



Review Article

Why are spine surgeons sued, and with what outcomes?

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ABSTRACT

Background: Why are spine surgeons sued, how successfully, and for how much? Typical bases for spinal medicolegal suits have included; the failure to timely diagnose and treat, surgical negligence, (i.e. especially resulting in significant neurological deficits), and the lack of informed consent. We reviewed 17 medicolegal spinal articles looking for additional reasons for suits, along with identifying other factors contributing to defense verdicts, plaintiffs' verdicts, or settlements.

Methods: After confirming the same three most likely causes of medicolegal suits, other factors leading to such suits included; the lack of patient access to surgeons postoperatively, poor postoperative management (i.e. contributing to new postoperative neurological deficits), failure to communicate between specialists/surgeons perioperatively, and failure to brace.

Results: Critical factors leading to more plaintiffs' verdicts and settlements along with higher payouts for both included new severe and/or catastrophic postoperative neurological deficits. Conversely, defense verdicts were more likely for those with less severe new and/or residual injuries. The total number of plaintiffs' verdicts ranged from 17-35.2%, settlements, from 8.3-37%, and defense verdicts from 27.7-75%.

Conclusion: The three most frequent bases for spinal medicolegal suits continue to include; failure to timely diagnose/treat, surgical negligence, and lack of informed consent. Here, we identified the following additional causes of such suits; the lack of patient access to surgeons perioperatively, poor postoperative management, lack of specialist/surgeon communication, and failure to brace. Further, more plaintiffs' verdicts or settlements and greater respective payouts were observed for those with new and/or more severe/catastrophic deficits, while more defense verdicts were typically rendered for patients with lesser new neurological injuries.

Keywords: Malpractice suits, Spine surgery, Orthopedics, Neurosurgery, Negligent surgery, Failure to diagnose/treat, Lack of Informed consent, Defense and plaintiffs' verdicts, Settlements, Payouts, Catastrophic neurological injury

INTRODUCTION

In this review of 17 medicolegal spine studies, we confirmed that the three major bases for spinal medicolegal suits still included; the failure to diagnose and treat in a timely fashion, negligent surgery, and the lack of informed consent [Table 1]. Further, we looked at other additional risk factors which uniquely contributed to plaintiffs' verdicts or settlements vs. defense verdicts [Tables 2-4].

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Table 1: Literature on malpractice claims.

Author [ref] Journal Year	Summary Case Data	Other Variables	Other Variables	Other Variables	Outcomes
Epstein^[8] Surg Neurol Int 2010	Verdict Search 54 Quad MC 20 years 1988-2008	25 Ant Surg 22 Post Surg 1 360 Surg 6 Surg Not Specified Avg time to verdict/ settlement 4.3 Years	Reasons for Suits 47 Negligent Surg 23 Lack Informed Consent 33 Failure Diagnose/Treat 15 Failure to Brace	44 Suits Involved Spine Surgeons 15 Quads No Damages Outcomes: 15 Defense V	Outcomes 19 Plaintiff Verdicts \$5.9 M ((\$540,000-\$18.4 M) 20 Settled \$2.8 M (66,500 to \$12 M)
Epstein^[9] J Spinal Disord Tech 2011	Verdict Search 68 Cervical Spine MC 10 Years Suits vs. 63 Spine Surgeons	48 Anterior (1-4 Level ACDF or ACF) 20 Posterior 7 Fusions 13 Lam +/- Fus 2-Other Surg 8 No Surgery	Postop Deficits Led to Suits Quad (41 pts) 21 Ant Ops 20 Post Ops 15 Less Deficits 22 Pain Alone	Reasons MC Negligence Lack Informed Consent Failed Treat/Diagnose Failed Brace	Outcomes 30 Defense V (10 Quads) 22 Plaintiff Verdicts (avg. \$4 M) 26 Settled (avg \$2.4 M)
Daniels EW^[2] Orthopedics 2012	MC Lumbar CES Emergency LexisNexis Academic Legal Search Database	Treated < 48 hrs-Better Outcomes 26.7% Loss BB “... degree of functional loss... not ...appear to affect verdicts ”	Variables Age/Sex Site 1 st Present Initial Diagnosis Rectal Exam Done/ Not Done	Variables Time to Eval By Specialist, Imaging Time to OR	“ Positive Association ...time to surgery > 48 hrs and ... Adverse Decisions
Quraishi^[15] Eur Spine J 2012	Incidence Litigation for Spine in England NHS Significant Cost	NHS Litigation Authority Database Successful Claims 2002-2010	235 Cases: 144 Acute 91 Elective	Total Claims \$60.5 M lbs \$28.6 M lbs Acute \$16.2 M lbs Elective	Legal Costs \$17.7 M lbs (31% paid by NHS-Rest Paid by Claimant
DePasse^[5] JNS Spine 2017	MC Spinal Epidural Abscess (SEA) Verdict Search Database 56 Cases Mean Age 47 23F, 33 M	MC Against: Internists 23.2% ED Physicians 14.3% Ortho 5.4% More Non Surgeons Sued ... Responsible for Initial Diagnosis...	Outcomes 17 (30.4%) Settled, 22 (39.3%) Defense 17 (30.4%) Plaintiff	Plaintiff Paid avg \$5,277,468 Million (\$185,000- \$19,792,000) Settled avg \$1,914,265 (\$100,000- \$4,500,000)	Para or Quad More Plaintiff Verdicts Higher Cost vs. Focal Weak or Pain
Daniels^[3] J Neurosurg Spine 2017	MC Outcomes 1988-2015 Verdict Search 234 Cases 66 (28%) Catastrophic Complication (CC): SCI, Anoxic Hypoxic BI, Death Vs. Non CC Defense	Outcomes/Times Defense 54.2% -127 Cases Verdict 5.1 yrs Plaintiff 26.1% -61 Cases Verdict 5.1 yrs Settled 19.6% -46 Cases Time 3.4 yrs	Award Costs Plaintiff \$4.04 M +/- \$6.8 Settlement \$1.9M +/- \$2.1M Significantly Less Money for Settlement	CC>PL Verdicts + >Awards \$6.1M vs. Non CC \$2.9M Diagnostic Delay >Plaintiff Verdict or Settlements Pl 42.9% Set 72.7%	Therapy Delay Favor Plaintiff or Settlements >PL (43.7% ,>Set 68.4% For MD Costs of Settlement Significantly less than Losing in Court

