial screw and rod construct (preferable dorsal C1-C2 fixation technique), alternative intra-operative surgical fixations when the initial selected technique is unviable, identification of anomalous CVJ vertebral arteries courses with 3-dimensional angiotomography, anticipated anesthetic related pre/post-operative difficult airway managements.

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P263: Low lumbar spinal fractures: functional and radiographic outcomes in workers subject to economic compensation

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Introduction: Low lumbar Spinal Fractures are infrequent as compared with thoracolumbar or thoracic fractures. There is still not consensus on its treatment. Patients having a worker's compensation, their treatment and its functional and radiographic outcomes have not been studied in Chile, and there are just a few studies around the world. We aimed to evaluate the functional and radiographic outcomes in workers subject to economic compensation. **Material and Methods:** Retrospective review of data from Hospital Del Trabajador, in Santiago de Chile. Included patients with Low Lumbar Spinal Fractures only, between 2016-2020, for whom clinical and radiographic follow up have done at least for one year. Radiographic outcome was done with

Cobb angle measurement at the beginning and ending of follow up. Functional outcome was done through Smiley-Webster (SW) scale, also through disability evaluation commissions, chronic low-back pain, or neurological deficit. **Results:** Included 34 patients after exclusions. Average age 44 years. 92% male vs 8% female. Mechanism of trauma: traffic accidents 32,4%, falls from height greater than 2meters (6.5 feet) 14,7%; falls lower than 2 meters height 26,5%; another mechanism 26,4%. Treatment: Conservative 41,2% Vs 58,8% surgical. Of those who were treated conservatively, 14,2% required surgical treatment. L4 was the most fractured in 41%, and its classification was A4 AOs spine 41%. Functional outcomes: No neurological deficit on 88,2% Vs 11,8% from paresthesia to cauda equina syndrome. Patients with conservative treatment: 66,6% went to habitual work re-incorporation (SW excellent 42%, good 58%); 14,2% SW Fair. 14,2% had some degree of disability, granted by evaluation commissions. Patients who underwent surgical treatment: 25% had habitual reincorporation to work (SW excellent 10%, good 90%), 5% are still on treatment. 70% with some degree of disability SW poor 70%. Most frequent sequela was chronic low back pain in 92%. Regarding radiographic findings in the conservative group, the average initial lordosis was -17° , SD 1.97. Major collapse in kyphosis occurred at L3, average -5° . One patient presented $+13^\circ$ in his control and was treated surgically. Follow-up on conservative treatment before returning to work was 145 days. Surgical group: They presented an average initial lordosis of -14° , post-surgical lordosis of -17° and a difference at one year of -6° . The average medical follow-up until their return to work was 382 days, which was statistically significant, $P < .05$. 10% required a complementary anterior approach. The most compressed vertebra in this group was L4 in 40%. **Conclusion:** Low lumbar spinal fractures are rare injuries. We found a high sequelae rate, as well as a reoperation rate. At 1 year on follow-up, the surgical group has yet to return to work. They had more days of absenteeism, a higher percentage of incapacity, and significantly longer return to work, as well with SW score. This study differs from previous in the non-working population, in which in the SW score 35% have excellent **Results** and only 9.5% have poor Results. Further studies and new scales are required to determine adequate return to work in patients with these injuries.

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P264: Neoplastic and infective pathological fractures of the fifth lumbar vertebra

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Introduction: A few reports are available in the literature of fractures of fifth lumbar vertebra. However, to our knowledge there is no report concerning pathological fractures of the fifth lumbar vertebra. It is the aim of this paper to report 10 patients

had pathological fractures of the fifth lumbar vertebra. **Materials and Methods:** The patients were 6 males and 4 females with a mean age of 54.4 (range; 25-71) years. One patient had neurological impairment (Frankel grade D). Pain was assessed on Denis pain scale. MRI pattern of the fracture was classified into: anterior wedging, central collapse, uniform collapse and posterior wedging. All patients were operated through a single posterior approach by curettage, biopsy and by transpedicular screw instrumentation. The anterior defect was reconstructed by anterior bone grafting (5 patients) or limited spinal shortening (1 patient) or both (1 patient) and anterior reconstruction was not performed in 3 patients. **Results:** Cause for pathological fractures was metastases in 5 patients; solitary myeloma in 2 patients and spinal infections in 3 patients with the causative microorganism in 2 patients was TB and staph aureus in the 3rd case. All patients got improvement of pain. The patient with pre-operative neurological deficit had neurological improvement to Frankel grade E. In the 7 patients with pathological fractures due to tumors, the pattern of collapse was central compression (3 patients), posterior wedging (3 patients) and uniform collapse (1 patient). For the 3 patients with pathological fractures due to infection, the pattern of collapse was uniform collapse (2 patients) and anterior wedging (1 patient). Mean follow up was 26.8 months. **Conclusion:** Similar to pathological vertebral fractures at other spinal levels, central collapse of the vertebral body is highly suggestive of malignant compression fracture while anterior vertebral wedging is highly suggestive of a benign compression fracture. What seems peculiar to the pathological fractures of L5 is the very high incidence of posterior wedging pattern. Surgical treatment of L5 pathological fractures through a single posterior exposure is a relatively simple and safe operation. It gives good access sufficient to excise the lesion and reconstruct the spine.

Keywords

spinal fracture, pathological fracture, spinal metastases, solitary myeloma, fracture of fifth lumbar vertebra, spinal infection

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P265: Spondylolysis treatment using a double-threaded compression screw.

Case report

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Introduction: Spondylolysis refers to a unilateral or bilateral defect of the posterior arch of the vertebral body at the level of the pars interarticularis. It usually presents at L5 and can be asymptomatic or manifest as low back pain. The prevalence in the pediatric and adolescent population is 4.4 to 4.7%, increasing athletes. When deciding to treat surgically, two methods have been proposed: segment arthrodesis or direct pars repair. Next, the case of a patient with spondylolysis managed by direct posterior arch repair is presented. **Material and Methods:** Case description: 8-year-old male who is evaluated for lumbar pain of 7 months of evolution, which began after a fall from a seesaw. Pain increases with activity and does not irradiate. With a high index of suspicion, X-rays and computed tomography of the lumbar spine were performed, finding unilateral spondylolysis of the left pars articular of L5, with a separation of 1.15 mm. **Results:** Surgical management is performed by direct repair of the pars with scarification of the area, placement of bone graft and osteosynthesis with a double-threaded compression screw. The patient presented adequate evolution at 8 weeks, without pain and with the ability to perform physical activity without restrictions. **Conclusion:** Spondylolysis should be suspected in pediatric patients with low back pain. Treatment by direct repair of the pars with a double-threaded compression screw appears to be a good alternative in these patients.

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P266: Spine trauma in octogenarian patients

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Introduction: Spine trauma is a growing phenomenon, especially in geriatric patients. Traumatic spine injuries are perceived as a major factor in significant morbidity, disability, and mortality. To-date, there is limited information regarding the characteristics of spine trauma in patients 80 year old or older. **Materials and Methods:** Comprehensive data regarding all registered octogenarian patients with spinal column injuries, in a Level I trauma center between the years 2015 to 2020 was collected. The extent of traumatic spine injuries in adults over 80, and their consequences was assessed. The gathered information was compared with data of a younger control group (age 19-70), with similar injuries. **Results:** 125 octogenarians underwent spine trauma between 2015 and 2020 (65F:60M). The average ISS score was 12.65. The most common comorbidity was a head injury in 33% of patients. There were 42 cervical injuries, 21 thoracic injuries, 41 injuries in the thoracolumbar junction and 18 lumbar injuries. There were 13 extension type injuries of the spine. 26%

of the patients underwent surgery for the fractures. Mortality rate 9% in the first month increasing to 20% within one year from the trauma. When comparing the octogenarian patients to the younger controls, they demonstrated similar comorbidities, ISS score, hospitalization time and surgical rate, however their mortality rates was significantly higher ($P < .001$). The highest mortality rate was seen in extension type injuries. **Conclusion:** Trauma in the octogenarian population is common, with high ISS scores and a high mortality rate. Extension type injuries have the highest rate of mortality and need to be identified and treated promptly. Further research needs to be extended into this type of population.

