Bangladesh Journal of Neuroscience 2012; Vol. 28 (2) : 102-107

Posterior Decompression with Fusion & Fixation by Pedicle Screw and Rod of Thoraco Lumbar Spine: A Study of 15 Cases

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Abstract:

Background & Objectives: *Thoraco-lumbar fracture is one of the common problems in spinal injury patients. It's early management can prevent complication after injury and can improve neurological function. The treatment plan of unstable fracture is controversial.* ***Methods:*** *The study was carried out at the department of neurosurgery, Bangabandhu Sheikh Mujib Medical University from June 2010 to July 2011 among the patients admitted with thoraco-lumbar spine fracture.* ***Results:*** *A total number of 15 patients with thoraco-lumbar spine fracture were included in the study. Among the 15 patients, 13(86.66%) were male. The highest number of patients were in age group of 1-20(40%) and 21-40(40%) years. The commonest cause of Thoraco-lumbar spine injuries were fall from height which was 8(53.33%) in number. The commonest site of injury was* L_1 *fracture in 4(60%) patients. It was documented that bladder dysfunction and lower limb weakness were the commonest sign. It was evident that, 10(66.70%) and 4(26.66%) of the patients were partially and completely improved after surgery respectively and 3(10%) of patients had wound infection.* ***Conclusion:*** *Thoraco-lumbar spine fracture with incomplete injury, early surgery can improve many of the patient's life.*

Key word: *Thoraco-lumbar, fracture, posterior decompression, fusion, fixation, pedicle screw.*

Introduction:

About 64% of spine fractures occur at the thoraco-lumbar (TL) spine , usually at T12-L1 level and 70% of these occur without immediate neurologic injury. Denis 3 column model of the spine attempts to identify CT criteria of instability of thoraco-lumbar spine fractures[1].This model has generally good predictive value, however, any attempt to create "rules" of instability will have some inherit inaccuracy[1].

The McAfee classification describes 6 main types of fractures[2]. A simplified system with four categories 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, no subluxation. CT spinal canal intact. Disruption of the anterior end plate[2].

The thoraco-lumbar injuries are the commonest spinal injuries[3]. The treatment of unstable fractures and fracture dislocations of thoraco-lumbar spine remains controversial[4]. The goal of the treatment of unstable thoraco-lumbar injuries is optimizing 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,

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significant advancements have been made in the surgical treatment of thoraco-lumbar 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° fusions, based on geographical, institutional, or individual preferences with little scientific basis[8].

A number of classification systems have been developed in an attempt to better define thoraco-lumbar trauma and aid treatment decision-making. These systems are typically based on either anatomical structures (Denis Three-Column System) or on proposed mechanisms of injury (Ferguson and Allen, and the AO system)[1,9]. 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 thoraco-lumbar 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 in-sufficient validity and reproducibility, and have not been widely popular[10-13]. The TLICS has been described and validated to address the shortcomings of the prior classification systems. The purpose of this paper is to review the TLICS system and to demonstrate its clinical application using 3 cases of thoraco-lumbar spine trauma.

Materials & Methods:

The study was carried out in the department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University, Dhaka. The study was undertaken during January 2010 to July 2012.

Cases were selected following the inclusion & exclusion criteria

1. Inclusion Criteria:

- Patients of either sex admitted with incomplete lumbar spine injury.

2. Exclusion criteria:

- Those patients who were operated second time due to complication excluded in this study.
- Complete injury.

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

Results:

Table-I

Distribution of patients by sex

Sex	Number	Percentage
Male	13	86.66
Female	2	13.33

Table-II

Distribution of patients by age (N=15)

Age in years	Number	Percentage
1-20	06	40.0
21-40	06	40.0
41-60	02	13.33
$\geq$ 61	01	6.67
Total	15	100.00

Table I showed the distributation of male and female were 86% and 13.33% respectively From Table II, it was evident that age group of 1-20 years and 21-40 years, belonged to the highest group.