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Table 1: (Continued).

Author [ref] Journal Year	Summary Case Data	Other Variables	Other Variables	Other Variables	Outcomes
Durand^[7] Spine 2018	MC 48 Incidental Durotomy (DT) with SS- Most Intraop DT Repaired No AE AE: Recurrent CSF Leak Infection Neural Injury 56.3% Defense Verdict (Most)	Most Alleged Neuro Deficit 86.7% 83.3% Without Neuro Deficits were Defense Verdicts Avg Payment Plaintiff/ Settled \$2,757,298 in 2016 56.3% Plaintiff Verdict with Added Surgery 43.8% Delay Diagnosis/ Treatment DT in	22.9% Alleged Improper DT repair More Plaintiff Verdicts 61.9% Delay Diagnosis/Rx vs. 29.6% No Delay Diagnosis/ Rx 72.7% Plaintiff Verdict Improper Repair DT 35.1% Plaintiff Verdict With Proper Dural Rx	Repeat Surg Not Impact Verdict 42.8% PL Verdict with Reoperation v 38.1% Without Reoperation DT May Not Be Benign	Wound Dehiscence Due to DT >Adverse Outcomes >Suits Timely Reop DT Not Increase Suits Spine Surgeons Must Defend Repair DT Technique
Agarwal^[1] Spine 2018	98 Cases Using Westlaw Legal Database MC Verdicts Settlements SS 2010-2015	Variables Studied Age, Sex Specialty of Defendant Outcomes Award Amount Cause MC Why Plaintiff Sued	63.3% Defense Verdicts Most Common Defendants Neurosurgeons 17.3% Orthop 23.8%	31.6% Failure to Diagnose 32.7% Failure to Treat 24.4% Lack of Informed Consent	Plaintiff Verdicts avg \$2.5M Settlements avg \$1.3 M >Plaintiffs Verdicts Failure to Diagnose-/ Rx, Death, Surg-Emergent Time to Defense Verdict avg 5.51 yrs Time to Plaintiff Verdict or Settlement avg 4.34 yrs
Makhni^[13] Spine J 2018	High Risk 103 MC-All SS 2010-2014 34% Lack Informed Consent	WestlawNext Subscription Based Legal Search Engine Contains Public Federal and State Court Records MC Consent Alone Compensated \$2,029,884 Only Intraop Complaints \$3, 667,530	Defense 75% (77of 103) 26 Both Plaintiff and Settlements Plaintiff Verdict avg \$3.945,456 Settlement avg \$2,384,775	Higher Payout For Plaintiff Verdicts Involving Orthopedic Surgeons + Nerve Injuries Wrong Level Surgery Lower Plaintiff Payout	Time to Defense Verdict avg 5.51 yrs Time to Plaintiff Verdict or Settlement avg 4.34 yrs
de Macedo Filho^[4] Neurosurg Focus 2020	Brazil Analysis 79 of 112 Neurosurgical Procedures 2008-2020 Under-reported AE in Brazil Used 79	DATSUS Brazilian Hospital Information System Total Procedures in Neurosurgery 842,041 Mortality Rate 11.37%	Mean LOS 10.15 days 79 Med Mal Suits 26.58% Court Decisions Unfavorable to Neurosurgery	More Spine Law Suits=Lower Payout v Fewer Brain Tumors But Higher Payouts	Mortality 1.5 Fold Higher in Public vs. Private Practices
Dronkers^[6] Neurosurg Focus 2020	Disciplinary Law-NSGY Netherlands 10 Years- 1322 MC NSGY Cases-123 Complaints	Used Informal Mediation Review Legal Cases v Consultant NSGY/ NSGY Residents 2009-2019	57 (4.3%) SS Cases Filed v Neurosurgery 40- First Instance 17 -Appeals	Spine 62.5% Highest Risk 27.5% Brain 7.5% PN 2.5% Peds	Most Complaints Preop and Intraop Care Failures in Communica-tion

(Contd...)

Table 1: (Continued).