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P267: Clinical follow up in operatively treated spine trauma patients at a level I trauma center

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Introduction: Clinical follow-up after injury allows clinicians to monitor the progression of recovery over time. The rate of clinical follow-up non-compliance in general orthopaedic trauma patients without spine trauma is reported to be between 30-70%, with 10-25% never showing up to any clinic visits. The current rate of follow-up of patients who have sustained spine trauma is unknown. The primary purpose of our study was to evaluate the postoperative clinical follow-up rate in spine trauma patients. Our secondary aim was to identify any independent risk factors regarding follow-up non-compliance. **Material and Methods:** After IRB approval, all patients admitted to a level I trauma center with spine injuries were retrospectively identified using CPT codes between January 2013 and December 2017. Each patient's EMR was reviewed to confirm eligibility. The exclusion criteria included: pediatric patients (< 18-year-old), pathologic fractures, non-acute trauma, and surgical care without instrumentation. Patient demographic characteristics, injury location and mechanism, and patient distance from the hospital were collected. The final clinical instructions and whether a return visit was requested or as needed were recorded. **Results:** Between January 2013 and December 2017, a total of 754 patients were available for review. There were excluded 37 non-acute trauma and 27 pediatric patients. There were 475 male and 215 female patients. Average age was 52 years \pm 2. Fracture distribution by region was: 320 cervical, 348 thoracolumbar and 21 sacral spine. A total of 690 patients were included, 34 patients died during hospital state and 78 patients had follow up plan at an outside facility. We had 578 patients return to follow up care. Overall follow up length was 213 days. Median follow up

length is 109 days. 115 (27.5%) patients were discharged by their healthcare provider and categorized as having complete clinical care. 419 (72.5%) patients failed to return for a clinical follow-up as requested by their healthcare provider and were classified as incomplete clinical care. 70 patients never returned for any follow up. We examined factors hypothesized to be associated with incomplete follow-up including age, illicit drug use, insurance, works compensation, distance, living arrangement, polytrauma and spine cord injury. Bivariate analysis identified insurance, illicit drug use, works compensation, polytrauma and spine cord injury as statistically significantly different between the compliance and non-compliance groups. 63 patients returned to the operating room for treatment of complications. 31 were wound related, 19 patients had hardware failure or non-union identified, 2 patients had screw revision and 11 hardware removal. Among those patients, 40 had incomplete care after their complications. **Conclusion:** Our data suggest that a 1-year clinic follow-up requirement may not be feasible. We observed a low rate of patients with a minimum 1-year clinical follow-up. Clinical care had been completed in 27.5% of patients prior to 1 year. Journal and grant reviewers may need to consider the feasibility and clinical relevance of these follow-up expectations.

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P268: What can we learn from YouTube on the topic of cement augmentation for vertebral fractures? A content-quality and optimization analysis

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Introduction: Cement augmentation is a minimally invasive treatment option for traumatic and osteoporotic vertebral fractures (VF). The increase in osteoporotic VF and dynamic Internet development encourages patients to search for solutions considering their health and available treatment methods. That is why verification of quality and adequacy of information on YouTube (YT) is of great importance. In this paper, we aimed to determine information quality available on cement augmentation on YT. **Material and Methods:** On the 21th of September 2021 an analysis was performed of the first 35 YT videos found for phrases “Vertebroplasty”;

“Kyphoplasty”; “Vertebral Augmentation”; “Cementoplasty”. The search was conducted with the default “relevance” sorting in “Incognito Mode” without being logged to any personal browser account. The exactness and quality were assessed by two independent evaluators using the DISCERN scoring system. The discrepancy between individual videos and the 2 evaluators (6th year Neurosurgery Resident and a 4th year Medical Student) was statistically evaluated and compared. Misleading information appearing in videos was flagged and verified by a neurosurgery specialist with over 15 years of experience in spine surgery. Exclusion criteria were non-English videos, equipment commercials and posts containing irrelevant information (e.g. music videos, pranks). **Results:** Out of 140 total number of videos, 50 were included. DISCERN score mean between Raters was 35.42 (STD ± 12,8) points which indicates overall poor video quality. The intraclass correlation coefficient achieved 0,97. The two lowest rated DISCERN questions (Q12 = 1.28; Q15 = 1.44) verified inclusion of support decision making and consequences of no treatment. Videos containing epidemiological data, symptoms, contradictions, Results and complications had a higher DISCERN score ($P < .05$). Animations and misleading information did not influence the DISCERN scoring system ($p > .05$). Qualitative analysis showed that the majority of videos had a Physician speaker ($n = 38, 76\%$). Indications were present in 34 of cases (68%), whereas procedure visualization in $n = 33$ posts (66%). The principle of augmentation procedure was explained to the viewer in 44% of movies ($n = 23$). Effects of conservative treatment were compared to augmentation in $n = 10$ videos (20%), procedure risks were not mentioned in 86% of videos ($n = 7$). Treatment contraindications appeared in $n = 5$ posts (10%). Intraoperative vertebral body biopsy at augmentation was mentioned in $n = 3$ videos (6%). Misleading information was noted in 16% movies ($n = 8$). **Conclusion:** YouTube is a popular and easily accessible source of information on cement augmentation procedures, but the quality in relation to patients' needs is insufficient. Although physician speakers were in the majority of videos the amount of misleading information, lack of procedure risks, treatment **Results** and procedure contraindications cannot be overlooked. Surgeons should be reluctant in advising patients to seek information on YT on this particular topic.

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P269: Identifying recipients of surgical decompression within 24 hours of acute traumatic spinal cord injury: critical insights from 10 trauma centers

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Introduction: Early surgical decompression within 24 hours after acute traumatic spinal cord injury (at-SCI) has been shown to improve neurological outcomes. It is currently unclear which characteristics predispose patients to receive early surgery and those that are at risk of delayed surgery. Identifying associated factors may inform emerging clinical guidelines. **Material and Methods:** At-SCI patients were identified from a multicenter, prospective database. Time to surgery was calculated from time of injury. ASIA Impairment Scale (AIS) was assessed up to 72 hours after injury. Missing information was imputed with multiple imputation at 40 iterations. A multi-level mixed-effects multivariate logistic regression model with hospital center as the random effect and early surgery as the dependent variable was performed with patient- and injury-specific variables recorded prior to surgery. Odds ratios were calculated for each inputted variable with 95% confidence intervals and p-values. Level of significance was set as $P < .05$. **Results:** A total of 580 patients (46.3 ± 17.9 years, 2.0% female) met the inclusion criteria, with 223 patients receiving early surgery (38.4%). The majority of patients were educated at or above secondary school (86.4%), married (5.7%), and of White Caucasian race (77.2%). Injuries were mostly cervical (63.0%) followed by thoracic (23.3%), 49.5% of patients presented as motor complete, 82.9% were blunt, and 56.4% were from high energy mechanisms. In the mixed-effects regression model, hypertension (OR: 2.61[1.17–5.81], $p = .019$) and being White Caucasian (OR: 1.73[1.02–2.92], $p = .041$) was associated with receiving early surgery. Being transferred from another hospital for surgery (OR: .50 [.32–.78], $p = .002$), lower baseline lower extremity motor score (LEMS, OR: .97[.95–.98], $p = .001$), and older age (OR: .98[.96–.99], $p = .001$) were associated with receiving delayed surgery. **Conclusion:** Our Results suggest that greater emphasis must be placed in ensuring at-SCI patients with lower baseline LEMS are part of the target for early surgery as well as prioritizing an equitable process for candidacy. Coordination and inefficiencies between transferring hospitals and receiving institutions must be further explored to ensure these patients are not systematically delayed, when feasible.

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P270: The role of inter-hospital transfer in neurological and functional outcomes of acute traumatic spinal cord injury: a propensity-score matched analysis of 1195 patients

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Introduction: Interhospital transfer from community hospitals to trauma centers can strain patients, healthcare systems, and delay appropriate care. However, the effects of transfer on patient outcomes after acute traumatic spinal cord injury (at-SCI), wherein time to surgery is critical, remain unclear. The aim of the study was to compare neurological and functional outcomes in transferred or directly admitted at-SCI patients. **Material and Methods:** Transferred or directly admitted adult at-SCI patients were identified from a multicenter, prospective database. ASIA Impairment Scale (AIS) grade was assessed at baseline (≤ 72 hr post-injury) with follow-up between 12 to 52 weeks. Functional independence Measure (FIM) was assessed at discharge with follow-up between 12 to 52 weeks. Primary outcomes were change in AIS grade/components and FIM scores. Secondary outcomes were length of stay and operative characteristics. Missing information was imputed with multiple imputation. Propensity-score matching between the transferred and directly admitted groups was performed using a caliper width of .2 for significantly different ($P < .5$) baseline variables. Results of continuous variables were reported as standardized mean differences (d), and discrete variables as difference in proportions (PD). **Results:** A total of 1195 at-SCI patients met the inclusion criteria, with 629 transferred patients (52.6%). The transferred group were older; had higher baseline pinprick, light-touch, and upper extremity motor scores (UEMS); greater proportion of women, hypertension, diabetes, smokers, and history of drug abuse; and lower proportion of high school graduates and high energy injuries. The two groups were distributed differently across clinical sites, injury level and types, race, and baseline AIS grades. After propensity-score matching, 350 pairs were matched. UEMS improved significantly more in directly admitted patients ($d = .163$, $p = .031$), as did light-touch ($d = .252$, $p = .001$), FIM motor scores ($d = .305$, $P < .001$), and FIM locomotion scores ($d = .331$, $P < .001$). Secondly, a greater proportion of directly admitted patients received ultra-early surgery (≤ 12 hr post-injury, PD = 16.9, $P < .001$) and anterior approach (PD = 8.0, $p = .028$). A greater proportion of transferred patients received early surgery (> 12 and ≤ 24 hr post-injury, PD = 7.2, $p = .002$), posterior approach (PD = 1.0, $p = .010$) and had greater surgical blood loss ($d = .239$, $p = .002$). **Conclusion:** Direct admission of at-SCI patients has a positive effect on neurological and functional recovery. Our findings suggest the inclusion of interhospital transfer status when prognosticating or building predictive models of patient outcomes. Feasibility of direct admission to a trauma center or surgery at a community site after at-SCI must be further investigated.

