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Thoracic Fracture-Dislocations without Neurologic Injury: 2 Cases Report and their Literature Review

Ribeiro H *, Teixeira R, Fernandes P, Nunes A, Sousa J and Almeida R

Hospital São Francisco Xavier, Centro Hospitalar Lisboa Ocidental, Lisboa, Portugal

Abstract

Thoracic spine fracture-dislocation represents 15% of all thoracic and lumbar fractures. The neurological injury occurs in 80% of cases, being extremely rare without spinal cord injury. We herein describe the clinical and imagiological features of two patients with fracture-dislocation of the upper thoracic spine without spinal cord injury. The first case is a patient of 60-year-old female with a T3/T4 fracture dislocation associated with a L2 burst type fracture. The patient underwent posterior decompression and reduction with pedicular screw fixation from T2 to T6 and 10 days after posterior transpedicular stabilization with screw in L1 to L3. The second case is a 37-year-old male, presented to us after a motorcycle accident with a T6/T7 fracture dislocation. Reduction and stabilization of the fracture-dislocation was achieved with transpedicular screw fixation in T4 to T6 and T9 to T10, after decompression from T6 to T8. Both patients are asymptomatic with a follow up of 12 and 18 months, Case 1 and Case 2 respectively. The presence of upper thoracic fracture dislocation without neurologic lesions is very rare and biomechanically justifiable when the middle column is separated from the posterior column.

Keywords: Thoracic fracture-dislocation; Thoracic spine fractures; Neural sparing

Introduction

Due to the unique sagittal orientation of facet joints and the presence of the costotransverse articulation of the thoracic spine segment, they are mechanically more stable to axial and horizontal translation [1,2]. The spinal canal is narrow, with little free space between the cord and the osseous ring. The thoracic spinal cord also has a relatively sparse blood supply [3-9]. Therefore, any compression or kyphosis in the thoracic spine almost always causes spinal cord injury which is usually severe in the upper thoracic spine. There are only a few cases of severe thoracic spinal fracture-dislocation without neurological symptoms in the literature [10-24]. Here, we report two case reports with a complete fracture-dislocation of thoracic spine without neurological deficit. Moreover, we discuss the clinical and radiological features, injury mechanism, treatment of the thoracic spinal fracture-dislocation and provide a review of the literature.

Case Report 1

A 60-year-old woman presented to us after a 4 meters height fall. On admission, the patient was fully oriented with stable vital signs, active movement of the upper and lower extremities, normal anal contractility and sphincter reflex were observed. No neurogenic bladder or fecal incontinence was observed. Plain radiographs and computed tomogram showed a T3/T4 fracture-dislocation (type C according to AO classification) with severe translational and rotational displacement and possible medular compression (Figures 1A, 1B and 1C). CCompression fracture, burst type (A4 according to AO classification), in the vertebral body of L2 associated with discontinuity of the posterior elements, apparently, without medular compression and fracture of L1/L2/L3 spine processes. There were also fractures involving the right transverse processes between T7 to T10, spines processes from T10 to L1. Additionally, showed multiple rib fractures with lung contusion, bilaterally complicated with pneumothorax and hemothorax, but without respiratory function compromise. There was also a left retro-renal hematoma with indication for conservative treatment. After one day of hospitalization, reduction and stabilization of the fracture-dislocation was achieved with transpedicular screw fixation from T2 to T6, except left pedicle of T4. To increase stabilization we used a cross – link at T4 level.

During surgery we verified a frank amount of liquor drainage due to a bilateral ventral spinal dural tear treated with tissue fibrin glue. Intra-operative neurophysiological monitoring was applied throughout the operation. The significant blood loss from comminuted fracture of the vertebral body was adjusted with two blood transfusions. The postoperative computed tomogram showed good realignment of the dislocated segment (Figures 2A and 2B). There were no postoperative complications. Close neurological follow-up revealed no pathological findings at this stage of the recovery. After 10 days, it was made a posterior stabilization with transpedicular screw fixation in L1 to L3, to fix the burst fracture in L2 vertebral body. In the early postoperative course the patient complained about intense back pain, VAS 9 in 10, with difficult control by opioids. No deteriorated neurological function was observed postoperatively. There was slight decrease lower limbs muscular force, Medical Research Council (MRC) grade 4 power in both lower limbs, we relate to the intensive care myopathy syndrome. The patient was discharged on day 20th after surgery and could walk with one crutch without any brace. At follow-up 6 months later, the patient had discreet back pain, specifically in thoraco-lumbar transition, VAS 3 in 10. At the 1 year follow-up the patient returned to her job and can walk a distance of 3 km without pain.