Author [ref] Journal Year	Summary Case Data	Other Variables	Other Variables	Other Variables	Outcomes
Sankey ^[17] Neurosurg Focus 2020	MC Misplaced Pedicle and Lateral Mass Screws in SS	68 Closed MC Misplaced Screws 32 Neurosurgery 31 Orthopedists Same Frequency as Defendants	Most Due to Misplaced Lumbar Pedicle Screws n=41 or 60.3% Remainder Lateral Mass Screws	Litigation Mean Paid \$1,204,422 ± \$753,832 1995 and 2019	56.3 mos (35.2-67.2) Plaintiff Verdicts 61.5 mos (51.4-77.2) Defense
Hatef ^[11] Neurosurg Focus 2020	Westlaw Edge Legal Research Service 26 MC All Spinal Fusions Trends Intraop Neural Monitoring (IONM) 19% Plaintiffs Verdicts:	<u>Plaintiff Verdicts</u> 54% Failure to Monitor Below SOC 46% Negligent IONM Same Outcomes with Either Type Monitoring Failure	Same Number Orthopedists and Neurosurgeons Failure to Monitor Required by SOC Failure to Interpret + Treat Significant IONM Changes- Improper Response	54% Defense Verdicts 19% Plaintiff 27% Settled	Settled avg \$7,58M Award Plaintiff Verdicts avg \$4,180,213 M
Jackson ^[12] Global Spine J 2021	MC SS Litigation Review 23 Studies Medline Embase Databases SS Most Litigious Procedures US	Identify Trends in Medical Malpractice Risk Claims-Need Improved Informed Consent-Better Discussion Operative and Non-Operative Treatment	Threat Malpractice Leads Spine Surgeons Use Defensive Medicine- “utilizing unnecessary or unindicated tests and studies”.	Practice Defensive Medicine in SS Limit Suits- Note Most Litigious Procedures	Use Better Informed Consent-Surg and Non-Surg Rx Outcomes Favor Defense Verdicts
Park ^[14] Clin Spine Surg 2021	MC Outcomes SS 2010-2019 257 Cases Westlaw Legal Database Studied Clinical Data Reason for Suits + Verdicts Identify Risk Factors	98 Non-Instrumented Fusions 148 Instrumented Fusions (110 1-Level, 99-MultiLevel), 83 Decompressions 95 Decompression/ Fusions 47 Fusions Only Defense Verdicts 182 (71%) Unpaid	Plaintiffs Verdicts 44 (17%) avg Paid \$2.03M Settlements \$1.1 M Plaintiffs Verdicts More Likely for NSGY vs. Ortho (33% vs. 18%) Due to: Intraop Error Instrumented AE Wrong Postop Management New Postop Neural Deficits	More Likely Plaintiff Verdict <u>Postop CES</u> <u>(+CES 55% v no CES</u> <u>26%)</u> <u>SSI (+SEEL 46% v no</u> <u>SSI 27%)</u> <u>Catastrophic Neuro</u> Injury <u>(+ CI 40% v no CI</u> <u>26%)</u>	Higher Plaintiff Awards <u>Multilevel v</u> 1-Level SS (\$2.61 Multi vs. \$0.92 1-L) <u>Improper</u> <u>Postop Rx</u> <u>(\$2.29 vs.</u> <u>\$1.12M)</u> Permanent New Neuro Deficits (\$2.29 vs. \$0.78 M

(Contd...)

Table 1: (Continued).

Author [ref] Journal Year	Summary Case Data	Other Variables	Other Variables	Other Variables	Outcomes
Harnett^[10] World Neurosurg 2021	Verdict-Search Chiroprac-tor Spinal Manipula-tion MC 1988-2018 48 Cases 93.5% (45) Spinal Manipulation	Chiropractors Defendants Plaintiff Verdict Amounts Claims Over-Aggressive Manipulation 33.3% (16 pts) Suit New Neuro Injury 66.7% (32pts)	Defense Verdicts 70.8% (34 pts) Plaintiffs Verdicts 20.8% (10 pts) avg Paid \$658,487 +/- \$697,045 Settled 8.3% (4pts) avg Paid \$596,667 +/- \$402,534	87.5% Required Surgery C56 32.4% > C67 26.5% 7 Strokes (14.6%) 2 Rib Fx 4.2% Due to Manipulation	Litigation Due to Neurological Injury due to Manipulation Requiring Surgery
Rae^[16] Spine 2022	Patient Complaints Potential Risks MC Events 6 Orthop SS 10 Year Period	Used Patient Complaint Analysis System 214 Complaints From 202 Patients Rate 0.79% 35% Complaint Most Access Availability	32% Care And Treatment 68 Complaints Care Treatment 34 Due to Lack of Satisfaction with Surgical Outcome	Complications Seen 26/34 cases Malpractice Event Rates Ranged from 0.06% to 0.65%	Spinal Suits More Likely: Postop Patients, Mental, Neuro, Behavioral - Develop-mental Disorders