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P271: Risk factors for loss to follow-up following acute traumatic spinal cord injury

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Introduction: Loss to follow-up (LTFU) after surgery for acute traumatic spinal cord injury (at-SCI) is detrimental for the reliability of longitudinal clinical research. Comprehensive risk factors at the level of patient, injury, intervention, and complication for long-term LTFU in this patient population remain unknown. **Material and Methods:** Adult at-SCI patients were identified in a multicentre, prospective registry who did not miss follow up or were lost at one-year. 12m-LTFU was defined as: did not come to follow up at 12 months and previously did not come to follow up at least 3 months after baseline ASIA Impairment Scale assessment (≤ 72 hours post-injury). Missing data was imputed with multiple imputation. Univariate analysis was performed for each independent variables, and predictors with $P < .2$ were included in the final multivariate model for backward stepwise logistic regression based on AIC values. Odds ratios with 95% confidence intervals were calculated with a significance level set as $P < .05$. **Results:** A total of 885 patients (46.5 \pm 17.6, 45.5% female) were eligible for inclusion. On univariate analysis, 23 variables were significant and included for feature selection. In the final model, patients were less likely to miss follow-up if they had higher baseline lower extremity motor scores (OR: .99[.98-.99], $p = .021$), received early surgery (OR: .49[.35-.69], $P < .001$), of Asian (OR: .31[.18-.54], $P < .001$) or Black race (OR: .63[95% CI .45-.88], $p = .006$) compared to White Caucasian, or had a systemic infection complication (OR: .35[.17-.70], $p = .003$). Independent predictors of 12m-LTFU were post-operative DVT (OR: 3.28[1.64-6.55], $p = .001$) and hematological complications (OR: 1.67[1.07-2.60], $p = .025$), and a history of malignancy (OR: 3.65[1.01-13.15], $p = .048$) and smoking (OR: 1.55[1.15-2.08], $p = .004$). Higher baseline GCS was associated with making follow-up (OR: .94[.88-1.00], $p = .053$) and diabetic history with 12m-LTFU (OR: 1.56[.97-2.52], $p = .068$), but were not statistically significant in the final model. **Conclusion:** Patients that had greater lower extremity motor disability, history of malignancy and smoking, experienced DVT and hematological complications, and received delayed surgery were at greater risk for 12m-LTFU and may require concerted patient engagement approaches to ensure comprehensive spinal care and track recovery trajectory.

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P272: Prediction of nonroutine discharge after acute care of traumatic spinal cord injury: insights from a prospective, multicenter registry

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Introduction: Optimizing post-operative discharge has been shown to impact patient recovery and reduce healthcare costs and risks associated with prolonged hospital stay. Predictive factors for favourable discharge to home or unfavourable discharge to nursing/long-term care (LTC) facilities after acute traumatic spinal cord injury (atSCI) are unclear. **Material and Methods:** Acute traumatic SCI patients were identified from a multicenter, prospective database. Surviving patients with recorded discharge information were included. Missing information was imputed with multiple imputation. Two multi-level mixed-effects multivariate logistic regression models with hospital center as the random effect was performed comparing routine discharge with discharge to i) home and ii) nursing/LTC facilities. Odds ratios were calculated for each inputted variable with 95% confidence intervals and p-values. Significance level was set as $P < .05$. **Results:** Of the 725 patients (48.9 \pm 18.0 years, 2.7% female) eligible for inclusion, 117 were discharged to home (16.1%) and 51 discharged to nursing/LTC facilities (7.0%). History of hypertension (OR: .08[.01-.79], $p = .031$), heart attack (OR: .08[.01-.87], $p = .038$), thoracic compared to cervical injuries (OR: .11[.03-.40], $p = .001$); and cardiopulmonary (OR: .36[.14-.90], $p = .029$), skin-related (OR: .12[.03-.47], $p = .002$), and UTI (OR: .28[.10-.72], $p = .009$) complications were less likely to be discharged to home. Higher baseline lower extremity (OR: 1.09[1.05-1.15], $P < .001$) and upper extremity (OR: 1.09[1.05-1.14], $P < .001$) motor scores, higher baseline ASIA Impairment Scale (AIS) grades of B (OR: 8.67[1.86-4.45], $p = .006$) and E (OR: 1.83[1.00-116.74], $p = .050$) compared to A, and wound infection was associated with home discharge. Discharge to nursing/LTC facilities was associated with older age (OR: 1.07[1.04-1.11], $P < .001$) and skin complications (OR: 5.74[2.13-15.43], $p = .001$). Patients that were male (OR: .29[.11-.81], $p = .018$), AIS grade of B (OR: .12[.02-.78], $p = .027$), and wound infection complication (OR: .06[.01-.56], $p = .014$) were less likely to be discharged to a nursing/LTC facility. **Conclusion:** In this multisite study accounting for hospital-level differences, older age, surgical complications and pre-operative comorbidity were the most significant drivers of nonhome and nursing/LTC discharge. Lower baseline injury severity was associated with favourable discharge to home.

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P273: Traumatic spinal fractures and circumferential reconstruction of the spinal column

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Introduction: The spinal fractures, especially in elderly, are related to biomechanical instability and axial pain. Many factors, identified by the AO-Spine Classification, suggest a more aggressive approach in the treatment of those fractures. **Methods:** This is a retrospective single center, multi-surgeon study of the patients operated at a single institution from the period of 2012 to 202. Every fracture was assessed using the AO Spine classification for spinal fractures. As a total of 17 patients, harboring 18 fractures were included. Type A3 and type A4 fractures (12/18) were the most common in this group. Only the patients, who underwent a circumferential reconstruction of the spinal column, including only the ones after a partial or complete resection of the vertebral body and dorsal fusion, were recruited. 6 of the patients became additional bone cement with the expandable cage to enhance the biomechanical stability. For the dorsal stabilization an O-Arm Medtronic navigational system was used. The AIS Classification was used for the assessment of the neurological outcome. **Results:** Mean age was: 62 ± 18.5 . Age above 60 years was found to be a risk factor for multiple revision surgeries, due to biomechanical stability and requiring a circumferential reconstruction of the spinal column ($P < .05$). As a total of 146 screws were inserted. Only one screw required intraoperative revision, due to suboptimal positioning. Bone cement applied together with the expandable cage did not alter the rate of revision surgeries after the circumferential reconstruction was completed. None of the patients developed surgery related morbidity. One of the patients developed a neurological deterioration (one point on the AIS), the others remained on the same level before surgery. **Conclusions:** The circumferential reconstruction of the spinal column is one of the most aggressive spinal procedures. Identifying the factors, which may lead to biomechanical unsustainability after the primary surgery, may reduce the risk for revision surgeries. The circumferential reconstruction of the spinal column is a feasible strategy in correcting the biomechanical instability related to fractures.

Tumors

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P274: Evolution of materials for implants in metastatic spine disease till date - Have we found an ideal material?

