Management of Thoracolumbar Fracture with Posterior Decompression with Fusion and Fixation by Pedicle Screw and Rod—Our Experience

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Introduction

Sixty-four percent of spine fractures occur at the thoracolumbar (TL) junction, usually at T12–L1, and 70% of these occur without immediate neurologic injury. Denis' 3-column model of the spine attempts to identify computed tomography (CT) criteria of instability of TL spine fractures.[1] This model has generally good predictive value; however, any attempt to create "rules" of instability will have some inherent inaccuracy.[1]

The McAfee classification describes six main types of fractures.[2] A simplified system with four categories as follows: lateral and anterior most common between T6–T8 and T12–L3; lateral X-ray wedging of the vertebral body (VB) anteriorly; no loss of height of posterior VB, and no subluxation; CT spinal canal intactand disruption of the anterior end plate.[2]

Thoracolumbar injuries are the most common spinal injuries.[3] The treatment of unstable fractures and fracture dislocations of TL spine remains controversial.[4] The goal of the treatment of unstable TL injuries is to optimize neural decompression while providing stable internal fixation over the least number of spinal segments.[5] Either anterior–posterior or both approaches can be used to achieve fusion.[6] However, posterior approach is less extensive. Pedicle screw devices allow immediate stable fixation as the screws traverse all the three columns. The pedicle screws are passed one level above and one level below the fractured vertebra via posterior approach.[7]

Injuries to the thoracic and lumbar spine account for > 50% of all spinal fractures and a large portion of acute spinal cord injuries.[8] Given this frequency and the significant impact of these injuries, significant advancements have been made in the surgical treatment of TL trauma. Despite the invention and continued evolution of spinal instrumentation and surgical techniques, medical decision-making in spine trauma remains controversial. Fracture treatment can vary widely, from bracing to invasive 360-degree fusions, based on geographical, institutional, or individual preferences with little scientific basis.[8]

Several classification systems have been developed in an attempt to better define TL trauma and aid treatment decision-making. These systems are typically based on either anatomical structures (Denis 3-column system) or on proposed mechanisms of injury (Ferguson and Allen classification, and the AO system).[1,9,10]

Overall, however, there is a paucity of strong data supporting the use of any of these systems. Additionally, there is currently no clear consensus regarding the optimal system for characterizing TL fractures. An ideal system must be simple and reproducible based on commonly identified clinical and radiographic parameters. Current systems are either excessively convoluted, with an impractical number of variables, or are too simple, lacking sufficient detail to provide clinically relevant information. These limitations have yielded classification systems that are difficult to implement, have shown insufficient validity and reproducibility, and have not been widely popular.[10-13]

Materials and Methods

This study was performed in the Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. The study was undertaken during January 2010 to July 2017.

Cases were selected following the inclusion and exclusion criteria.

1. Inclusion criteria:
   - Patients of either sex admitted with incomplete lumber spine injury.
2. Exclusion criteria:
   - Those patients who were operated second time due to complication.
   - Complete injury.

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Data was collected in a form regarding clinical presentation. Clinical examination, investigating procedure, postoperative evaluation, and only those patients who gave consent were included in the study.

Surgery

All the patients underwent posterior decompression and fusion and fixation by pedicle screw and rod (►**Figs. 1**–**5**).

Results

It was evident that age group 1 to 20 years and 21 to 40 years belonged to the highest group.

It was found that the most common cause of occurrence was fall from height, 33 (73.33%).

It was evident that the most common site of compression was at the L1 vertebrae (60%), followed by D12 fracture (33.33%).

It was documented that the most common fracture type was wedge fracture, 27 (60%).

►**Table 1** showed that most of the patients had paraparesis (86.66%), the remaining 13.33% had monoparesis. The result revealed that most of the patients (86.67%) had suffered from bladder dysfunction.

It was found that 13.33% of patients had wound infection and were treated by proper antibiotics and wound dressing.

It was documented that 42 (93.33%) of the patients improved after surgery.

Fig. 1 Perioperative photograph.