SS=Spine Surgery, MC=Malpractice Cases, Rx=Treatments, L=Legal, D=Database, ID=Identify, Dec=Decompression, DecFus=Decompression/Fusion, à, PL=Plaintiff, Set=Settlement, SSI=Surgical Site Infection, Intraop=Intraoperative, AE=Adverse Events, Postop=Postoperative, CES=Cauda Equina Syndrome, CI=Catastrophic Injury, Neuro=Neurological, NSGY=Neurosurgery, Ortho=Orthopedics, SCI=Spinal Cord Injury, BI=Brain Injury, yr/ yrs=Years, Dx=Diagnosis, IF=Informed Consent, DATSUS (Brazil)=Departamento de Inforamtica do SUS), Peds=Pediatrics, PN=Peripheral Nerve Surgery , ID=Incidental Durotomy, DT=Dural Tears, ACF=Anterior Cervical Discectomy/Fusion, ACF=Anterior Corpectomy Fusion, Lam=Laminectomy, Quad=Quadriplegia, Ant=Anterior, Post=Posterior Surgery, Surg=Surgery, M=Million Dollars, NHS=National Health Service, IONM=Intraoperative Neural Monitoring, BB=Bowel and Bladder, MC=Malpractice Claims, SEA=Spinal Epidural Abscesses, Para=Paraplegic, V=Verdicts , v or vs=Versus, Fx=Fractures

Table 2: Summary of defense, plaintiffs verdicts and settlements.

Reference	Defense	Plaintiff	Settlement	Etiology
Epstein^[8] Surg Neurol Int 2010	15/54 27.7%	19/54 35.2%	20/54 37%	54 Cervical Surgery Quadriplegia/Cervical
Epstein^[9] J Spinal Disord Tech 2011	30/78 38.5%	22/78 28.2%	26/78 33.3%	78 Cervical Surgery 41 Quadriplegia 15 Lesser Neuro Deficit 22 Deficit Pain Only
DePasse^[5] JNS Spine 2017	39.3%	30.4%	30.4%	54 Spinal Epidural Abscesses
Daniels^[3] J Neurosurg Spine 2017	54.2%	26.1%	19.6%	234 Spine Surgery 66 Catastrophic Injuries
Makhni^[13] Spine J 2018	75%	26 Shared Plaintiff Verdicts/ Settlements	26 Shared Plaintiff Verdicts/ Settlements	103 Spine Surgery
Hatef^[11] Neurosurg Focus 2020	54%	27%	19%	26 Spinal Fusions
Park^[14] Clin Spine Surg 2021	71%	17%	12%	246 Spine Operations 98 Non-Instrumented Fusions 145 Instrumented Fusions
Harnett^[10] World Neurosurg 2021	70.8%	20.8%	8.3%	48 Chiropractic Manipulation
Range	27.7-75%	17-35.2%	8.3-37%	Total Ranges

Neuro=Neurological, Neurosurg=Neurosurgery, Clin=Clinical, Surg=Surgery, Int=International, J=Journal, Max=Maximum, Neurol=Neurology, Disord=Disorders, Tech=Techniques

Table 3: Summary of amounts of plaintiffs verdicts and settlements.

Reference	Defense	Plaintiff	Settlement	Etiology
Epstein ^[8] Surg Neurol Int 2010	NA	\$5.9 M Range 540,000- \$18.4 M	\$2.8 M Range 66,500 – \$12 M	54 Cervical Surgery Quadriplegia/Cervical
Epstein ^[9] J Spinal Disord Tech 2011	NA	\$4.0 M	\$2.4 M	78 Total Cervical Surgery 41 Quadriplegia 15 Less Deficit 22 Pain Only
DePasse ^[5] JNS Spine 2017	NA	\$5.3 M 185,000- \$19.8 M	\$1.9 M 100,000-\$4.5 M	54 Spinal Epidural Abscesses
Daniels ^[3] J Neurosurg Spine 2017	NA	\$4.04 M +/- \$6.8 M (Max Range \$10.84M)	\$1.9 M +/- \$2.1 M (Max Range \$4.0 M)	234 Spine Surgery: 66 Catastrophic Injuries
Makhni ^[13] Spine J 2018	NA	\$3.9 M	\$2.4 M	103 Spine Surgery
Hatef ^[11] Neurosurg Focus 2020	NA	\$4.18 M	\$7.58 M	26 Spinal Fusions
Park ^[14] Clin Spine Surg 2021	NA	\$2.03 M	\$1.1 M	246 Spine Operations 98 Non-Instrumented Fusions 145 Instrumented Fusions
Harnett ^[10] World Neurosurg 2021	NA	Mean \$658,487 +/- \$697,045 (Max Range \$1, 355,532)	Mean \$596,663 +/- \$402,534 (Max Range \$999,197)	48 Chiropractic Manipulation
Range of Mean Payouts	NA	\$0.66 M- \$10.84 M	\$0.6 M-\$7.58 M	Total Ranges of Mean Payouts
Maximum Payout Range	NA	\$19.8 M	\$12 M	Maximum Payout
Lowest Range Payouts	NA	185,000	\$66,500	Minimum Payout

M=Million, Neurosurg=Neurosurgery, Clin=Clinical, Surg=Surgery, Int=International, J=Journal, Max=Maximum, Neurol=Neurology, Disord=Disorders, Tech=Techniques

