Surgical Management of Dorso-Lumbar Spinal Injuries with Posterior Instrumentation

Jhatoth Venkateshwarlu¹, Venkateshwar Rao T², RamKumar Reddy K³, Hanmandlu B⁴

ABSTRACT

Introduction: Thoracolumbar segment is second most commonly involved segment in the spinal cord following spinal injuries followed by cervical segment. The goal of treatment of every spinal injury is restoration of the patient to maximum possible function with disability free life. In this study, we stabilize the cases of the unstable thoracolumbar spine injuries with or without decompression and pedicular screw & rod instrumentation. We have evaluated all patients for maintenance of spinal correction and neurological improvement after posterior instrumentation in thoracic and lumbar spinal fractures and clinical outcome in terms of spinal scoring system called as Denis work and pain scale.

Materials and Methods: Twenty adult patients (13 male and 7 female) who underwent posterior instrumentation with pedicle screw and rod system for acute thoracolumbar injuries at single institution were included in this prospective study. The average age of the study group was 38 years.

Results: Fall from height was the main mode of injuries. The most common vertebrae involved in this series were between T11 - L2 to the extent up to 75%. In 75% of the patients, the fractures were reduced by using polyaxial implants and in 25% of the patients both monoaxial and polyaxial implants were used. The average regional angle during pre-operative stage was 16.50 ± 5.020 and 4.450 ± 4.150 during 1 year post-operative period. There was a significant difference between pre op and post-operative regional angles. The mean difference of vertebral height between pre and 12th postoperative week was 8.8 mms, pre and 24th postoperative week was 7.95 mm and pre and 1 year post-operative period was 7.95 mm. During 1 year post-operative period, ASIA grade A was 5%, grade B was 0%, C was 5%, D was 20% and E was 70%. Among all the subjects 20% of the patients returned to their previous work or physically challenging job and 35% were able to return to previous employment to heavy labour with some restriction. About 45% of the patients had no pain and 30% had occasional minimal pain with no need for medication at the end of one year follow up period.

Conclusion: There is restoration of vertebral body height, mean regional angle and mean anterior wedge angle with posterior instrumentation in thoracolumbar fractures. Neurological recovery was seen significantly when all cases with neurological deficits were clubbed together as per ASIA grading. Improved clinical outcome, in terms of work capacity and decrease in pain according to Denis work scale and Denis pain scale respectively.

Keywords: Thoracolumbar fractures, posterior instrumentation, pedicle screw

INTRODUCTION

The spinal traumas are common and leading problem in orthopedic practice. The individuals are at risk of high energy trauma in the modern era. [1, 2, 3] Thoraco-lumbar fractures are serious injuries of concern, if left untreated may result in marked morbidity and disability to the patient. The fractures to spine are reported to be around 6% approximately of the trauma patients, of which around 2.6% of the patients sustains spinal cord or nerve root level neurological injury. Such fractures are commonly associated with motor and sensory
disturbance, bladder and bowel disturbances, erectile dysfunction, deformities like kyphosis, scoliosis as result of neurological injury. The patients are also prone for bed sores and pulmonary infections. [4]

Thoracolumbar segment is second most commonly involved segment in the spinal cord following spinal injuries followed by cervical segment. It constitutes 30 to 60% of all spinal injuries. The trauma of thoracolumbar segment is high in thoracolumbar junction to the extent up to 60% between T12 to L2.[5] Only 15 - 20% of the fractures at thoracolumbar level are associated with neurological injury. [6] Thoracolumbar injuries classically exhibit a bimodal distribution, with peaks among males under 30 years of age and in the geriatric population. [7]

In this study, we stabilize the cases of the unstable thoracolumbar spine injuries with or without decompression and either pedicular screw and rod instrumentation. The variable screw placement system as a means of transpedicular fixation of unstable spine is a very rigid fixation system. This is achieved by entering pedicle through the “force nucleus”. The junction of the pedicle superior and inferior facets, the pages, transverse process and lamina.[8]

We have evaluated all patients for maintenance of spinal correction and neurological improvement after posterior instrumentation in thoracic and lumbar spinal fractures and clinical outcome in terms of spinal scoring system called as Denis work and pain scale.

MATERIALS AND METHODS

Patients aged 19 to 50 years that underwent pedicle screw fixation from 2009 to 2013 at our institution were the subjects of the study.

Inclusion criteria

Traumatic thoracic, lumbar or thoracolumbar fractures. Unstable fractures with or without neurological deficits. Patient with complete spinal cord injury for the purpose of stabilization.

Exclusion criteria

Patients not willing for surgery. Patients medically unfit for surgery. Traumatic cervical fracture with traumatic quadriplegia. Patient age more than 60 years.

Ethics approval

The study was approved by our institutional review board. 20 patients (13 males and 7 females) of average age 38 years were included in the study the patients were followed up for a mean of 30 months. A detailed history was obtained for evaluating the mode of trauma, ASIA grading, sensory level and to check for any spinal deformity. They were clinically and radiologically evaluated for ensuring the thoracolumbar fracture. Plain X-ray in antero-posterior and lateral views were obtained and the instability of the spine was confirmed using White and Punjabi criteria of spinal instability. Fracture classified according to AO classification.[9]

Laboratory investigations were carried out before surgery. MRI/CT[10] scan was conducted to evaluate the relationships and instability of the spine. 80% of fractures are between T11 to L2. Surgical procedure was performed in prone position, through posterior approach to spine. [11,12,13] The pedicles were identified, by identifying the point of convergence of a horizontal line along center of transverse process and vertical line along centre of superior facet. Using a rongeur cortical bone was removed around the pedicle entry point. Pilot hole is made with use of sharp Trocar with stopper. Blunt Kirschner wires were placed into the pedicle and their position was confirmed under image intensifier on both antero-posterior and lateral views. Pedicle probe was passed with rotating it over 30 degrees clockwise and antilockwise so it entered the pedicle at the region of least resistance which is the centre of the pedicle. The depth of the pedicle was confirmed with probe by the markings on it and confirming its position by passing it to 80% of its depth. Now the pedicles were tapped with 5.5mm or 6.25mm taps depending on appropriate size.