Case Report 2

A 37-year-old male sustained severe spinal injury from a motorcycle accident. On admission, the patient was awake and fully orientated, Glasgow Coma Score 15, hemodynamically stable. He denied numbness and weakness in his extremities. Physical examination revealed that he was neurologically intact without sensory or motor deficits and had

***Corresponding author:** Hugo Filipe Marques Ribeiro, Hospital São Francisco Xavier, Centro Hospitalar Lisboa Ocidental, Lisboa, Portugal, Tel: + 935522248; E-mail: hribeiro.1990@gmail.com

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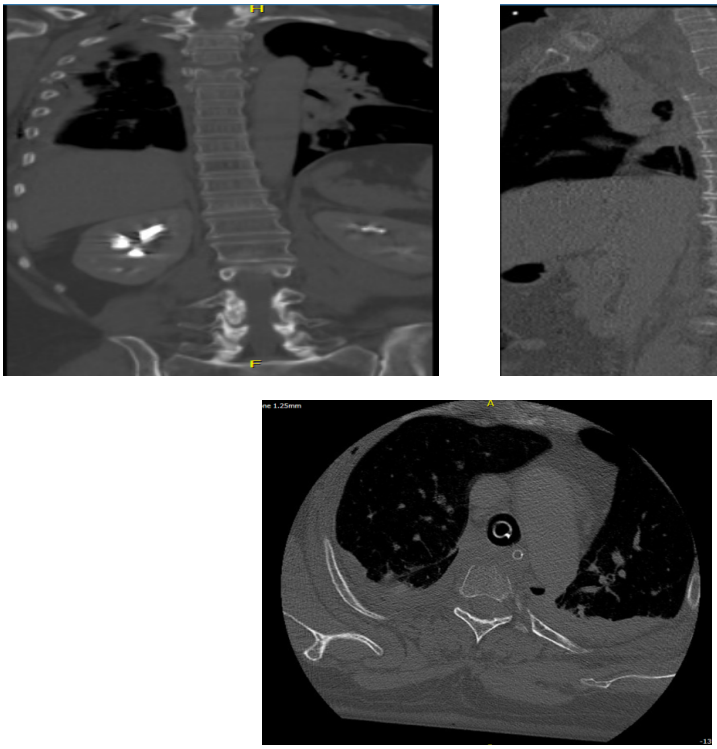

Figure 1: (A) Pre-operative coronal CT scan showing T3/T4 fracture dislocation. **(B)** Pre-operative sagital CT scan showing T3/T4 fracture dislocation. **(C)** Pre-operative axial CT scan showing the left pedicle and transverse process fracture, in T4 vertebrae level, and associated bilateral hemothorax.

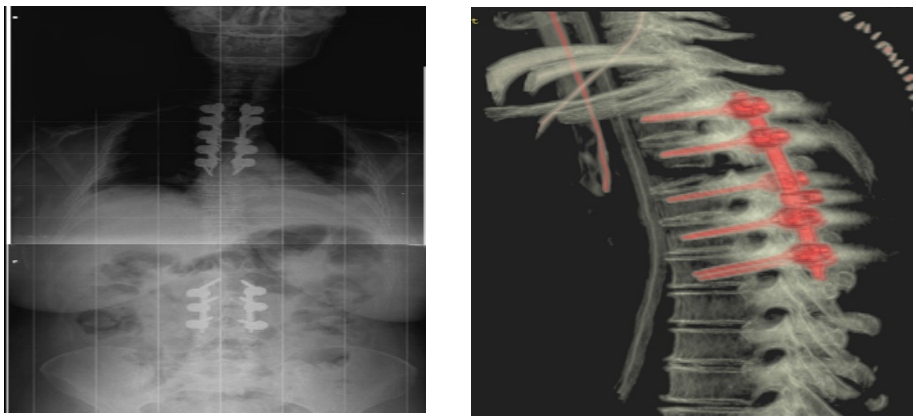

Figure 2: (A) Antero-posterior spine x-ray after open reduction and segmental instrumentation. **(B)** The 3-dimensional reconstruction revealed the normal alignment.

normal reflexes. Normal anal contractility and sphincter reflex were observed. Computed tomography revealed a T5/T6 complete fracture with lateral displacement of T6. Both vertebrae had left pedicle fracture. There were also fractures involving the right pedicle of C7, body fracture of T5 and T6, with retropulsion of bony fragments into the spinal canal. Associated injuries were a right-sided 9th rib fracture with pulmonary contusion resulting in right hemo-pneumothorax, which was treated by chest tube insertion, and left kidney contusion. Despite the absence of normal neurological deficits, the spine was considered unstable and an operation was planned on the day of admission (Figures 3A, 3B and 3C).