Reasons for Medicolegal Suits in Spine Surgery

Failure to diagnose and treat in a timely fashion

Various studies cite different reasons for medicolegal suits involving spine surgery [Table 1].^[1-3,7-9] Epstein in 2010 found that two of the major reasons for cervical spine medicolegal suits involving 54 quadriplegic patients included (i.e. in descending/overlapping order); negligent surgery (47 cases), and failure to timely diagnose and treat (33 cases) [Table 1].^[8] In a separate study in 2011, Epstein cited the same 2 dominant reasons for filing medicolegal spinal suits, but now 41 patients in this other sample were quadriplegic, 15 showed less severe neurological deficits, and 22 had pain alone. Notably, this series included 37 patients with “less severe” neurological deficits that resulted in an increase in defense verdicts (i.e. 27.7% defense verdicts in the 2010 series vs. the higher 38.5% in the 2011 study) [Tables 2-4].^[9] Daniels *et al.* (2012) cited the failure

to timely diagnose/treat lumbar cauda equina syndromes as the major contributing factor leading to plaintiffs’ verdicts in their series [Table 1].^[2] In a separate study by a different Daniels *et al.* in (2017), where 66 out of 234 spine patients sustained postoperative catastrophic neurological injuries, the main factors contributing to plaintiffs’ verdicts or settlements were delays in obtaining a timely diagnosis and administering treatment (i.e. 42.9% plaintiffs’ verdicts vs. 72.7% settlements) [Tables 1-4].^[3] As anticipated, mean payouts for plaintiffs’ verdicts (i.e. \$4.04 M +/- \$6.8 M) were significantly higher than for settlements (i.e. \$1.9 M +/- \$2.1 M); both plaintiffs’ verdicts and settlement payouts were also markedly increased by catastrophic injuries. For Durand’s 48 patients sustaining incidental intraoperative durotomies (i.e. DT-dural tears), delays in the timely diagnosis/treatment also favored plaintiffs’ verdicts (i.e. with delays 61.9% plaintiffs’ verdicts vs. 29.6% plaintiffs’ verdicts without delays) [Table 1].^[7] Agarwal *et*

Table 4: Time until defense or plaintiffs' verdicts or settlements.

Author [Reference] Journal Year	Spine Operations	Spine Operations And/or Defense/Plaintiffs Verdicts or Settlements	Mean Time to Defense Verdicts or to Verdicts and/or Settlements	Mean Time to Plaintiffs Verdicts and/or Settlements
Epstein ^[8] Surg Neurol Int 210	54 Cervical Operations	54 Quadriplegic Patients 27.7% Defense V 35.2% Plaintiffs V 37% Settlements	Mean Time to Verdicts and/or Settlements 4.3 Years	Mean Time to Verdicts and/or Settlements 4.3 Years
Daniels ^[3] J Neurosurg Spine 2017	234 Varied Spinal Cases	66 of 234 Catastrophic Injuries 54.2% Defense V 26.1% Plaintiffs V 19.6% Settlements	Mean Time to Defense Verdicts 5.1 yr	Mean time to Plaintiff Verdicts 5.1 yr Mean Time to Settlements 3.5 yr
Makhni ^[13] Spine J 2018	103 Varied Spinal Cases	Defense Verdicts 77/103 (75%) Plaintiffs' Verdicts and Settlements 26/10 (25%)	Mean Time to Defense Verdicts 5.5 yrs	Mean Time to Plaintiffs Verdicts or Settlements 4.3 yrs
Sankey ^[17] Neurosurg Focus 2020	68 Misplaced Spinal Screws Lumbar/ Cervical	41 Misplaced Pedicle Screws (Lumbar) 17 Misplaced Lateral Mass Screws (Cervical)	Mean Time to Defense Verdicts 61.5 mos (5.1 yrs)	Mean Time to Plaintiffs Verdicts or Settlements 56.3 mos (4.7 yrs)
Summary Data	459 Varied Spinal Cases		Range 4.3-5.5 yrs	Mean Time to: Plaintiffs V 5.1 yrs Settlements 3.5 yr Plaintiffs V and Settlements 4.3-4.7 yrs

V=Verdicts, Neurosurg=Neurosurgery, J=Journal, mos=-Months, yr/yrs=Year/Years, , Neurosurg=Neurosurgery, Clin=Clinical, Surg=Surgery, Int=International, J=Journal, Neurol=Neurology

al. (2018), in 98 spinal medicolegal cases (Westlaw Legal Database), separately cited the failure to diagnose (31.6% cases) and treat (32.6% of cases) along with death and surgical emergencies as major causes/contributors to plaintiffs' verdicts [Table 1].^[1]

Failure to diagnose/treat lumbar cauda equina syndromes (CES)

Using the LexisNexis Database, Daniels *et al.* (2012) examined the following multiple variables contributing to CES suits; whether a rectal exam was performed when the patient originally presented (i.e. typically the lack thereof), and the time it took for a specialist to see the patient, obtain imaging, and operate [Table 1]. They identified a; "positive association...between the time to surgery of > 48 hrs. and an adverse decision".^[2] Park *et al.*, (2021) further found that plaintiffs' verdicts were more likely if patients exhibited postoperative cauda equina syndromes (i.e. with CES 55% vs. without CES 26%).^[14]

Failure to diagnose and treat spinal epidural abscesses (SEA)

DePasse *et al.* (2017) noted that their 56 suits were mostly against physicians who failed to diagnose a SEA; these predominantly included internists (23.2%), and emergency

room physicians (14.3%), with only 5.4% involving spinal orthopedic surgeons [Table 1].^[5] Further, the more severe the deficits, the more likely plaintiffs' verdicts and settlements would be rendered with higher payouts averaging \$5.27 M, while settlements (30.4%) averaged 1.9 M.