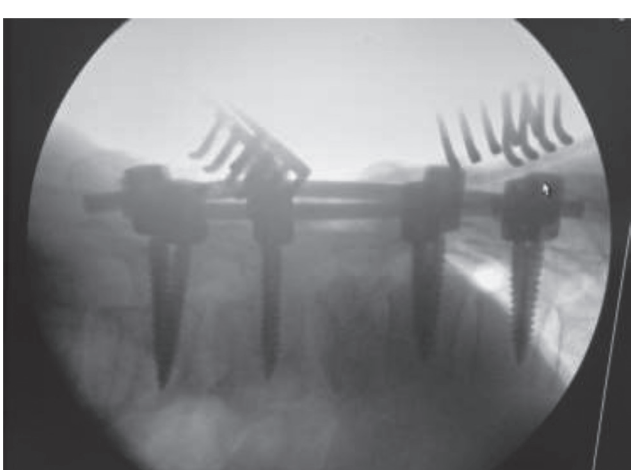

Fig. 2 Perioperative X-ray.

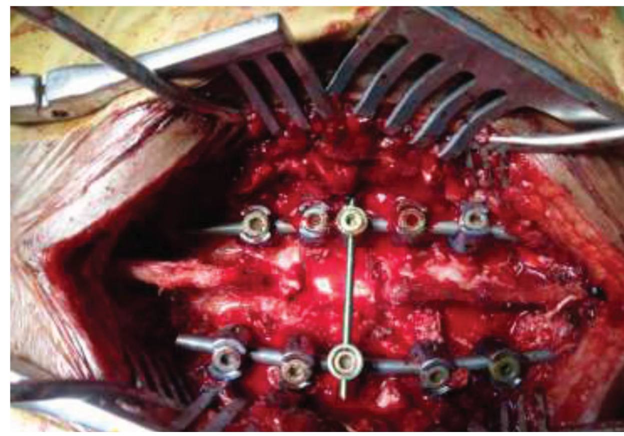

Fig. 3 Perioperative picture with cross bar.

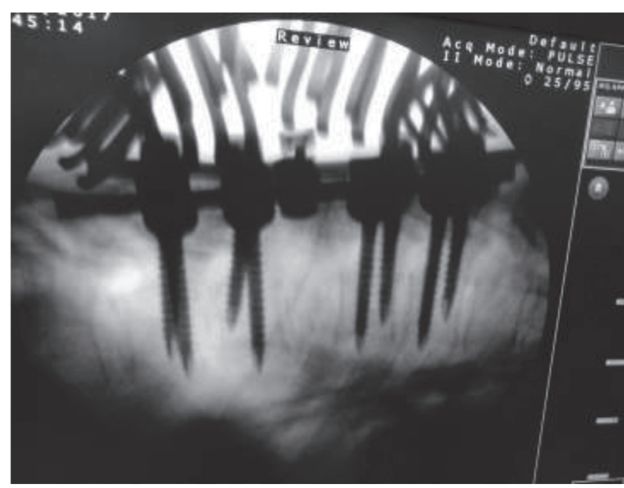

Fig. 4 Perioperative X-ray with cross bar.

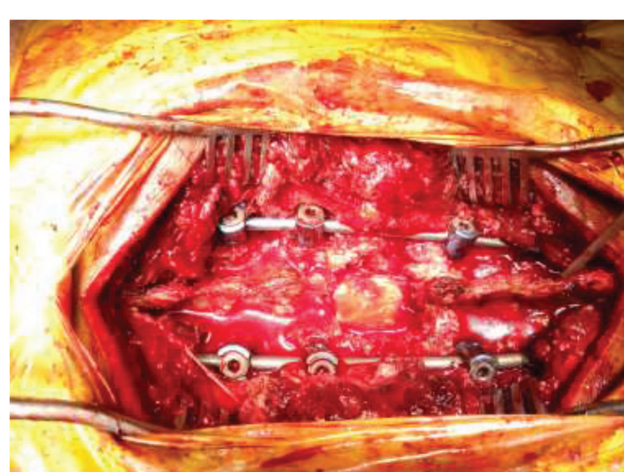

Fig. 5 Perioperative picture showing decompression and fixation.