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Introduction: “Metastatic Spine Disease” (MSD) often requires surgical intervention and instrumentation with spinal

implants. Ti6Al4V is widely used in metastatic spine tumor surgery (MSTS) and is the current implant material of choice due to improved biocompatibility, mechanical properties, and compatibility with imaging modalities compared to stainless steel. However, it is still not the ideal implant material due to the following issues. **Material and Methods:** A review of the literature was performed to expound on the: (1) evolution of Ti6Al4V as the “gold standard” material for spinal implants; (2) advantages and disadvantages of Ti6Al4V for MSTS; (3) newer alternatives to Ti6Al4V; and (4) ideal properties of an implant material used in MSTS. Comparison was also made between the various implant materials used in MSTS, with regards to the ideal properties. The MeSH terms used for the literature search included “spinal neoplasms”, “surgery”, “stainless steel”, “titanium”, “polyetheretherketone”, “PEEK”, “carbon fiber”, “hydroxyapatite”, “titanium dioxide”, “porosity”, “elastic modulus”, “weight-bearing”, “corrosion”, “radiotherapy”, “magnetic resonance imaging”, “artifacts”, and “osseointegration”. In addition, the following free text words were also used: “metastatic spine tumor surgery”, “spine surgery”, “implants”, “titanium alloy”, “surface coating”, “composite”, “rigidity”, “fatigue strength”, “bioactivity”, “intraoperative contouring”, “intraoperative cutting”, “computed tomography”, and “stress shielding”. Logical strings were created using the MeSH terms and free text words to search in PubMed and Google Scholar and retrieve the relevant articles. **Results:** Ti6Al4V implants cause stress-shielding as their Young’s modulus (110 gigapascal [GPa]) is higher than cortical bone (17–21 GPa). Ti6Al4V also generates artifacts on CT and MRI, which interfere with the process of postoperative radiotherapy (RT), including treatment planning and delivery. Similarly, charged particle therapy is hindered in the presence of Ti6Al4V. In addition, artifacts on CT and MRI may result in delayed recognition of tumor recurrence and postoperative complications. In comparison, Polyether-ether-ketone (PEEK) is a promising alternative. PEEK has a low Young’s modulus (3.6 GPa), which Results in optimal load-sharing and produces minimal artifacts on imaging with less hinderance on postoperative RT. **Conclusion:** With the increasing incidence of MSD, it is an opportune time for the development of spinal implants that possess all the ideal material properties for use in MSTS. While PEEK is bioinert and unable to provide sufficient stability in the immediate postoperative period, these issues may possibly be mitigated by combining PEEK with other materials to form composites/through surface modification, although further research is required in these areas.

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P275: Management of spine and pelvic tumors with en bloc resection

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Introduction: En Bloc resection of spine and pelvic tumors are gold standard treatment method whenever possible. It is a challenging surgery and needs experience with multidisciplinary approach. **Material and Methods:** From 2018-2021 we operated 19 primary malign spine and pelvic tumors. Most common tumors were chordoma, chondrosarcoma and malign nerve sheath tumors. **Results:** 9 were female and 10 of them were male. Age distribution were between 3-77 yrs. Average surgery time was 2-7 hour and blood loss was 200 cc-1900 cc. Average duration of hospitalization was 5 days (3-7 days). There was no peroperative complication. 5 of tumor cases mainly chordomas were operated due to local recurrences whom were operated previously by other surgeons. All chordomas had local recurrences. 2 of 19 cases were died within follow-up period. **Conclusion:** Management of Spine and pelvic tumors need multidisciplinary approach. Surgical intervention need experience and skills.

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P276: Rate of spontaneous fusion without arthrodesis after percutaneous fixation for spinal metastases: a multi-center retrospective study

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Introduction: The aim of this study is to evaluate the rate of spontaneous fusion observed in a series of spinal metastases (SM) in patients treated with minimally invasive stabilization surgery without arthrodesis. **Material and Methods:** This is a multicentric, retrospective and observational study. We reviewed the files of patients over 18 years old, operated on for SM using percutaneous spinal stabilization without arthrodesis, minimum 3-month follow-up. The following variables were included: demographics, prior and postoperative radiation history, SM location, epidural spinal cord compression score (ESCC), spinal instability neoplastic scale (SINS), and surgery related data like number of levels instrumented, addition of kyphoplasty and screw augmentation. Primary outcome measure was spontaneous fusion, observed in the patients' last CT scan. Multivariable analysis was performed to identify baseline and factors associated with spontaneous fusion. **Results:** Seventy-two patients were analyzed. Mean age was 62 years old, 39 were men and 75% had an intermediate SINS score. In 48.6% tumor separation

surgery was performed. Short instrumentation was indicated in 54.2% of patients, in 29.2% kyphoplasty was added, and 8.3% the patients had screw augmentation. 12.5% had preoperative radiotherapy and 84.5% received postoperative radiotherapy. In sixteen patients (22.2%) spontaneous fusion was observed. In 73.6% of cases, survival was longer than 6 months. Comparing baseline preoperative characteristics and outcomes in patients with spontaneous fusion versus without spontaneous fusion, preoperative radiotherapy ($p = .01$) and longer survival ($p = .023$) were both significant. In the multivariate analysis preoperative radiotherapy was identified like a predictor of spontaneous fusion. **Conclusion:** 22.2% of patients that were treated by percutaneous spinal fixation for the treatment of spinal metastasis presented a spontaneous fusion. Percutaneous screw fixation without arthrodesis seems to be enough to stabilize a metastatic unstable vertebra. Preoperative radiotherapy was showed like a predictor factor towards spontaneous fusion, but considering the small size of this subgroup, more study is needed.

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P277: En bloc excision for residual giant cell tumour with chest wall reconstruction: case report of a novel technique

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Introduction: Giant cell tumour is a locally aggressive primary bone tumour which commonly afflicts epiphyseal region but can affect axial skeleton in 10% of cases. Recurrence up to 70% & malignant transformation up to 2-3% has been reported in literature. Giant cell tumour of spine usually entails total en bloc resection and chest wall reconstruction may be needed if the tumour is large. **Material and Methods:** We report a 28-year-old gentleman who presented with pain in back within a month after initially being operated for a locally aggressive lytic lesion of thoracic vertebra T8-T9. Imaging work-up has shown a localised eccentric lesion involving posterior elements & body of T8-T9 vertebra with a large paraspinal component encasing exiting nerve root at the corresponding levels. Pre-operatively selective arterial embolization of feeder vessels was done using polyvinyl alcohol particles. Patient underwent long-segment posterior stabilisation with costo-transversectomy at 08 levels with total en bloc resection of the tumour and chest wall reconstruction with titanium mesh. Anterior column reconstruction with cage & cement. Wound was closed by plastic surgeon with a pedicled latissimus dorsi transposition flap. **Results:** Histological examination was suggestive of Giant cell tumour with negative margins. Post-operatively patient is on Denosumab and is symptom-free and with no imaging evidence of recurrence on follow-up for six months. **Conclusion:** The novelty of present case is chest wall reconstruction with titanium mesh. Our's is probably the first case of residual GCT where chest wall

reconstruction was done. This case also highlights the importance of multi-disciplinary surgical management for spinal tumours.

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P278: Extra osseous spread of multiple myeloma mimicking a Pancoast tumor: an extremely unusual presentation

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Introduction: Extra osseous multiple myeloma with epidural spinal cord compression mimicking a Pancoast tumor is an extremely unusual presentation. We report a challenging case of epidural compression associated an extra osseous multiple myeloma mimicking a Pancoast tumor. **Material and Methods:** We encountered a 55-year-old-male patient who presented with sudden onset of spastic paraparesis with bowel and bladder involvement for the past 15 days. Patient was investigated with MRI of the spine which showed pathological destruction of the T2 body with soft tissue component along the right rib causing right lung apex obliteration with thoracic epidural compromise leading to spastic paraparesis. A provisional diagnosis of a malignant lesion of T2 was made. After an informed consent, the patient was taken to the operation theatre wherein surgical decompression and biopsy from T2 vertebra and soft tissue along with resection of the 2nd rib was performed. On cytological examination of the biopsy sample, there were abundant plasma cells. Serum electrophoresis showed M spike and bone marrow study showed 55-60% plasma cells. The histopathological examination of the biopsy specimen was confirmative of a plasma cell neoplasm (multiple myeloma with extraosseous involvement). To the best of our knowledge, this is first case of multiple myeloma with extraosseous spread mimicking a Pancoast tumor. **Results:** Multiple myeloma commonly presents with pathological vertebral fractures. Extraosseous spread to lungs along the rib mimicking a Pancoast tumor is challenging case to diagnose and manage. One must be aware of this presentation and prognosticate patient accordingly. **Conclusion:** In the presence of confusing imaging findings, the clinical presentation, presence of epidural component and the concertina collapse of vertebrae can lead us to a diagnosis of multiple myeloma. One must be aware of this presentation and prognosticate patient accordingly. Timely surgical intervention can add to better outcomes as in our case

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P279: Primary extra-skeletal Ewing's sarcoma presenting as an epidural soft

tissue lesion causing cauda equina syndrome in an adolescent girl: a case report

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Introduction: Primary spinal epidural Ewing's Sarcoma (ES) is a rare extraosseous lesion. Extraosseous Ewing's Sarcoma has a similar demographic as osseous Ewing's Sarcoma, primarily affecting adolescents and young adults and male propensity. Reported 5-year survival is 0% to 37.5% for spinal extraosseous Ewing's Sarcoma. **Case Report:** A fifteen-year-old girl presented with low backache associated with sudden onset of weakness and radiculopathy of both lower limbs for 10 days, bowel and bladder involvement for 3 days. Physical examination revealed grade 0/5 power and absent sensations below L4 dermatomal level and perianal region. Plantar reflex was mute bilaterally. Magnetic resonance imaging revealed an extradural lesion within the spinal canal at the L3-L4 level. The patient underwent an emergency posterior decompression, extradural lesion excision and instrumented stabilization L3-L5. Based on histopathological examination of the tissue specimen, we diagnosed the lesion as Ewing's sarcoma. **Results:** Patient received 8 cycles of chemotherapy and radiation therapy. At third year follow up patient is walking and disease-free. **Conclusion:** Primary extra-skeletal Ewing's sarcoma presenting as an epidural lesion in the lumbar spine is a rare clinical entity that should be considered as a differential for spinal epidural lesions. Treatment for such cases is almost always an early surgical intervention due to its rapid onset and compressive neurological symptoms. Wide decompression with instrumented fusion and excision of the lesion followed by chemo and radiotherapy are recommended.