Variables contributing to delays in diagnosis and treatment

In 4 studies, multiple variables contributed to delays in diagnosis and treatment [Table 1].^[2,7,13] In Daniels *et al.* (2012) series focusing on cauda equina syndromes, major variables contributing to delays in diagnosis and treatment included; the site of initial evaluation, initially missed diagnoses, the failure to perform a rectal exam, and the time it took for a specialist to be consulted, to complete imaging, and perform surgery [Table 1].^[2] They specifically found a; "Positive association *between* the time to surgery of over 48 hours and adverse decisions". For Durand *et al.* (2018) 48 cases involving incidental durotomies, delays in diagnosis and treatment included the failure to recognize a recurrent postoperative cerebrospinal fluid (CSF) leak in a timely fashion, (i.e. delayed), or surgeons' initial or subsequent "improper" (i.e. negligent) repair of a dural tear resulting in recurrent CSF fistulas [Table 1].^[7] Other factors included; infection, wound dehiscence, and/or a

new neural injury [Table 1].^[7] Makhni *et al.* (2018) cited the following additional factors as contributing to spinal diagnostic/therapeutic delays; the presence of a nerve injury, involvement of an orthopedic surgeon, and wrong level surgery [Table 1].^[13]

Surgical negligence

Several studies addressed negligent surgery/technical surgical errors as contributing to plaintiffs' verdicts and settlements.^[7-10, 14, 17] Epstein (2010) found that negligent surgery was a major reason for filing medical legal spine suits in 47 of 54 quadriplegic cases, and also played a significant role in the 2011 study (i.e. that included 41 of 78 quadriplegic patients).^[8,9] Out of Durand *et al.* (2018) 48 patients sustaining intraoperative dural tears (DT), improper dural repair techniques largely accounted for the higher 72.7% rate of plaintiffs' verdicts vs. a much lower 35.1% for those considered to have undergone appropriate DT repairs [Table 1].^[7] Sankey *et al.* (2020) uniquely cited technical surgical negligence as the main reason for 68 spinal medicolegal suits (i.e. involving misplaced lumbar pedicle screws [41 patients], and cervical lateral mass screws [27 cases]) [Tables 1 and 4].^[17] Harnett *et al.*, (2021) observed that chiropractic manipulation was responsible for all 48 medicolegal spinal suits; this included 32 patients with new neurological injuries, 87.5% of whom subsequently required spinal surgery [Tables 1-3].^[10] Looking at 257 malpractice spine cases from the Westlaw Legal Database, Park *et al.* (2021) found intraoperative technical errors/negligence (i.e. new deficits attributed to more multilevel instrumented fusions), and improper/poor postoperative management contributed to the 17% incidence of plaintiffs' verdicts, and 12% settlements [Tables 1-3].^[14]

Negligent dural repair

Durand *et al.* (2018) analyzed 48 cases involving "incidental durotomies using three legal databases; they alleged delays in diagnosis/treatment (43.8%), or cited "improper durotomy repair" (22.9%) [Table 1].^[7] Plaintiffs' verdicts rose to 61.9% with delays in diagnosis and treatment vs. 29.6% without delays, while 72.7% of cases resulted in plaintiffs' verdicts for "improper" DT repair techniques vs. 29.6% without. Interestingly, and consistent with our other findings, the number of defense verdicts markedly increased (i.e. to 83.3%) where patients exhibited no neurological deficits.

Negligent placement of spinal screws

In Sankey *et al.* (2020) 32 neurosurgeons and 31 orthopedists (31) were sued for 68 cases attributed to misplaced spinal screws, (i.e. 41 lumbar pedicle screws, 17 cervical lateral mass screws) [Table 1].^[17] Combined plaintiffs verdicts/settlements paid an average of \$1.2 M +/- \$753,832.

Negligent surgery and failures of postoperative management contributed to more plaintiffs' verdicts and settlements

Park *et al.* (2021) 257 spinal cases resulted in 17% plaintiffs' verdicts, and 12% settlements largely attributed to: intraoperative errors/negligence in instrumented fusions, failures in postoperative management, and new postoperative neurological deficits [Table 1].^[14] Plaintiffs verdicts were also more likely if patients exhibited new postoperative cauda equina syndromes (i.e. with CES 55% vs. no CES 26%), postoperative surgical site infections (SSI) (i.e. with SSI 46% vs. 27% without), and new catastrophic neurological injuries (i.e. with injuries 40% vs. 26% without). Further, higher plaintiffs' awards were associated with multilevel vs. 1-level instrumented fusions, poor postoperative management, and new/permanent postoperative neurological deficits.