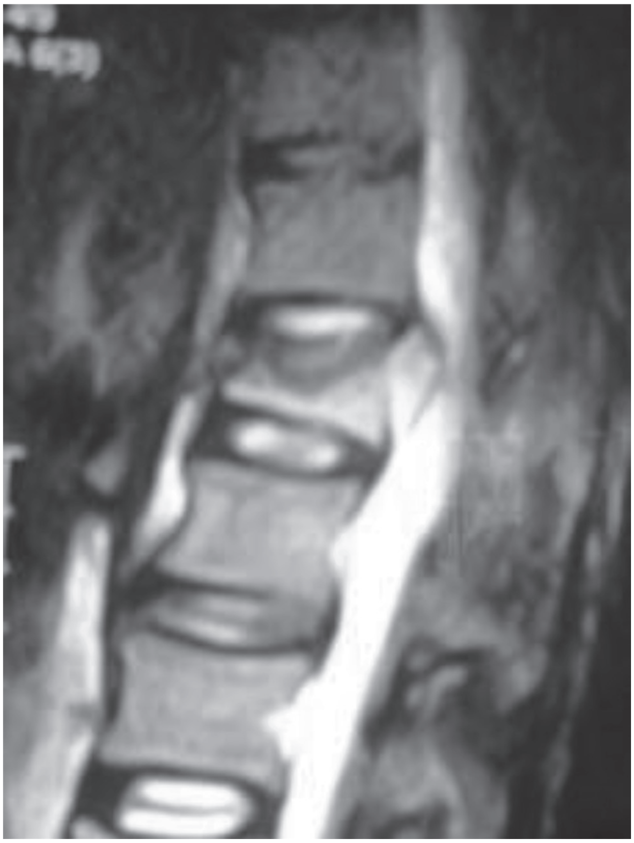

Fig. 6 L1 compression fracture.

Table 1 Distribution of patients by type of symptoms (*N* = 45)

Clinical features	Number	Percentage
Paraparesis	39	86.66
Monoparesis	6	13.33
Bladder dysfunction	39	86.66
Bladder and bowel dysfunction	9	20.0
Sexual dysfunction	6	13.33
Bowel dysfunction	6	13.33
Bladder, bowel, and sexual dysfunction	6	13.33
Autonomic function intact	3	6.67

Discussion

Exact evaluation of the pedicles is an essential prerequisite for posterior platting and the application of fixator systems. The pedicles are short conical tubes with an oval cross-section. The objective is to insert the screws through the center of the pedicles, approximately parallel to the upper end plates or angled downward. The screws should coverage toward the midline to an end plate or be angled downward. The screws should coverage toward the midline to a certain extent—up to 20% depending on the spinal level—to ensure that they do not penetrate the lateral wall of the VB. The long axis of the pedicle can be identified either by direct exposure or by image intensification. Although each method is reliable by itself, it is best to use a combination of the two. In addition, there are other aids for deciding screw position which are useful particularly when the anatomic landmarks are difficult to define due to distorted anatomic relationships.[14]

Thoracic spine: The point of entry is just below the rim of the upper facet joint, 3-mm lateral to the center of the joint near the base of the transverse process. This screw should be angled 7 to 10 degrees toward the midline and 10 to 20% caudally.[14]

Lumbar spine: At practically all levels, the long axis of the pedicle pierces the lamina at the intersection of two lines: a vertical line tangential to the border of the superior articular process, and horizontal line bisecting the transverse process. Their point of intersection lies in the angle between the superior articular process and the base of the transverse process (►**Fig. 6**). The screws should converge by 5 degree at the TL junction and by 10 to 15 degrees as one progress form L2 to L5.[14]

In any case, anteroposterior (AP) and lateral preoperative X-rays are indispensable. If there is any suggestion of anatomic variations, then CT scans are essential. They give information about pedicle diameter and direction; intraoperatively, the use of image intensification is indispensable too. It confirms the location and direction of the screw. In every difficult case, intraoperative myelography with image intensification helps to identify the medial border in relationship to the nerve root.[14]