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P280: A recurrent case of cervical myelopathy due to recurrence of C2 GCT post denosumab therapy

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Introduction: Management of GCT of the upper cervical spine (cGCT) is demanding due to locally aggressive nature of the tumour and critical neurovascular structures in close proximity. At present we don't have guidelines on how long D-ab therapy should be continued. To best of our knowledge, this is the first reported incidence of recurrent myelopathy due to rapid recurrence of GCT of the axis post Denosumab therapy. **Material and**

Methods: A 25/M patient presented with neck pain with numbness in bilateral upper limbs with increasing difficulty in eating and performing fine motor skills and gait disturbance since 3 months. MRI and CT showed expansile lesion in odontoid process (Giant cell Tumor). Tumour resection and posterior stabilization from C1-C4 was done. Postoperatively patient was started on injection Denosumab. There was near remission with no further growth in tumor mass and symptoms resolved with improvement in neurology. 3 months post discontinuation of Denosumab therapy, patient presented with recurrence of the tumor and myelopathy. **Results:** Patient was then managed with surgical resection of tumor and instrumentation anteriorly followed by radiotherapy. **Conclusion:** Complexity of upper cervical spine anatomy renders achieving tumor free margin without damaging critical neurovascular structures a daunting task with high rates of recurrence. This case demonstrates good clinico-radiological outcome following D-ab use in cGCT. However, there recurrence after cessation of D-ab is a possibility and mechanism is yet to be understood. The authors wish to highlight the role of diligent long-term follow-up after stopping Denosumab.

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P281: Locally advanced Askin's tumour in an adult managed with wide local excision of the tumour and chest wall reconstruction with titanium mesh

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Introduction: Askin's tumour is a peripheral primitive neuroectodermal tumor (PNET) arising from the thoracopulmonary region. They are rare tumours usually seen in children and adolescents and their occurrence in adults is even rarer. Due to their rarity, literature concerning the optimal management and **Results** is sparse. They always carry a poorer prognosis when compared to other primary malignant chest wall tumours. **Material and Methods:** We present a case of a 29 year old male who presented to the OPD with a swelling over the left side of posterior chest wall and dull aching pain since 6 months. Whole body PET-CT revealed a mass arising from posterolateral chest wall infiltrating basal pleura, diaphragm and eroding the 9th rib. CT guided biopsy of the mass on histopathological examination showed a malignant small round cell tumour with CD99, FLI-1 and Vimentin positivity on IHC. Based on these findings a diagnosis of locally advanced Askin's tumour was made. Post Neo-adjuvant chemotherapy with VAC-IE regimen, PET-CT showed a large residual mass involving the 9th rib was noted with no other abnormal radiotracers elsewhere in the body. He was managed with wide local excision of the tumour and chest wall reconstruction. **Results:** The patient was managed with neo-adjuvant chemotherapy followed by wide local excision

extending from 7th to 11th ribs along with the tumour mass. Also included the diaphragmatic mesh repair and chest wall reconstruction using a Titanium mesh. Later was followed by adjuvant chemotherapy. This patient had a follow-up of 9 months with no recurrence or any further metastatic deposits elsewhere in the body. **Conclusion:** Askin's tumor is a rare, highly malignant tumour with a poor prognosis. Their management involves aggressive multidisciplinary approach. It involves radical surgery which may require extensive resection of the thoracic wall with immediate reconstruction along with pre and postoperative chemotherapy for a better outcome. Chest wall integrity can be achieved with local muscle flaps and various biological and synthetic materials to reconstruct large chest wall defects. In spite of such immense efforts, the prognosis remains poor in these rare tumours.

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P282: Extradural Ewing's sarcoma an uncommon diagnosis

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Ewing sarcoma (ES) is among the most frequented extremity osseous tumor in childhood even though, primary spinal extradural Ewing's sarcoma is an uncommon tumor. We present a 19-year-old woman with bilateral leg weakness and costal pain. Apart from that, no other symptoms were related. An MR was performed and showed an extradural lesion around D4-D6 with widening of the foramen of D5-D6 along with intense contrast enhancement. The radiological diagnosis was of a Schwannoma. In the review of Tsutsumi et al they found that de ES was indistinguishable from other tumors from the spine because its presentation does not have any specific marker. After the intervention in which a gross total resections was completed, a primary spinal extradural Ewing's sarcoma was observed in the anatomopatological examination. A treatment with vincristine, doxorubicin and cyclophosphamide alternating with ifosfamide and etoposide. Three months after the surgery there were no residual tumor nor regrowth and the bilateral leg weakness is improving gradually. At the moment there is no intention to initiate a radiotherapy treatment.

822

P283: Acute spinal subdural hematoma as a rare presentation of a thoracic schwannoma: case report and literature review

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Introduction: Acute non-traumatic spinal subdural hematoma is a rare pathology, comprising 4.1% of all intraspinal hematomas. The main etiologies are coagulopathies, anticoagulant therapy, ruptured vascular malformations, and tumors like schwannomas. We report the case of a patient with a thoracic schwannoma presenting as an acute spinal subdural hematoma. To our knowledge, only 7 cases have been described in the literature.

Materials and Methods: A 60-year-old female suffered a mild chest trauma due to a fall at home. Ten hours after the trauma, she presented to the ED with a sudden complete medullary syndrome with a sensitive level at T6 (ASIA A). Past medical history was relevant for chronic intermittent acetylsalicylic acid use. The spinal MRI revealed, in the T2-weighted sequence, a hyperintense extra-axial collection between T3-T5 levels with an extensive area of spinal cord edema, suggesting an acute hemorrhage in the epidural and subdural spaces. **Results:** We performed a left T3-T5 laminectomy, 18-hours after the onset of symptoms. The subdural hematoma (SDH) was drained, and an intradural extramedullary spinal tumor emerging from the T5-root was found and resected. At immediate postoperative evaluation, the patient recovered partial muscle strength of the lower limbs (3/5, bilateral). The histopathological report described a yellowish-brown lesion, corresponding to a WHO grade 1 schwannoma with a Ki67 of 10%. At 3-month follow-up, muscle strength improved in the right lower limb up to 4/5, while left lower limb strength remained stable. **Conclusion:** In the setting of an acute spinal SDH after a mild trauma, different etiologies should be ruled out, including tumors such as schwannomas. The diagnosis of hemorrhagic spinal schwannomas could be challenging, and early surgical management is important for neurological prognosis.

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P284: Far-lateral cervical approach for excision of upper cervical (C1-C4) anterolateral and anterior meningiomas and dumbbell schwannomas: technical report and case series

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Study Design: Technical report and case series. Objective: To demonstrate the surgical details of the far-lateral approach (FLA)

technique for the excision of the upper cervical anterolateral and anterior meningiomas and dumbbell schwannomas, and to assess the clinical and radiological outcomes in patients who underwent surgery. **Methods:** We demonstrated the FLA technique and reported reviewed patients who underwent the FLA for C1-C4 anterolateral and anterior meningiomas and dumbbell schwannomas between June 2007 and June 202. All patients' relative preoperative demographic, clinical, radiographic, operative, histopathological, and perioperative complications and follow-up clinical and radiographic data were reported. **Results:** A total of 19 patients including 12 females and 7 males with a mean age 56.7 ± 17.6 years and mean duration of symptoms 12.8 ± 12.3 months were reported. Nine patients with anterolateral meningiomas, five with anterior meningiomas, and 5 with dumbbell schwannomas underwent uneventful FLA procedures. Gross total resection (GTR) of tumors was reported in 17 patients (89.5%). Preoperative Japanese Orthopedic Association (JOA) score was normal in ten, grade-I in five, and grade-II in 4 patients, while at the last follow-up it improved to normal in seventeen and grade-I in two patients. Reported postoperative JOA scores at 6 months and at the last follow-up showed that all patients improved at least one grade on JOA scores. There was cerebrospinal fluid (CSF) leak into the suction drain in three patients and superficial wound infection in another one. **Conclusion:** Our Results advocate the use of the far-lateral approach in the resection of the upper cervical anterolateral and anterior meningiomas and dumbbell schwannomas as a safe and effective technique.