Negligent failure to use intraoperative neural monitoring or improper intraoperative neural monitoring

Hatef *et al.* (2020) evaluated 26 medicolegal cases addressing failures to use intraoperative neural monitoring (IONM) (i.e. arguing the Standard of Care required monitoring), and "improper" or negligent monitoring (i.e. failure to appropriately respond/treat significant changes) [Tables 1-3].^[11] Of interest, clinical outcomes were similar for both groups. The 19% plaintiffs' verdicts (54% for failure to monitor, and 46% for negligent monitoring) resulted in an average \$4.2 M awards, while the 27% settlements averaged substantially higher at \$7.58 M; notably, there were 54% defense verdicts [Tables 2 and 3].

Negligent chiropractic manipulation

Harnett *et al.*, (2021) evaluated 48 spinal medicolegal suits (Verdict Search) against chiropractors; 45 had undergone direct spinal manipulation that resulted in 32 new post-manipulation neurological deficits with 87.5% of these patients requiring surgery [Table 1].^[10]

Lack of informed consent

Multiple studies raised lack of informed consent as a major reason for filing medicolegal suits [Table 1].^[1,8,9,12,13] Epstein (2010) found that 23 of 54 quadriplegic patients cited lack of informed consent as a reason for bringing medicolegal suits [Table 1].^[8] The separate 2011 study also cited lack of informed consent as a major contributor to filing such suits [Table 1].^[9] In 24.4% of their 98 spinal suits drawn from the Westlaw Legal Database, Agarwal *et al.* (2018) stated the lack of informed consent played a major role in 24.4% of their 98 spinal suits [Table 1].^[1] Reviewing 103 spine surgery malpractice cases culled from the WestlawNext Medicolegal database, Makhni *et al.* (2018) observed a higher 34% of patients who largely sued for the lack of informed consent

[Tables 1-4].^[13] When Jackson *et al.* (2021) reviewed “trends” identified in 23 spinal malpractice articles (i.e. from Medline and Embase Databases), they concluded that improvement in preoperative informed consent (i.e. better preoperative discussions of operative vs. non-operative management) could reduce the number spine malpractice actions in the future [Table 1].^[12]

Other reasons for spinal malpractice suits

Other reasons were identified for patients filing spinal malpractice actions. [Table 1]^[6,16] When Dronkers *et al.* (2020) evaluated 57 complaints against neurosurgery attendings/residents (i.e. for 40 first instance, 17 appeals - 62.5% involving spine surgery) in the Netherlands, the predominant “complaints” included the lack of adequate communication between specialists/surgeons (i.e. preoperatively/perioperatively), and failures in postoperative care [Table 1].^[6] Analyzing 214 complaints from 202 patients for spine-related malpractice events (i.e. involving 6 orthopedic spine surgeons over a 10 year period), Rae *et al.* (2022) further identified a 35% incidence of the “lack of access to the surgeons postoperatively”, and another 32% cited failures in postoperative care/treatment (i.e. including 34 dissatisfied with postoperative results) [Table 1].^[16]

It is Not Just the Spine Surgeons Who are Sued

In spine malpractice cases, many suits were brought against treating physicians other than spinal surgeons [Table 1].^[1,5,10,14,17] For DePasse *et al.* (2017) 56 cases involving spinal epidural abscesses, medicolegal suits were predominantly brought against internists (23.2%), and emergency room physicians (14.3%), followed by just 5.4% against orthopedic surgeons.^[5] The major reason for the failures to “timely” diagnose/treat SEA in spine patients was primarily attributed to mistakes made by these “primary screeners”.

Variable Frequency of Medicolegal Suits Against Neurosurgeons, Orthopedic Surgeons, and Chiropractors

In Agarwal *et al.* (2018 study) 98 suits, spinal neurosurgeons were defendants in 17.3% of cases, while 23.8% were orthopedists.^[11] Out of Sankey *et al.* (2020), 68 medical malpractice cases involving misplaced spinal screws, patients nearly equally sued neurosurgeons (32-47%) and orthopedists (31-45.6%).^[17] Alternatively, for Park *et al.* (2021) non-instrumented vs. instrumented fusion series, more neurosurgeons (33%) than orthopedists (18%) were sued.^[14] Notably, in Harnett *et al.* study (2021) chiropractors were sued for their direct roles in spinal manipulation in 45 of 48 malpractice cases [Table 1].^[10]

Catastrophic Injuries and More Severe Neurological Deficits Led to More Plaintiffs’ Verdicts and Settlements

In our review of 17 medicolegal studies, greater neurological deficits and/or catastrophic injuries led to more frequent and higher plaintiffs verdicts and settlements, and fewer defense verdicts [Tables 1-3].^[3,5,8,14] Epstein’s series involving 54 quadriplegic patients resulted in the highest percentage of plaintiffs verdicts (35.2%) and settlements (37%), and the smallest number (27.7%) of defense verdicts.^[8] In Daniels *et al.* (2017) series, in which 66 of 234 malpractice claims involved catastrophic injuries, the results included 26.1% plaintiffs’ verdicts, with higher mean average payouts of \$6.1 M vs. \$2.9 M without such catastrophic injuries (average \$4.04 M).^[3] DePasse *et al.* (2017) series comprised of 54 patients with spinal epidural abscesses (SEA) and significant neurological deficits, demonstrated the second highest percentage of plaintiffs’ verdicts (30.4%), and third highest (30.4%) incidence of settlements.^[5] In Park *et al.*, (2021) although 17% of cases resulted in plaintiff’s verdicts, that percentage increased to 40% for patients with catastrophic neurological injuries (vs. 26% without), and these resulted in increased payouts (i.e. \$2.29 M with new deficits vs. \$0.78 M without).^[14] Further, new postoperative cauda equina syndromes also increased the frequency of plaintiffs’ verdicts (i.e. with CES 55% plaintiffs’ verdicts vs. without CES 26%).^[14]