At the lumbar spine, the inferior and inferior lateral aspect of the pedicle can be exposed by dissecting subperiosteally from the base of the transverse process anteriorly. The soft tissue with the spinal nerve and blood vessels are carefully retracted with a curved dissector. A small curved dissector is used to probe the lateral wall of the pedicle. If necessary, the inferior part of the medial wall may also be probed. In addition, osteotomy of the base of the transverse process can help to identify the pedicle. Alternatively, the spinal canal can be opened and the medial wall of the pedicle identified. The latter two techniques are usually not necessary in routine procedures. At the sacral level, it is very helpful to expose the S1 nerve root, which allows visualization of the lateral wall of the S1 canal.[14]

Alter identification of the entry point and the direction of the pedicle, the posterior cortex is perforated for approximately 5 mm using a 3.5-mm drill, preferably with the oscillating attachment. Continued drilling of the pedicle can be dangerous. A safer technique is to prepare the entry points with the pedicle awl and to open the pedicle with a pedicle feeler. This preparation is performed on the junction between the pedicle and VB. The circumference of the canal is checked with the tip of the AO depth gauge, which has an angled tip to ensure that perforation of the bone has not occurred; particularly medially. Image intensification with the gauge or a Kirschner wire in place confirms the proper position. The depth gauge may be inserted into the cancellous bone of the VB and the anterior cortex is not perforated. If there is doubt regarding the depth, take a lateral radiography and ensure that the depth gauge does not penetrate more than 80% of the AP body diameter, then the anterior cortex will not be perforated.[14]

In previous study, the average age group was 37 years (± 11.7 years), there were 18 (69%) male patients and 8 (31%) female patients. The average follow-up period was 30 months (± 13.5 months).[15] In our study, the highest age group was

21 to 40 years, that is 36 (80%) (►**Table 2**). It was evident that 35 (77.78%) were males and 10 (22.22%) were females (►**Table 3**).

In previous study, 10 patients sustained unstable burst fractures and 3 patients sustained translational injuries (fracture dislocation).[15] In our study, 27 (60%) had compressed fracture, 9 (20%) (►**Figs. 6–8**) had unstable burst fracture, and 3 (6.67%) had fracture dislocation (►**Table 4**). Thirty-three patients sustained injury from fall from height, while road traffic injury, fall of heavy object on the back, and pathological fracture (►**Fig. 9**) were the mode of injury in 6, 4, and 2 patients, respectively (►**Table 5**). Regarding the level of the injury, it was seen that L1 level was the most vulnerable level followed by D12, L2, and D6 levels (►**Table 6**).

Table 2 Distribution of patients by age (***N*** = 45)

Age in y	Number	Percentage
1–20	4	8.89
21–40	36	80.00
41–60	3	6.67
≥ 61	2	4.44
Total	45	100.00

Table 3 Distribution of patients by sex

Sex	Number	Percentage
Male	35	77.78
Female	10	22.22

Fig. 7 Preoperative X-ray of L1 fracture with retropulsed fragment.

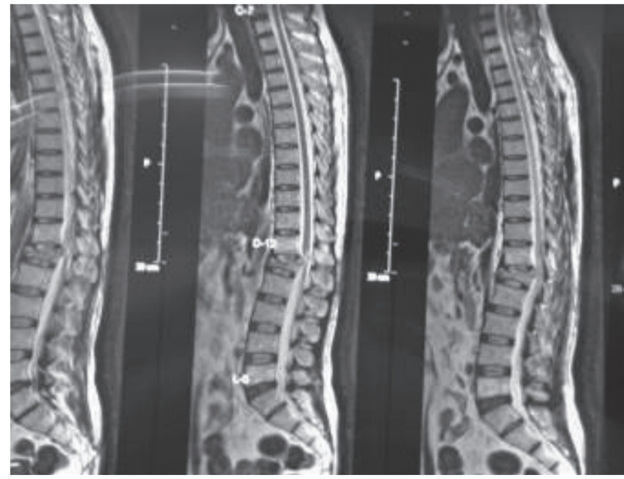

Fig. 8 Magnetic resonance imaging (MRI) of same patient.