Table-III

Distribution of patients by causes of compressive fracture (N=15)

Causes	Number	Percentage
Fall from height	08	53.33
Road traffic accident	04	26.67
Fall of heavy object on back	02	13.33
Pathological fracture	01	6.67
Total	15	100.00

It was found (Table III) that the commonest causes of occurrence were fall from height in 8(53.33%) cases.

Table-IV

Distribution of patients by site of compression (N=15)

Site	Number	Percentage
L_1	09	60.0
D_{12}	05	33.33
L_2	02	13.33
Total	15	100.00

It was evident that (Table IV), the commonest site of compression was at L_1 vertebrae (60%), followed by D_{12} fracture (33.33%).

Table-V

Distribution of patients by the types of injury (n=15).

Type	Number	Percentage
Wedge fracture	9	60.00
Burst fracture	3	20.00
Seat belt injury	2	13.33
Fracture dislocation	1	6.67

It was documented that (Table V), the commonest fracture type was wedge fracture 9(60%).

Table-VI

Distribution of patients by type of weakness and outcome (N=15)

Clinical features	Number	Percentage
Paraparesis	13	86.66
Monoparesis	02	13.33
Bladder dysfunction	13	86.66
Bladder & Bowel dysfunction	03	20.0
Sexual dysfunction	02	13.33
Bowel dysfunction	02	13.33
Bladder, Bowel & Sexual dysfunction	02	13.33
Autonomic Function intact	01	6.67

Table VI, showed that the most of the sufferers had paraparesis (86.66%), the remaining 13.33% had monoparesis. The result revealed that the most of the patient (86.67%) had suffered from bladder dysfunction.

Table-VII

Distribution of the patients by complication of surgery (n=15)

Complication	Number	Percentage
Wound infection	03	20.0
Per operative bleeding	01	6.67
Respiratory distress	01	6.67

It was found that (Table VII), 20% of patients had wound infection and were treated by proper antibiotics and wound dressing.

Table-VIII

Distribution of the patients by outcome after surgery (n=15)

Improvement	Number	Percentage
Partially improved	10	66.67
Completely improved	04	26.66
No improvement	01	6.67

It was documented that 13(93.34%) of the patients improved after surgery (Table VIII).

