Journal of Orthopaedics 13 (2016) 278–281

Contents lists available at ScienceDirect

Journal of Orthopaedics

journal homepage: www.elsevier.com/locate/jor

Review Article

Management of burst fractures in the thoracolumbar spine

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ARTICLE INFO

Article history:
Received 8 April 2016
Accepted 7 June 2016
Available online 28 June 2016

Keywords:
Thoracolumbar spine
Compression fracture
Burst fracture
Neurological deficit
Conservative treatment
Surgical treatment

ABSTRACT

The most common fractures in the spine take place in the thoracolumbar region. Currently there is no consensus regarding optimum treatment.
Objective: Analyze the current medical literature available regarding treatment of compression fractures of the thoracolumbar spine.
Methods: Research of current literature in medical databases.
Results: Regarding current available literature, we found no consensus in the treatment of compression fractures in the thoracolumbar spine.
Conclusions: Burst fractures of the thoracolumbar junction is a very common condition, treatment of each patient must be individualized. Conservative treatment is recommended for stable fractures without neurological compromise and less than 35° of kyphosis.

1. Introduction

Research of current literature in medical databases such as pubmed was made, using the keywords thoracolumbar spine, compression fracture, burst fracture, neurological deficit, conservative treatment, surgical treatment. 220 articles were found, of which 68 were included. Within these were review articles, systematic reviews, randomized controlled trials, cohort and case–control types.

Fractures of the thoracolumbar spine represent 90% of all spine fractures, followed by cervical and lastly by lumbar spine fractures. This area is made up of T11 to L2 vertebrae, and it is considered biomechanically the weakest point in the spine.[1,2] Vertebral fractures are divided in 3 groups according to (*Arbeitsgemeinschaft für Osteosynthesefrage*) Classification. Type A are those caused by compression and Type B are those caused by flexion and distraction forces accompanied by lesions in the posterior ligament complex. Type C are any type of fracture that is accompanied by displacement in the sagittal or coronal plane.[1,6] Type A are the most frequent. Main causes of fractures in the thoracolumbar spine are: high-energy trauma (young patients) and low energy trauma (older patients). 20–40% of fractures in this segment present neurological compromise. More than 30% of the young patients may develop chronic pain, which leads to lack of work. The proper treatment for these lesions is very important.[2–4,6] Current treatment goals are: preventing neurological damage, establishing adequate stability and fusion, recovering sagittal balance, initiating early rehabilitation and reinstating patient to work. Nonetheless, there is still much controversy over what the ideal treatment represents.[1–6]

2. Anatomy of the thoracolumbar spine

This region represents the transition zone from a rigid segment to a mobile segment, making it very vulnerable to traumatic lesions.[3,4] The thoracic spine is the most rigid segment in the whole spine; this is due to the presence of the rib cage. On the other hand, the lumbar spine is one of the most flexible ones.[3–6] The spinal cord ends approximately at L1–L2, meaning that fractures at this level or below, generally displays as *cauda equina syndrome*. Fractures above L1 can be associated by spinal cord compression symptoms.[3–7]

3. Spine stability

The thoracolumbar region is the most likely to suffer lesions due to its transition from a rigid segment to a mobile one. Stability in this zone depends on the integrity of the ligaments and bony components. Stability in a fracture is determined by its mechanical and neurological status. Denis et al. classify instability into 3 groups:

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http://dx.doi.org/10.1016/j.jor.2016.06.007
0972-978X/

mechanical (first degree), neurological (second degree) and mixed instability (third degree).[6]

The integrity of the posterior ligamentous complex defines mechanical stability. In plain X-rays, this can be evaluated measuring the interspinous space (>30°–35° kyphosis) and the loss of vertebral body height (>50%).[8–10] Computed tomography is the best method to evaluate the bony components of a fracture. Magnetic resonance determines the treatment plan allowing us to evaluate the integrity of the ligaments. Many studies have reported high sensibility and specificity in MRI to evaluate these structures, comparing them to the lesions seen during surgery.[6,7,9,10] Neurological stability is determined by the ASIA (American Spinal Injury Association) classification. There are 5 types of neurological status: being "A": patient has complete neurological deficit. "B" and "C" are incomplete lesions and "E" represents no neurological compromise. Any type of lesion not classified as E will be determined as neurological instability. However, this is independent of the mechanical stability, and does not make it an indication of surgery. The only surgical indication dependent of this status is a progressive deterioration of the patient. If a patient presents type A lesion, this should be re-evaluated when spinal shock has resolved. If it does not change, it has very low probability of recovery; therefore, the goal of treatment is only to stabilize the spine and recovering sagittal balance.[11,13–18]