Table 4 Distribution of patients by the types of injury (***n*** = 45)

Type	Number	Percentage
Wedge fracture	27	60.00
Burst fracture	9	20.00
Seat belt injury	6	13.33
Fracture dislocation	3	6.67

Fig. 9 Preoperative magnetic resonance imaging (MRI) of dorsal spine shows Pott's disease involving D6,7 vertebrae.

Paraparesis and bladder dysfunction were highest among the presenting symptoms. Patients also presented with monoparesis, bowel dysfunction only, both bladder and bowel dysfunction, and sexual dysfunction with 3 patients having intact autonomic function (►**Table 1**). Surgery was performed as early as possible, provided the patients were fit for surgery (►**Figs. 10–15**). In previous

Table 5 Distribution of patients by causes of compressive fracture (*N* = 45)

Causes	Number	Percentage
Fall from height	33	73.33
Road traffic accident	6	13.33
Fall of heavy object on back	4	8.89
Pathological fracture	2	4.44
Total	45	100.00

Table 6 Distribution of patients by site of compression (*N* = 45)

Site	Number	Percentage
L1	27	60.0
D12	14	31.11
L2	3	6.67
D6	1	2.22
Total	45	100.00

Fig. 10 Posterior fixation of L1 fracture with pedicle screw and rod.

Fig. 11 Lateral view of posterior fixation of L1 fracture with pedicle screw.

Fig. 12 Postoperative X-ray, AP view.

Fig. 13 Postoperative X-ray of dorsal spine lateral view.

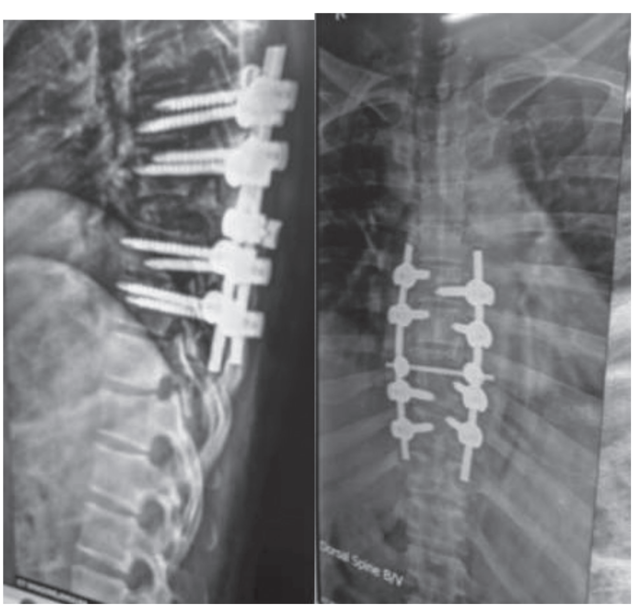

Fig. 14 Postoperative X-ray, lateral and AP view.

study, four patients experienced massive bleeding of more than 3,000 mL, and three of them sustained combined injuries, such as extremity fractures or internal organ injuries, requiring surgery and dural tube tear.[15] In our study, wound infection was seen in 6 patients. We had per-operative bleeding in 3 (3.67%) and 3 (6.67%) patients had dural tear (►**Table 7**). Among the 13 study patients, neurological improvement was observed in 12 (92%).[7] In our study,

Fig. 15 Postoperative X-ray of adjacent level fixation.

Table 7 Distribution of the patients by complication of surgery (***n*** = 45)

Complication	Number	Percentage
Wound infection	6	13.33
Per-operative bleeding	3	6.67
Respiratory distress	3	6.67

Table 8 Distribution of the patients by outcome after surgery (***n*** = 45)

Improvement	Number	Percentage
Partially improved	33	73.33
Completely improved	9	20.00
No improvement	3	6.67

clinical improvement occurred in 42 (93.33%) patients (►**Table 8**, ►**Fig. 16**).

Conclusion

Patient with incomplete spine injury showed good to excellent recovery and could be mobilized early with external support by pedicle screw fixation. So early surgery with

Fig. 16 Clinical improvement of patient after posterior fixation.

posterior decompression and fusion and fixation can improved the patients' neurological function.

Conflict of Interest

None declared.

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