Reduction and stabilization of the fracture-dislocation was achieved with transpedicular screw fixation from T4 to T6 and T9 to T10. After decompression from T6 to T8, a dural tear was found and treated with tissue fibrin glue and spongostan®. Realignment of the spine was achieved with 2 rods after placement of transpedicle screws. Finally, we set two cross-links to achieve additional stability. Intra-operative neurophysiological monitoring was applied throughout the operation. The blood loss from comminuted fracture of the vertebral body was solved by two blood transfusions. No deterioration of the neurological function was observed postoperatively. C7 fracture had indication for conservative treatment with cervical collar. The patient was discharged after 2 weeks and could walk without assistance. An anatomic alignment was obtained and maintained at discharge as well as at subsequent follow-up appointments. At 2- month follow-up, the patient complained about sporadic thoracic pain, VAS 4 in 10, which

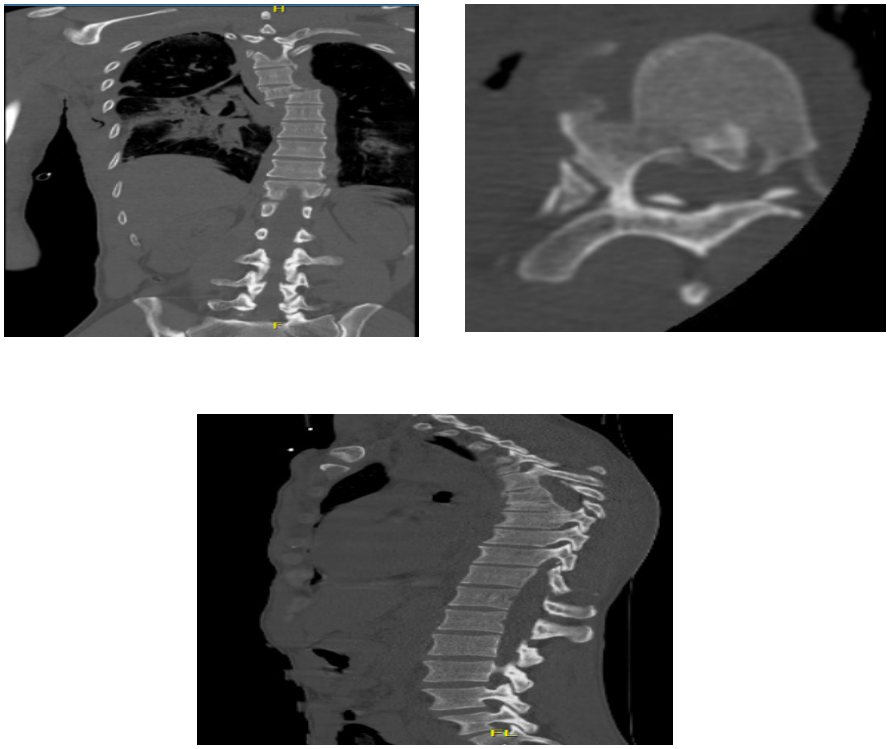

Figure 3: (A) Pre-operative coronal CT scan showing T5/T6 fracture dislocation. **(B)** Pre-operative sagital CT scan showing T5/T6 fracture dislocation. **(C)** Pre-operative axial CT scan showing right antero-lateral vertebral body fracture of T5 and T6, with retropulsion of bony fragments into the spinal canal and left pedicle fracture of T5 and T6.