4. AO classification

Boehler proposed the first classification over 75 years ago. The objective was to improve communication between doctors, establish a prognosis and determine the treatment. Denis proposed the 3-column theory, emphasizing that lesions to the middle column should be treated as unstable fractures.[6,14,18] He classified fractures in the thoracolumbar segment in 4 categories: compression, burst, flexion-distraction (seat-belt) and fracture–luxation.[6,19] This classification is important because it integrates neurological status and it is simple. The inter-observer correlation is low and differentiating from unstable and stable in a burst fracture may be difficult. MacAfee et al. emphasize that the posterior ligament complex is very important and states 6 categories due to 3 types of forces that are involved: compression, distraction and translation.[19] According to the trauma mechanism it can be classified as: wedge fracture, stable burst fractures, unstable burst fractures, chance fracture, lesions by flexion or distraction, and translation. However, this is not widely used due to its complexity and its validity has not been verified. AO classifies them into 3 groups: compression, distraction and rotation. "A" to "C", being more unstable as it progresses to "C" (Table 1).

Table 1
Numerical coding for spine in AO is no. 5, sub-classification for segments follows as: 51: cervical, 52: thorax and 53: lumbar. Adding to B and C should be the vertebral body lesions IE. Fracture L2 53–B2 (A3). There are modifiers in cervical spine different to thoracolumbar spine.

AO classification		
A	1	1 endplate affected
	2	Both endplates are involved but not the posterior wall
	3	1 endplate and the posterior wall
	4	Both endplates and posterior wall
B	1	Chance fractures
	2	Lesions to posterior ligaments and vertebral body involvement
	3	Hiperextension lesions
C	Any fractures accompanied by rotational displacement	

This classification has proved high reliability intra- and inter-observer. Still, no definition has been reached regarding fracture stability and it does not take into account the neurological status.[20,21] Vaccaro et al., proposed the latest classification called TLISS (Thoraco-Lumbar Injury Severity Score) and this includes the trauma mechanism, integrity of the ligamentous components and the patients neurological status. These were given individual scoring and then they are added to reach a final score, determining the treatment based on the score. If the score was lower than 3, conservative treatment can be given, if it is more than 5, surgical treatment should be given. This classification has proven good reliability index and intra-observer correlation (kappa, 0.24–0.724) in various studies.[20–23]

5. Imaging

Simple lateral X-rays can identify as much as 80% of the bony lesions in the spine. However, they are not necessary for initial evaluation if a CT scan is avaiable.[19,24]

The MRI is the most sensitive method to evaluate soft tissue. It offers the best imaging of neurologic, ligamentous and disc structures. It is useful in patients that have initial imaging that does not justify the clinical setting. In cases with neurological deficit without structural evidence in X-rays or CT scan (SIWORA), the MRI can help with information of value for diagnostics. Approximately 25% of patients with neurological deficit in the initial evaluation with cervical or thoracic lesion have changes in the treatment plan after the MRI is done.[19,23]

6. Initial medical treatment

6.1. Does NASCIS work?

This scheme has been considered matter of a lot of controversy. There is neither enough evidence to support the policy of treatment nor are there the guidelines of how spinal cord treatment should take place. Subsequent studies have given proof of the ineffectiveness of methylprednisolone (MP) as treatment in the last decade. Currently, high doses of MP cannot be recommended as standard care; however, it is still an option until substituted by future therapies based on clinical evidence. The administration of MP is neither approved as the standard of care nor is it considered as a recommended treatment. The test of efficiency of this pharmaceutical and its effects are weak and could represent effects due to random factors.[25–27]

7. Conservative treatment

7.1. Indications

(1) Compression fractures (A1, A2) without neurological compromise and a kyphosis angle less than 35°. (2) TCLIS score less than 6 points. (3) Patients in whom surgical treatment is not an option due to their general medical conditions.[28,13] However, Daily et al. demonstrated in 22 patients with neurological déficit experienced improvement with average recovery rate of 93%.[15]

7.2. Type of treatment and follow-up

Conservative treatment consists in the postural reduction of the patient, having bed rest and adequate use of the thoracolumbar corset, as well as rehabilitation. Recommendations are bed rest for 8–12 weeks, followed by assisted mobilization. There are some authors that recommend a shorter bed rest period, approximately 4–6 weeks.[16,28,13,32]