916

P285: Is multimodal approach the preferable strategy for vertebral hemangioma management: our experience with case series of 9 patients

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Introduction: The occurrence of hemangioma in the vertebrae is not so uncommon. Despite the prevalence, the management of this tumor is not yet resolute. The armamentarium provides multidisciplinary treatment options. In face of interdisciplinary choices, an obstinate regimen has not yet been proclaimed. The conventional approach may cause huge amount of blood loss leading to coagulopathy and may even result in death. A multimodal approach allows for circumventing these dreaded complications. In this case series, we report our learning with management of 9 cases of aggressive vertebral hemangiomas (VH). **Material and Methods:** The variables of the patients who were diagnosed and treated for VH, between June 2015 to

September 2019, were incorporated by searching the institutional database. 9 patients (7 males, 2 females) with age ranging from 16 to 52 years were identified. Preintervention considerations: All of the patients were symptomatic. 4 patients presented with non-aggressive hemangiomas, with back pain being their chief-complaint. The degree of invasion in Tomita classification for these tumors was stage III and below. Their ODI (Oswestry Disability Index) scores were 61% and higher. The rest 5 patients had symptomatic and aggressive hemangiomas and were Tomita grade IV and higher. There was neurological involvement in these patients. Their pre-operative ASIA Impairment Scale and Nurick scores ranged from B to D & 2 to 5 respectively. Arterial embolization was performed with the help of interventional radiologist and all spinal procedures were performed by two spine surgeons. Intervention: Our intervention was broadly classified into surgical and non-surgical. We chose a multidisciplinary approach in every case. We delivered at least two modalities in each case. The decision was determined by counsel of multidisciplinary team. The non-surgical cases were dealt with transarterial-embolization, percutaneous ethanol injection or vertebroplasty. Surgical intervention was also integrated with other interventions and modalities on case to case basis. Surgery was indicated for aggressive tumors therefore all surgical cases were embolised preoperatively. Along with it, intraoperative ethanol, vertebroplasty or both were added. Posterior midline approach was made. Pedicle screws were placed at adjacent levels. Ethanol and Vertebroplasty caused decreased blood flow, aiding in bony curettage and laminectomy, further helping in adequate decompression and placement of bone graft helping in proper fusion. **Results:** The follow-up periods varied from 6 months to 2 years. All surgical cases showed E on ASIA scale and Nurick grade 1, except for one case of revision which was D and 2 on ASIA and Nurick scale respectively. The 4 non-surgical patients showed ODI score of < 10% in last assessment. The MRI for the operated patients was performed a year after the procedure and for non-surgical patients 6 months after the intervention. There was no evidence of recurring lesion. **Conclusion:** Our experience leads to the inference that for management of symptomatic vertebral hemangiomas multimodal approach should be an established protocol. We have experienced that acceptable lesion obliteration with lesser morbidity can be achieved by following this strategy.

978

P286: Rare case of a malignant transformation of benign spinal Schwannoma

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Introduction: Spinal schwannomas are the most common intradural extramedullary spinal tumors and locate electively in the cervical or the lumbar spine. A malignant transformation of a benign spinal schwannoma rarely occurred. **Material and Methods:** We report an exceptional case of malignant transformation of a benign schwannoma arising in the thoracic spine of a 31-year-old man without previous history of Recklinghausen disease. **Results:** The patient presented to our emergencies with signs of spinal cord compression for the past four months. Physical examination revealed spastic para paresis with T7 sensory level. MRI of the spine revealed a solid well-defined intra-extra foraminal lesion at the D7 level with low T1, high T2 signals, and strong contrast enhancement. A subtotal tumor removal was achieved via a posterolateral approach and the final histological diagnosis was a benign schwannoma. The patient was readmitted 4 months later for secondary aggravation. Imaging investigation showed local recurrence but with massive D7 vertebral body destruction. Surgical biopsy was obtained confirming the malignant transformation and further screening revealed mediastinal and pulmonary metastases. The patient died one month later from cardiac failure. He was undergoing adjunctive radiation therapy. **Conclusion:** Although the malignant transformation of a benign spinal schwannoma is exceptional, a careful follow-up should be indicated to detect on time such unfortunate events.

980

P287: Primary spinal B-lymphoblastic lymphoma: a case report

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Introduction: B-lymphoblastic lymphoma belongs to non-Hodgkin lymphoma. The primary spinal location is rare. It is often secondary to a systemic form and occurs in the late stages of disease progression. The discovery of primary spinal B lymphoma by spinal cord compression is unusual. We present a case taken in charge at our institution by reviewing the current data in the literature. **Material and Methods:** We report an exceptional case of malignant Primary spinal B-lymphoblastic lymphoma arising in the lumbar spine of a 24-year-old woman. **Results:** A 24-year-old young woman was admitted in February 2014 for progressive heaviness in both lower limbs, which had progressed for 2 months with recent worsening, all in a context of apyrexia. Neurological examination showed paraplegia, and a D12 sensory level. The standard x-ray of the lumbar spine showed L2 vertebral lysis. Further exploration by spinal cord magnetic resonance imaging (MRI) demonstrated L2 bodily involvement by a tumor process with a T1 and T2 hypo signal, which was enhanced after injection

of contrast product and responsible for a retreat of the posterior wall at this level with marked compression of the dural sheath. A first surgery consisted of a decompression laminectomy, followed quickly by a lateral approach of the body of L2 via a left lumbotomy. Resection of the L2 vertebral body was macroscopically complete. Stabilization of the system was ensured by inter-somatic cage and a titanium rod fixed by two screws to the vertebral bodies of L1 and L3. Histological study showed a diffuse proliferation of large undifferentiated cells with a convoluted nucleus and abundant, clear cytoplasm. The mitotic index was high and was associated with a reaction contingent of lymphocytes and eosinophils. In immunohistochemical studies, tumor cells expressed CD2. Staining with CK7, CK20, EMA, PS100, TTF1, CD1a, CD3 and CD68 was negative and the final diagnosis retained was diffuse large cell lymphoma. The postoperative period was marked by a clear clinical recovery under functional rehabilitation. Adjuvant chemotherapy was administered and the patient is perfectly independent and without any sign of recurrence at the last clinical check-up 4 months after surgery. **Conclusion:** Non-Hodgkin lymphomas are an uncommon cause of spinal cord compression and their clinical and radiological presentation is not very specific. Radical surgery retains its place despite the chemosensitivity of such lesions. Prospective studies will be necessary to define exactly the place of radiotherapy in the therapeutic arsenal. Long-term follow-up is indicated in order to diagnose any recurrence in time.

982

P288: Spinal meningiomas: report of 2 cases with rare extradural location

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Introduction: Spinal meningiomas are mostly intradural extramedullary. Pure extradural meningiomas are rare and may be misdiagnosed with other tumor of that location. We report two cases of dorsal pure extradural meningiomas. **Material and Methods:** We report 2 rare cases of spinal extradural meningioma operated in our department. **Results:** Case1: A 33-year-old woman was presented to our department for back pain and motor weakness of both lower limbs over the last two months. On examination she had an unsteady gait with paraplegia, exaggerated T-reflex, T5 sensory level but no sphincter disturbance. MRI revealed T3-T4 crescent shaped extradural lesion, hypointense to the spinal cord on T1-weighted images, T2 hyperintense, with important enhancement after Gadolinium injection. The patient was operated with posterolateral approach and had recovered completely. Histological examination revealed a grade I meningioma. Case 2: A 70-year-old man was admitted to our department complaining of back pain and sensory changes of

both lower limbs for the past 8 months and difficulty in walking for the past two days without sphincter disturbances. On admission, the patient's neurological examination revealed paraparesis, a T6 sensory level and exaggerated knee and ankle reflexes along with extensor plantar response in both sides. MRI revealed an anterolateral extradural lesion at T5 level T1 hypointense, T2 hyperintense, with important enhancement after Gadolinium injection. The patient underwent a posterolateral approach in emergency. The definitive histological diagnosis was a grade II meningioma. The neurological condition improved continuously, and follow-up examinations showed no more motor weakness. **Conclusion:** Extradural meningiomas are rare but should be considered in the differential diagnosis of extradural lesions. Prognosis relates to the extent of resection which should be as complete as possible to decrease risk of recurrence.