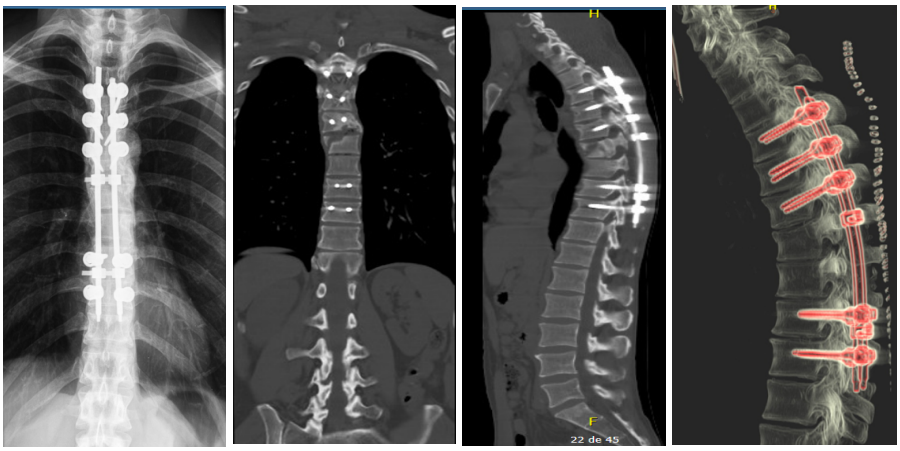

Figure 4: (A) Post-operative antero-posterior x-ray showing the reduced lateral dislocation and internal fixation. (**B)** Post-operative coronal CT scan showing the reduced lateral dislocation and internal fixation. **(C)** Sagital CT scan after open reduction and segmental instrumentation. **(D)** The 3-dimensional reconstruction revealed the normal alignment after the insertion of instruments.

improves with analgesics. At the 18-month follow-up, the patient was able to walk 2 km a day continuously and returned to his job (Figures 4A, 4B, 4C and 4D).

Discussion

Fracture-dislocation of the thoracic vertebrae without neurological symptoms is very rare [3]. The rib cage and the orientation of the facet joints provide the thoracic spine with a certain rigidity and protection against injury. Consequently a substantial force is required to produce failure of this spinal region [5]. In 1981 Denis [2] introduced his three-column spine concept. He rated fracture-dislocations as the most biomechanically unstable fractures, being associated with the highest incidence of cord injury among the different fracture types. In 1994 Magerl and coauthors [7] introduced a new classification that have become generally accepted, they define fracture-dislocations as rotational injuries relating to rotation as the main pathogenic force. All these fracture classifications, however, are unanimous in describing fracture-dislocations as failure of all three columns resulting in a high degree of instability. In a thorough study of the biomechanics of spinal injuries, Roaf [9] found the spine to be highly vulnerable to rotational and shear forces.

He found that hyperflexion or hyperextension alone are unlikely to

S. No	Case authors	Level	Cause	Diagnosis	Pedicle fracture	Body fracture	Dislocation	Treatment
1	Gertzbein and Offierski [10]	T5/T6	Direct trauma	Immediate	Bilateral T6-T8	None	T5 antero-lateral	Conservative (halofemoral traction)
2	Vichard et al. [11]	T8/T9	Car accident	Immediate	Right T8 Left T9	None	T8 lateral	Conservative (halo cast)
3	Weber and Sutherland [12]	T6/T7	Motorcycle accident	After 2 days	Bilateral T7-T9 Right T 10	Fractures through T7-T 10	T6 lateral	Operative (anterior AO-plate, posterior Luque)
4	Harryman [13]	T6/T7	Car accident	Immediate	Bilateral T5-T8	None	T6 anterolateral	Operative (spinal fusion)
5	Sasson and Mozes [14]	T9/T10	Car accident	Immediate	Bilateral T9 and T 10 Bilateral T7-T10	None	T7 anterolateral	Conservative (halofemoral traction)
6	Uriarte et al. [15]	T7/T8	Motorcycle accident	Immediate	Bilateral T7-T10	Horizontal shear fracture T7	T7 anterolateral	Conservative (halofemoral traction)
7	Simpson et al. [16]	T9/T10	Motorcycle accident	Immediate	Bilateral T9, right T7, left T8	None	T9 anterolateral	Operative (Harrington)
8	Krallis et al. [17]	T7/T8	Motorcycle accident	Immediate	Bilateral T7	None	T7 anterolatera	Conservative (cast)
9	Miyasaka et al. [18]	T6/T8	Motorcycle accident	Immediate	Bilateral T9	Vertical fractures through T6-T8 and T 10	T6 posterior T7 and T8 anterolateral	Conservative (cast)
10	De Lucas et al. [18]	T8/T9	Car accident	Immediate	Right T8	Burst fracture T8 shear fracture T9	T8 anterolateral	Operative (anterior fusion)
11	Korovessis et al. [20]	T5/T6	Motorcycle accident	After 6 weeks	Bilateral T5 and T6	None	T5 lateral	Operative (Luque)
12	Liljenqvist et al. [21]	T9/T10	Car accident	Immediate	Left T9	Vertical fracture T9	T9 antero-lateral	Operative
13	Potter et al. [22]	T4/T5	Fall	Immediate	?	?	T5 anterior	Operative
14	Anthes et al. [23]	T4/T6	Motorcycle accident	Immediate	?	Comminute anterior wedging T4	?	?
15	Jiang B et al. [24]	T6/T7	Motorcycle accident	Immediate	Bilateral T6/T7	?	T6 antero-lateral	Operative

Table 1: Data compiled from the 15 previously published cases of thoracic fracture dislocation with neural sparing.