7.3. Clinical results

Even though conservative treatment can reach good clinical results in patients with type A fractures, for compression fractures, physical therapy and brace were considered the most tolerable method. Brace therapy scored significantly better on the Visual Analogue Scores for residual pain and on the Oswestry Disability Index.[28,13,32] Some progress to kyphosis has been reported in the follow-up, to the point of needing corrective osteotomy.[13,15–17,28–31,34–36]

8. Surgical treatment

8.1. Goals

The main goals in treatment include: (1) spinal cord and foraminal to enhance recovery, (2) restoring sagittal balance, (3) early stabilization to allow rehabilitation and gait, (4) prevention of progressive deformity with neurological manifestations and (5) preserve the spine functions by achieving adequate fusion.[17,35,37–39]

8.2. Indications

Generally, surgical treatment is indicated in patients with compression type fractures (A3, A4) or compression fractures with neurological deficit that have bony fragments in medullary canal. In patients with bony fragments invading medullary canal without neurological compromise, it is enough to achieve adequate stability.[37,39,40] Patients with kyphosis $>35^\circ$ need surgical stabilization due to the high risk of progressing to worse outcomes.[39–42]

8.3. Short, long segment instrumentation, or adding a screw to the fractured vertebrae

Controversy still exists over how many segments should be fixed when treating a thoracolumbar fracture. Some studies have shown that 2 vertebrae above and 2 below are best, giving adequate rigidity and consequently better stability. Other studies have reported that a long instrumentation sacrifices unnecessary segments that are not damaged, and fixing 1 above and 1 below fractured vertebrae attains equal stability but less rigidity and preserved healthy segments.[43–46] Recently, there have been reports that an intermediate screw in the fractured vertebrae augments rigidity with higher fusion rates and less time in achieving it. They also mention that it helps acquire better alignment.[46–49]

8.4. Is the cross-link necessary?

The cross-link or transverse traction device has been used to add rigidity to the instrumentation, having as main goal to diminish the lever arm in the construct. This is why they are very useful in long instrumentations or in kyphosis (thoracolumbar union). In short segment instrumentations, with or without screw in the fractured vertebrae, reports have shown similar results regarding fusion rates and stability with or without the cross-link.[50–53]

8.5. Surgical vs conservative

Many of the fractures in the thoracolumbar region are stable and can be managed conservatively with a strict follow-up but only if the patient is neurologically intact. Reports say there are no differences in outcome comparing them to surgical treatment.[54,55] Patients with kyphosis $>35^\circ$ should be operated, and there are reports of progression causing chronic pain.[55,57] On the other hand, there have been differences in patients who had surgery had better recovery than those managed conservatively. Regarding pain, patients who had surgery had less need of pain medication compared to conservative treatment.[16,28,17,32,35,55,57]

9. Minimally invasive surgery

In the last decade, there have been developments in new techniques for minimally invasive surgery, diminishing open surgery mobility as well as having better rehabilitation. These new techniques require a steep learning curve and to be able to dominate them we must first dominate open surgery.[58] Whenever possible, the thoracoscopic approach of fractures offers significant advantages, mainly seen in lower pain postoperatively, aesthetic results, less morbidity and quicker return to daily activities. Reports show less time with pain medication in 31% compared to open 42%.

90% fusion rate has been documented in thoracoscopy approach, with minimum complications and a mean surgical time of 3.5 h, this being longer than open surgery. These techniques are limited to people with pulmonary restriction, pulmonary adherence or severe comorbids.[58–60] The minimally invasive technique with percutaneous screws without fusion in patients with compression fractures offer better results with less postoperative pain but longer surgical time, and no differences in rehabilitation.[58,60] Compared with open procedures, minimally invasive spine surgery allows to be addressed through smaller incisions with less soft-tissue damage and postoperative pain, which may lead to shorter hospitalizations and earlier mobility for the patient.[61] MISS techniques may be an excellent solution in the politrauma patients, providing "damage-control spinal stabilization."[62]

10. Conclusions

Thoracolumbar fractures are very common. It is important to have a complete physical examination and imaging studies should be reviewed carefully. Every lesion should be classified as stable or unstable regarding mechanical properties of the spine and neurological status, including regional or local kyphosis. Every patient has to be individualized according to the properties of the lesions. Conservative treatment is recommended in patients with stable fractures without neurological compromise and less than 35° of kyphosis. If the integrity of the posterior ligament complex is in doubt, a MRI should be done. For unstable fractures, surgical treatment should be standard. However, recently there are authors who have suggested instrumentation without fusion, but this has yet to be studied with comparative methods. Independently of the technique used, the objectives remain the same: stabilizing the spine, preserving function and recovering sagittal balance.

Conflicts of interest

The authors have none to declare.

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