984

P289: Assessment of metastatic spine patients for corpectomy and dorsal stabilization

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Introduction: With the improvement of the treating modalities of the patients with carcinoma, the life-expectancy of these patients increases. Due to increased life-expectancy there is an increase of the prevalence of spinal metastasis. The decision for surgical intervention is made upon many factors, including patient's age, primary disease, and distant metastasis. The modified Tokuhashi score system and Spinal Instability Neoplastic score represent two important tools in the assessment of the patients, candidates for a corpectomy and dorsal stabilization. **Methods:** 8 patients with metastatic spine tumours (2 Plasmocytoma, 2 Mamma Ca, 1 CUP Syndrome, 1 Melanotic Schwannoma and 1 Prostata Ca) were enrolled. Mean age was 67.8 ± 11.8 . The indication for surgery was based on Modified Tokuhashi score. In our group, there were 5 patients in group 1 and 3 patients in group 2. Nevertheless, the approach to these patients has to be performed by a multidisciplinary team of experienced physicians. Regarding the instability of the spine, all patients were scored on the Spinal Instability Neoplastic score (5 patients belong to the group between 7-12 points and 3 patients have scored more than 13 points on the SINS, whereas the median score was 12,6 (9-17 points). The higher SINS corresponds to higher likelihood for surgical intervention. **Results:** No early postoperative complications were observed. None of the patients experienced transitory or permanent neurological deterioration. Tokuhashi Score Mean: 6.5 ± 3.3 ; SE: -1,1. SINS: Mean 11.7 ; ± 3.66 , SE-1.22. One patient died less than 6 months after the circumferential reconstruction,

three patients died 1 year later, and the other 4 were treated in other facilities. **Conclusions:** The proper preoperative assessment of the patients with metastatic spine is the key for successful treatment. The assessment scales are only a part of the multidisciplinary approach to these patients. However, the circumferential reconstruction of the spinal column remains a feasible option for the potential surgical candidates.

I025

P290: Intramedullary thoraco-lumbar ganglioglioma: case report

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Introduction: Ganglioglioma is a slow-growing tumor composed of variably differentiated neuronal cells admixed with neoplastic astrocytes representing approximately .5 % of all primary central nervous system tumors. Gangliogliomas of the spinal cord are even rarer, and the conus medullaris is an exceptional site for their occurrence. **Material and Methods:** We report an unusual case of Ganglioglioma of the thoracolumbar spinal cord, including the conus medullaris associated with an extensive hydromyelia. **Results:** A 19-year-old female patient without previous history neurofibromatosis type 1 (NF1) presented to our emergencies with progressive weakness in her lower limbs for the past 3 weeks, aggravated one day prior to her admission by sphincter disturbances. Spinal MRI revealed an intramedullary lesion within the thoracolumbar spinal cord, including the conus medullaris associated to a C6-D8 hydromyelia. The tumor was completely removed by a posterior approach under neurophysiological monitoring. Pathological investigation showed a Ganglioglioma consisting of predominantly mature ganglion cells associated with glial elements. No adjunctive treatment was administered and the patient is symptom free with no clinical or radiological evidence of recurrence at most recent follow-up examination, one year later. **Conclusion:** Although rare, Ganglioglioma should be included in the differential diagnosis of conus medullaris tumors with hydromyelia. Early recognition, diagnosis, and treatment are imperative to improve prognosis and minimize neurological sequelae.

I030

P291: Factors associated with retro-odontoid pseudotumors in hemodialysis patients

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Introduction: Hemodialysis has been reported to be associated with retro-odontoid pseudotumor (ROP), but the clinical characteristics of which have not been well described. The purpose of the present study was to investigate the factors associated with ROP in hemodialysis patients. **Material and Methods:** A retrospective clinical study was conducted of hemodialysis patients with available both CT and MRI data of cervical spinal lesions at a single institution from 2012 to 2021. Patients' clinical records including radiological imaging were assessed, and a case-control analysis was performed between the patients with ROP (pseudotumor group) and those without (control group). **Results:** We analyzed 46 patients in this study. The mean duration of hemodialysis was 22 years (range, 1-42 years). The mean retro-odontoid soft tissue (ROST) thickness was 4.3 ± 2.0 mm. Thirty patients (65%) had ROP and were included in pseudotumor group. The pseudotumor group showed significantly longer duration of hemodialysis ($p = .01$), and significantly higher incidence of the destructive spondyloarthropathy (DSA) change in O-C1 ($p = .03$), the cystic/osteolytic lesions in C1 lateral mass ($p = .01$), and the cystic/osteolytic lesions in C2 dens ($p = .02$). In a multiple regression analysis, the cystic/osteolytic lesions in C1 lateral mass remained associated with ROP ($p = .04$). **Conclusion:** The development of ROP in hemodialysis patients was associated with the existence of cystic/osteolytic lesions in C1 lateral masses. The current study suggests that surgeons should pay attention to occipito-cervical junction for the radiolucent changes and development of ROP.

I089

P292: Surgical management of sacral tumors: our experience

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Introduction: Sacral lesions maybe challenging because of nonspecific clinical features and diagnosis is often delayed. Although they represent a minority of spinal tumors, their surgical management warrants much attention. Primary tumors of the sacrum are rare lesions and account for fewer than 7% of all spinal tumors. Metastatic lesions, multiple myeloma, and lymphoma are far more common than primary sacral tumors. Chordoma is the most common primary malignant sacral tumor accounting for approximately 45% of cases. **Methods:** We retrospectively reviewed the cases of sacral tumors treated in the department of neurosurgery of Fattouma Bourguiba University hospital, Monastir, Tunisia between

1989 and 202. Medical records, clinical imaging and surgical management were recorded and compared to relevant literature. **Results:** Ten patients were included (6 males and 4 females). Age at presentation ranged between 4 months and 76 years (mean 43.4 years). Bowel and bladder dysfunction and sciatica were the most common presenting symptoms (40% of patients). The mean diagnostic delay was 1.44 year. All patients underwent at least one surgical resection. Chordoma was present in four cases. Other diagnosis included lymphoma, lipoma, teratoma and plasmocytoma (one case each). Significant postoperative improvement was achieved in all patients with benign tumor and only in 2 cases with malignant neoplasms. We noted a loco regional tumor extension in one case and three cases of chordoma recurred within 16 months. The mean survival period of patients with malignant tumor was 3.2 years. **Conclusion:** A tailored approach balancing between neural compression, lumbopelvic stability, and optimal oncological resection depending on the type of lesion should be recommended in all cases and could result in acceptable outcomes.

1113

P293: Separation surgery, fixation with carbonfiber implants and SBRT - A new standard of care in oligo-metastatic spinal disease?

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Introduction: The management of spinal metastases focuses on reducing symptoms and protecting the spinal cord and has historically involved extracorporeal radiotherapy alone. The use of separation surgery techniques alongside stereotactic radiotherapy (SBRT) to treat spinal metastases has increased. There has been an ongoing debate about the choice of the most appropriate spinal implants. **Materials and Methods:** We present a case of a 48-year-old female patient who was diagnosed with a metastatic deposit of a breast cancer withing L1 with an Epidural Spinal Cord Compression (ESCC) score greater than 1a. At the time of the diagnosis her prognosis was estimated to be more than 2 years. She underwent a posterior instrumented fusion with a carbon-fibre fixation system and separation surgery (debulking of the tumour around the spinal cord). She was subsequently treated with SBRT and adhered to long term follow up. **Results:** The patient was discharged on the second postoperative day achieving complete resolution of the mechanical back pain. SBRT was performed 8 weeks after the surgery, and it was noted that the planning of this

procedure was far more straightforward due to the lack of artifacts from the spinal implants. A total of 57Gy was applied to the vertebral body L1 with no local or systemic toxicity observed. The patient regained ECOG status of 1 shortly after, but sadly passed away of multiple brain metastases 36 months later. Her spinal disease remained well controlled throughout the follow-up. **Conclusions:** The concept of separation surgery followed by SBRT has gained in popularity when dealing with spinal oligometastatic disease. Carbonfiber implants appear to be safe and relatively easy to apply. Their use, due to limited number of artefacts in both CT and MR imaging, makes SBRT much more straightforward and follow up imaging easier to be interpreted.

1170

P294: A rare case of primary spinal germ cell tumor

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Introduction: Primary tumors represent 10 to 20% of vertebral tumors. They can be primitive or secondary. Primary malignant tumors are dominated by chondrosarcoma, osteosarcoma, Ewing's sarcoma, giant cell sarcoma. Malignant germ cell tumors are tumors arise from the transformation of primitive germ cells. These tumors are mainly localized to the genitals. The localization of a primary malignant germ cell tumor (PMGT) in the dorsal spine is exceptional. **Methods:** We report an exceptional case of primary spinal germ cell tumor arising in the thoracic spine of a 46-year-old female operated in our department. **Results:** We report the observation of a 46-year-old patient, who consults for mechanical-looking back spinal pain evolving for 4 months associated with right intercostal neuralgia and transit disorders of the alternating constipation-diarrhea type. Dorsal spine finds lysis of the right pedicle of D1. MRI of the spinal cord shows a lobulated mass, well limited from the bodies of D9, D10, invading the medullary canal. The patient was operated by a laminectomy from D8 to D10 with resection of the epidural tumor tissue, decompressing the roots. Pathological examination of the surgical specimen concluded with a poorly differentiated malignant germ cell tumor. **Conclusion:** Malignant Germ Cell Tumor with dorsal vertebral localization are rare and their discovery in an adult subject is exceptional. Any delay in diagnosis weighs down the prognosis because of possible neurological complications. Treatment involves surgery and chemotherapy.