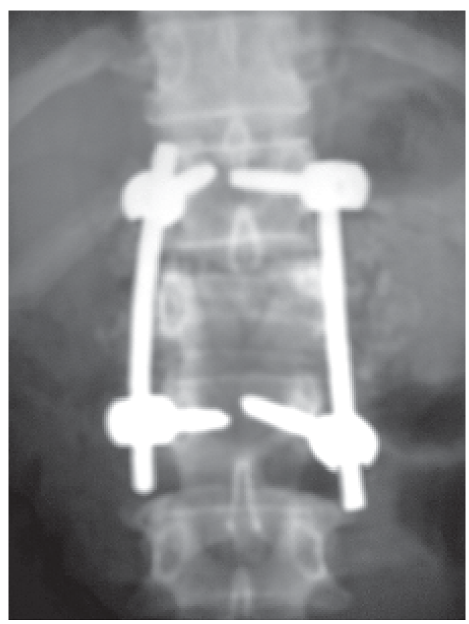

Fig.-1: *Posterior fixation of L1 fracture with pedicle screw and rod.*

Fig.-2: *L1 compression fracture*

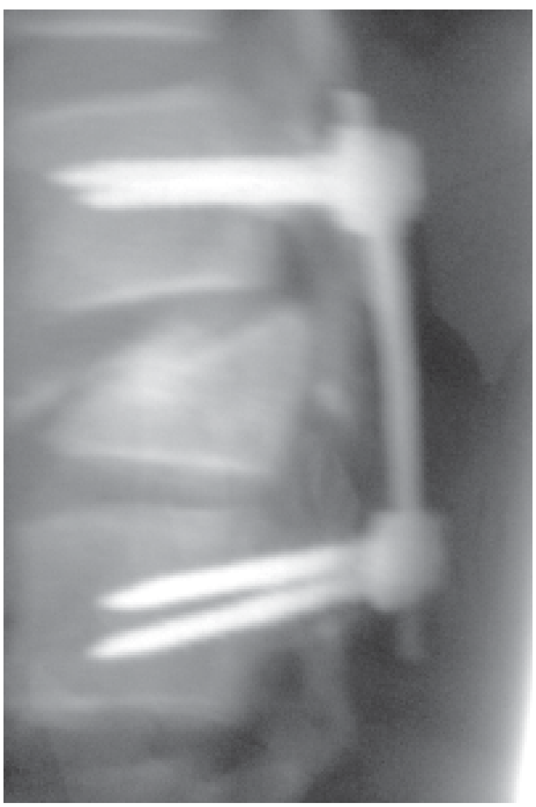

Fig.-3: *Lateral view of posterior fixation of L1 fracture with pedicle screw*

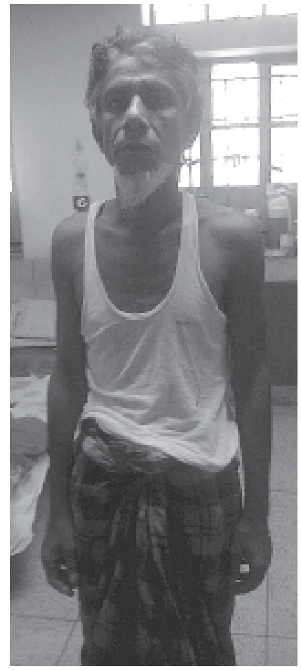

Fig.-4: *Clinical improvement of patients after posterior fixation*

Discussion:

Exact evaluation of the pedicles is an essential pre-requisite for posterior plating 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 be aimed towards the midline to an end plate or to be angled downward. The screws should have coverage towards the midline to a certain extent, up to 20% depending on the spinal level, in order to ensure that they do not penetrate the lateral wall of the vertebral body. 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].

At 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 7-10^{0} towards the midline and 10- 20% caudally[14].

At lumbar spine, practically at 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. 1). The screws should be converged by 5^{0} at the thoraco-lumbar junction and by 10-15^{0} as one progress form L2 - L5[14].

Proper placement of screws in the sacrum is difficult because of its variable anatomy. The screws may be introduced a different points and in different directions, depending upon the instrumentation and the quality of the bone. In general, the entry point is located at the intersection of two lines: a vertical line tangential to the lateral border of the S1 facet and a horizontal line tangential to the inferior border of this facet. In most cases, the screws converge towards the midline and aim towards the anterior corner of the promontory. An alternative possibility is to insert the screws more sagitally or parallel to the sacroiliac joint. The entry point shifts slightly medially as the screw direction diverges. Screws inserted parallel to the sacroiliac joint aims towards the anterior superior angle of the lateral mass of the sacrum. When positioning screws in the sacrum so as to achieve optimal purchase, it is necessary to note the density of the bone - the subchondral bone is the strongest, whereas the lateral mass of the sacrum is often very osteoporotic, some-times even hollow[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 tissues with the spinal nerve and blood vessels were 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 opened and the medial wall of the pedicle identified. The latter two techniques are usually not necessary in routine pro-cedures. At the sacral level, it is very helpful to ex-pose the S nerve root, which allows visualization of the lateral wall of the spinal canal[15].

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 per-formed to the junction between the pedicle and vertebral body. 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 vertebral body 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[16].

In previous study the average age group were 37 years (± 11.7 years), there were 9(69%) male patients and 4(31%) female patients. The average follow-up period was 30 months (± 13.5 months)[16]. In our study the highest age group were 1-20 years and 21-40 years that was 6(40%). It was evident that 13(86.66%) were male and 2(13.33%) were female. In previous study 10 patients sustained unstable burst fractures and 3 patients sustained translational injuries (fracture-dislocation)[16]. In our study 9(60%) were compressed fracture, 3(20%) (Fig. 2 and 3) were unstable burst fracture and 1(6.67%) were fracture dislocation. Surgery was performed as early as possible, provided the patients were fit for surgery. In previous 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[16]. In our study 5(33.33%) patients had dural tear.

Among the 13 study patients, neurological improvement was observed in 12 (92%)[7]. In our study (Fig. 4) clinical improvement occurs in 14(93.33%) of patients.

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

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