create a fracture-dislocation, but that in association with a rotational force, failure of all three columns becomes far more likely. Depending on the additional compressive impact, fractures of the vertebral bodies may occur. Most thoracic fracture dislocations with neural sparing occurred between T-6 and T-10 Miyasaka and coauthors [18-24], explained this occurrence by the fact that in this area the spinous processes extend farther inferiorly than in any other part of the spine. Consequently, they stated, strong shear forces would be concentrated in the middle column, leading to fractures of either pedicle and preservation of the spinal canal. So spontaneous spinal decompression is considered to be the main mechanism [16] and the ribcage helps maintain the stability of an injured thoracic spine, decreasing the risk of neurological injury [13]. In this two cases there was synchronous pedicle fractures, case report 1 with fracture dislocation in T3/T4 and bilateral pedicle fracture in T3/T4 and in case report 2 with fracture dislocation in T5/T6 and left pedicle fracture in T5/6. This is the key mechanism by which the spinal cord did not shift and spinal cord injury did not occur.

There are two different patterns of dislocation that occur depending on the direction of the force experienced by the spinal column. One is anterior–posterior [14,16,18-24] and the other is lateral or rotational dislocation [10,12, 13,15,16]. In this series, the dislocation in the case 1 was secondary to anterior-posterior shear force. In contrast, the dislocation in case 2 was due to forced flexion combined with rotation. In Table 1, the key data of all 15 reported cases of thoracic fracture-dislocation without neurological deficit have been compiled. Almost all thoracic fracture-dislocation with neural sparing occurred between T6 and T9, except 3 of the 15 reported cases. Which is in accordance with the findings of Hanley and Eskay [8], most fracture-dislocations occurred between T6 and T9 because of horizontal orientation of the vertebrae around the apex of the thoracic kyphosis. Table 1 indicates that the most of the thoracic fracture-dislocation resulted from motor accident (13 out of 15), like the second case report. And only one case described as a fall from a height like our first case report. High-velocity impact with considerable high energy may be the main pattern of injury leading to thoracic fracture-dislocation without neurological deficits. Table 1 shows that fractures of the pedicle (13 out of 15 cases, and the other two are unknown) lead to separation of the posterior from the middle column and avoidance of cord injury by maintaining the spinal canal. So fracture of the pedicle is a precondition for avoiding spinal cord injury. Currently, there are no clear-cut guidelines for the treatment of thoracic fracture-dislocations (Table 1) without any neurological deficits. Several case studies have treated these patients with halo-femoral traction and bed rest followed by rigid casting [16,18,10,14,15]. Closed reduction by means of traction is not only impossible, but also carries the danger of a neurological lesion due to narrowing of the spinal canal during traction. Conservative treatment is the first choice in older patients and in those with underlying diseases or serious complications [18]. The optimum treatment for thoracolumbar fracture-dislocation lesions is decompression followed by reduction and internal fixation if the patient's condition is suitable for surgery. A major challenge in surgical management is achieving reduction and preserving the neurologic function after stabilization. In all our cases,

reduction of the fracture and dislocation was considered necessary to produce a more biomechanically stable spine, to enhance the possibility of fusion, and to prevent delayed neurologic deterioration. However, reduction entails highly significant risks, especially in neurologically uncompromised individuals with severe thoracic displacement [13].

The optimal surgical approach for decompression and stabilization is controversial. The majority of studies prefer posterior reduction, internal fixation and postero-lateral fusion [15-24]. Posterior reduction and stabilization without anterior fusion increases the risk of loss of reduction, instrumentation failure, and non-union in long-term follow-up. In addition, attempting to reconstruct the anterior and middle columns through a posterior approach entails a great risk especially in the patient who is neurologically intact. Another method that has been described includes a combined anterior–posterior approach with corpectomy, anterior intervertebral fusion, and subsequent posterior instrumentation. This technique usually involves longer operating times and has a greater risk of surgical complications. Furthermore, it commonly requires two surgical teams and longer postoperative hospital stays and higher postoperative morbidity.

Conclusion

The two case reports presented here, together with a review of the 15 other reported cases of thoracic fracture-dislocations without spinal cord injury, allow us to conclude that: in the majority of thoracic fracture-dislocations with neural sparing the patients were victims of high energy traumas (motor vehicle accidents), severe thoracic fracture-dislocations may be associated with neural sparing if the middle column is separated from the posterior column, decompression is essential before reduction thoracic spinal fracture-dislocation without neurological deficits.

Conflict of Interest

None of the authors has any potential conflict of interest.

Informed Consent

Informed consent was obtained from all individual participants in this case report

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