I 187

P295: Vertebral cementoplasty in spine metastasis treatment

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Introduction: Cementoplasty techniques, in particular kyphoplasty, are increasingly establishing themselves as a particularly interesting therapeutic option in the therapeutic arsenal of vertebral metastases, with promising **Results**. The main objective of our work is to study the short-term effect of cementoplasty in the treatment of pain associated with vertebral metastases. We further evaluated the effect of cementoplasty in terms of radiological outcomes. **Material and Methods:** We conducted a 4-year single-center retrospective study of 15 patients with vertebral metastases without neurological signs, for a total of 23 cementoplasties. All the patients were operated by the same surgeon. Percutaneous transpedicular approach was used for all the patients. We evaluated preoperative and postoperative pain using visual analog scale (VAS). Angular kyphosis and Beck index were estimated using plain radiographs and CT Scan. We noted the occurrence of complications such as cement leakage, neurologic impairment and thrombo-embolic accidents. **Results:** The average age of our patients was 55.13 years. The mean preoperative VAS was 8.46 and reached an average of 2.73 until the last follow-up, ie 2 years postoperatively, attesting to the significant reduction in vertebral pain ($P < .05$). The Beck index went from a mean of .58 preoperatively to a mean of .84 postoperatively, with a significant difference ($P < .05$). Angular kyphosis went from a mean of 17.8° preoperatively to 7.3° postoperatively at the last follow-up with a significant difference ($P < .05$). Three cases of PMMA leakage were noted, without clinical consequences. **Conclusion:** The techniques of vertebral cementoplasty are reliable, efficient and reproducible, for the management of vertebral metastatic lesions, and this in its two main aspects, analgesia and stabilization. The anti-tumor effect consolidates the interest in these techniques. The low frequency of complications associated with cementoplasty also explains the reliability of this technique.

I 208

P296: Eosinophilic granuloma of C3 in an adolescent. A case report and literature review

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Introduction: Eosinophilic granuloma (EG) is a rare, tumorlike lesion, infrequently affecting the cervical spine, particularly in adults. Although vastly described in literature, the majority of the reported cases are children and there is still no consensus on its treatment in older patients. We present a case of a C3 eosinophilic granuloma in a 16-year-old patient, who was treated conservatively, with good Results, including complete return to his previous activities. **Clinical case:** A 16-year-old male, elite rugby player, presented with a history of persistent neckpain, mainly at night, with no previous trauma. On physical examination, he reported neck pain with axial compression of the head, without neurological impairment. Both computed tomography (CT) and magnetic resonance imaging (MRI) described an aggressive lytic lesion in the C3 vertebral body, with monostotic presentation on positron emission tomography computed tomography (PET-CT), compatible with a primary spine tumor. A CT-guided percutaneous biopsy was obtained, which identified Langerhans cells, confirming the diagnosis of an EG. As he presented no symptoms or imaging findings of evident bone instability, as well as no neurological impairment, the patient was treated conservatively, with a cervical brace, oral pain medication and close follow-up. A CT obtained after 4 months of treatment showed reparative changes of the C3 vertebral body. At this point, the patient reported no neck pain, so he was able to return to his previous activities. **Conclusions:** Although an EG is rare in older adolescents, it should be considered in the differential diagnosis of primary vertebral aggressive lytic lesions. Imaging and a vertebral biopsy are paramount to confirm the diagnosis. Treatment modality depends on symptoms, involvement of adjacent structures and stability of the affected vertebra. Conservative management including clinical and imaging follow-up is a viable option.

Keywords

Eosinophilic granuloma, Bone tumor, Cervical, Langerhans cell histiocytosis, Histiocytosis X

I 228

P297: Osteochondroma arising from C6 vertebral body with myelopathy treated with en bloc excision and anterior cervical fusion: a rare case report

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Introduction: Osteochondroma of cervical spine arising from anterior elements of spine is a very unique presentation. Incidence of cervical spine osteochondroma is less than 1% of all tumors arising from spine. Less than 1 % of spinal Osteochondromas present with neurological deficit. In this case report we present a rare presentation of an Osteochondroma which arises from the vertebral body of C6 cervical spine causing compression of spinal cord and neurological deficits. **Materials and Methods:** A 18 year old female patient, presented with chief complaints of neck pain radiating to bilateral upper limbs, unsteady gait and difficulty in walking since last 3 months. Patient symptoms were insidious in onset and gradually progressed to a condition where she was not able to walk more than 10 steps. On examination, flexion of neck was painful, decreased sensation over right side C6 dermatome area. Bilateral biceps and triceps power was grade 3, bilateral hand grip was weak, spasticity as well as grade 4 power in bilateral lower limbs. Hoffman's sign was positive, supinator reflex was inverted, bilateral knee jerk was exaggerated and bilateral ankle clonus present with plantar reflexes exaggerated. CT and MRI Scans had shown an osseous outgrowth from C6 vertebral body causing spinal cord compression. Diagnostic assessment - Plain radiographs revealed a bony mass on C6 vertebral body but it was not able to show complete details due to overlapping shadows, MRI and 3D CT scan were done to locate the exact origin, size, extent and invasion of tumor, which revealed outgrowth arising from left side of posterior aspect of C6 vertebral body and growing towards canal with significant cord compression. **Results:** The patient underwent C5-6 corpectomy, en bloc excision of osteochondroma with anterior cervical fusion using cervical plate and screws. Histopathological examination confirmed a diagnosis of osteochondroma. Postoperatively, the patient started walking on day 2 with significant improvement in her neurodeficits. At 2 year follow up there was complete recovery with no evidence of neurological deficits, myelopathy and recurrence. **Conclusion:** Osteochondroma arising from vertebral body is extremely rare presentation. En bloc excision of tumor with anterior cervical approach is the treatment of choice in such patients with excellent Results.

1280

P298: Giant schwannoma presenting as renal mass

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Introduction: Spinal schwannomas arise from the cells covering the nerves within the spinal canal. In most cases,

they remain confined within the intradural extramedullary space, but occasionally they extend into the extradural space resembling abdominal masses. **Aim and Objective:** Diagnosis and surgical management of giant schwannoma which presented as renal mass. **Material and Methods:** 35 years old female presented with UTI, which was due to renal mass. MRI was suggestive of giant schwannoma arising from right L2 nerve root of size 7.4 x 5.5 x 9 cm in size extending from L1 to L4 pressing on the kidney and ureter. No neurological deficit was present. Excision of tumor was done from posterior and retroperitoneal approach. Posteriorly tumor is separated from L2 nerve root and intradural extradural part was removed. Via retroperitoneal approach, the remaining tumor is removed. **Results:** Duration of surgery was 6 hours with 600 ml blood loss. There was no Neurological deficit or postoperative complication. Histopathology report was Schwannoma. No recurrence at 6 months **Conclusion:** Schwannoma can present as renal mass. Type 4 schwannoma requires surgical excision from anterior and posterior approach.

1395

P299: Medullary compression secondary to thoracic multiple myeloma. Case report

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Introduction: Multiple Myeloma (MM) represents approximately 10% of hematological pathologies. The diagnosis of MM requires the presence of one or more defining events of myeloma (MDE) in addition to evidence of a 10 % or more clonal plasma cells on bone marrow examination or a biopsy-proven plasmacytoma. **Methods:** Case report. A 70-year-old patient, 3 months previously back pain without improvement with analgesic treatment, previous days presented a increase in pain at the thoracic level associated with a strength and sensitivity decrease in bilaterally pelvic limbs; Physical examination revealed pain at the level of the spinous and paravertebral process of T7, T8, T9, tendon reflexes, sensitivity to pain, proprioception, temperature were absent in lower extremities (T8 to S1), pelvic limb weakness 2/5 bilateral MRC scale, saddle anesthesia, urinary retention, bulbocavernous reflex and anal present. **Results:** In MRI the lesion invades the vertebral body of T8 and T7, as well the spinal canal at these levels; due to the neurological deficit that the patient presented we decide to perform a posterior decompression T7-T8, with spinal canal decompression + instrumentation T4-T11 + intraoperative biopsy of bone marrow, tumor tissue and soft tissue. In the histopathological study, approximately 10% of the nuclei had a 1q duplication and a deletion of the

variable region of the immunoglobulin heavy chain gene. The cells stained positive for CD138 and CD79a, thus confirming the plasma cell lineage. Bone marrow aspirate showed mild to moderate plasmacytosis (5% to 20%). **Conclusion:** This case is presented to highlight that a

considerable percentage of osteolytic pathologies present more than one spinal injury and it is necessary to seek these injuries in an intentional way as well as a multidisciplinary assessment of the systemic pathology for an adequate evolution of the patient.