Less Severe Neurological Deficits Correlated with More Defense Verdicts

More defense verdicts were observed in series where patients had less severe neurological deficits.^[3,5,9-11,14] In Epstein’s (2011) series based on 41 of 78 quadriplegic patients, with 15 showing lesser neurological deficits, and 22 exhibiting pain alone, there were more defense verdicts (38.5%) compared with the 2010 study involving 54 quadriplegic patients (27.7%) [Table 2].^[9] The incidence of defense verdicts in the remaining 15 studies, excluding Epstein’s 2 series, ranged from 39.2% to 75%, and included patients undergoing various types of spine operations, including fusions, and chiropractic manipulation [Tables 1-3].^[3,5,11,14]

Highest Mean, and Highest and Lowest Payouts for Plaintiffs’ Verdicts

The mean payouts for plaintiffs verdicts ranged from \$0.66 Million to \$5.9M [Tables 1-3].^[3,8,10] The largest mean of \$5.9 M was paid to plaintiffs (i.e. 19 of 54 quadriplegic patients) in Epstein’s 2010 series. This was followed by the average of \$5.3 M paid for plaintiffs’ verdicts in DePasse’s series of 54 patients with spinal epidural abscesses. The highest range of plaintiffs verdict payouts occurred in Depasse’s series, at \$19.8 M (54 SEA patients), followed by \$18.4 M in Epstein’s 2010 series (54 quadriplegic series), and by \$10.84 M for Daniels’ 234 patients (66 with catastrophic

injuries) undergoing a mixture of spinal procedures.^[3,5,8] The lowest range of payouts for plaintiffs verdicts was \$185,000 in DePasse's 54 SEA, succeeded by \$540,000 in Epstein's 2010 series.^[5,8]

Highest Mean, and Highest and Lowest Payouts for Settlements

The highest mean payouts for settlements ranged from \$7.58 M for the 26 patients in Hatef's series undergoing spinal fusions, to \$2.8 in Epstein's 2010 and \$2.4 M in Epstein's 2011 studies respectively [Tables 1-3]^[8,9,11] The highest range of settlement was \$12 M for Epstein's 54 quadriplegic, followed by DePasse's \$4.5 M (i.e. for 54 SEA).^[5,8] Notably, the lowest range for a settlement was \$66,500 seen in Epstein's 54 quadriplegic patients (2010), with Depasse's \$100,000 for the 54 patients with SEA being next.^[5,8]

Mean Duration and Range of Times for Verdicts or Settlements to be Rendered

Four studies offered the mean and ranges of times until verdicts or settlements were reached [Table 4].^[3,8,13,17] The mean range in years for defense verdicts across the 4 studies varied from 4.3 (i.e. mean time to verdicts and settlements) to 5.1 to 5.5 years. Plaintiffs verdicts alone were rendered at an average of 5.1 years, settlements at 3.5 years, and for combined plaintiffs verdicts/settlements at 4.3-4.7 years.

Medicolegal Suits Involved Multiple Different Spine Operations

Multiple types of spinal procedures led to medicolegal suits, [Table 1].^[3,5,7,8,14,17] Epstein's 2010 54 quadriplegic patients had undergone anterior (25 patients), posterior (22 patients), circumferential (1 patient), or undefined (6 cases) cervical procedures.^[8] In 2011, the 78 cervical cases included 48 1-4 level anterior discectomy-fusions/1 level anterior corpectomy-fusions, 20 posterior cervical procedures (7 fusions, 13 laminectomy/fusions), 2 other "procedures", while 9 procedures were unstated.^[9] Multiple other surgeons performed different surgical approaches at various other spinal levels; Depasse operated on 56 spinal epidural abscesses, Daniels (2017) performed 234 spinal cases, Durand dealt with 48 lumbar dural tears, Sankey identified 41 patients with misplaced spinal screws, and Park performed a combination of 83 decompressions, 95 decompressions/fusions, and 47 fusions alone.^[3,5,7,14,17]

Spinal Litigation in England: A Report from the National Health Service (NHS)

Quraishi *et al.* (2012) focused on the costs of spinal litigation to the National Health Service in England vs. the costs to claimants within their socialized medical system [Table 1].^[15]

Using a Litigation Authority Database of Successful Spinal Claims 2002-2010, 235 cases (i.e. 144 were acute, and 91 were elective procedures), the total cost of claims was 60.5 Million pounds, with 31% of the costs borne by the NHS.

CONCLUSION

Most medicolegal spinal suits arise from the failure to timely diagnosis/treat a spinal problem, negligent surgery, the lack of informed consent, limited access of patients to their surgeons perioperatively, poor postoperative management, and failures of communication between specialists/surgeons [Table 1]. The more severe/catastrophic the postoperative neurological deficits, the more plaintiffs' verdicts and settlements were rendered, along with higher payouts for both groups [Tables 2-3].

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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