The pedicle was probed in all four quadrants with a pedicle sound to make sure that solid tube of bone exists and violation of pedicular cortex has not occurred and the screws of appropriate lengths were selected and inserted into the pedicles with help of monaxial or polyaxial inserter depending on the implant used. During insertion the positions of the screws were checked with image intensifier in both anteroposterior and lateral views. A rod contouring template is placed into the slots of the implants. The template is shaped to reflect the natural curve of spine. A under contoured rod was used to create distraction-extension assembly.

The appropriate sized rods (10mm) were selected and contoured using cam action bending instrument to match the template. The rods were held with self-locking, long rod holder and aligned and placed over the slots on the implant placed. A rod pusher straight or curved can be used to push the rod into implant slots. The rod is fixed by inserting the screw. Using angled spreader, distraction is applied by placing the prongs of spreader straddling the rod and in contact with the head of the implant. Adequate distraction is applied for correction of deformity and the screw is tightened with long hex screw.

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driver.\textsuperscript{[14,15,16]}

All the patients were followed up in OPD every 4th week after surgery for 6 months and at each follow up clinical, radiological and neurological examination was done to assess spinal stability.

At the end of 6 month of follow up the patients were evaluated clinically by using Denis work and pain scale. Evaluation of neurological status with ASIA grading and radiological assessment of deformity was done at the time of admission, 12th week, 24th week and 1 year.

\textit{Post Operative Rehabilitation}

Early mobilization is important to prevent secondary complications. The in-patients were made to move in bed, sit with a back rest. In successive reviews, the patients were made to do the following exercises with the aim of strengthening the back extensors and lower extremities, improving posture and reducing pain within the tolerable limits of individual patients:

1) Supine lying over rolled up towel to facilitate thoracic extension
2) Erect sitting on a chair with no back rest, chin retraction, scapular retraction and abdominal muscles contraction.
3) Trunk mobility in sitting by hands on shoulder, gentle rotation in both directions, and lateral flexion on either side.
4) Standing wall push-ups.
5) Briding in supine with knees bent and feet flat on the couch, lifting the pelvis and back off the couch.
6) Hip extension in prone.
7) Stepping up and down a high step, alternate legs.
8) Prone trunk extension.

\textbf{RESULTS}

\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Denis work scale} & \textbf{Frequency} & \textbf{Percent} \\
\hline
W1 & 2 & 20.0 \\
W2 & 7 & 35.0 \\
W3 & 6 & 30.0 \\
W4 & 5 & 25.0 \\
\hline
Total & 20 & 100 \\
\hline
\end{tabular}
\caption{Distribution of study group according to Denis work scale}
\end{table}

\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Denis work scale} & \textbf{Frequency} & \textbf{Percent} \\
\hline
P1 & 9 & 45.0 \\
P2 & 6 & 30.0 \\
P3 & 4 & 20.0 \\
P4 & 1 & 5.0 \\
\hline
Total & 20 & 100 \\
\hline
\end{tabular}
\caption{Distribution of study group according to Denis pain scale}
\end{table}

\begin{graph}
\centering
\includegraphics[width=\textwidth]{graph1}
\caption{Distribution of study group according to ASIA Grade}
\end{graph}

\begin{graph}
\centering
\includegraphics[width=\textwidth]{graph3}
\caption{Distribution of study group according to Denis work scale}
\end{graph}
No neurological, vascular, or visceral complications encountered in any of the 20 patients. However, one screw breakage and 2 screws misplaced, without any symptomatology. Neurological status was improved according to ASIA grade, and improved Denis pain score and Denis work scale.

**DISCUSSION**

The goal of treatment of every spinal injury is restoration of the patient to maximum possible function with disability free life. Operative intervention is intended to convey immediate stability to the spine, allow for the correction of deformities, and optimize neurologic improvement by directly or indirectly relieving any residual impingement of the neural elements.

This study used stabilization of the cases of the unstable thoracolumbar spine injuries with or without decompression and pedicular screw and rod instrumentation.

The mean age of the study group was 38 years. 13 males and 7 females, 70% of the patients had injury due to fall from height. About 55% of the patients had type A fractures, 30% had type B fractures and 15% had type C fractures in this study (AO classification).

The most common vertebrae involved in this series were between T11 - L2 to the extent up to 75%. In 75% of the patients, the fractures were reduced by using polyaxial implants and in 25% of the patients both monoaxial and polyaxial implants were used.

The average regional angle during pre-operative stage was 16.50 ± 5.020 and 4.450 ± 4.150 during 24th post-operative week. The ASIA grading for neurological state during pre-operative period, were graded 15% as grade A, 5% as grade B, 30% as C, 35% as D and 15% as grade E. During last follow up, grade A was 5%, grade B was 0%, C was 5%, D was 20% and E was 70%.

85% of the study group had shown no complications, screw break and screw misplacement were observed in 15% of the study group.

In this case series, 20% of the patients were able to return to their previous work or physically challenging job, 35% were able to return to previous employment to heavy labour with some restriction, 30% of the patients were unable to return to their previous employment but worked for full time in their new employment and 25% of the patients were unable to return to their full time work.

About 45% of the patients had no pain, 30% had occasional minimal pain with no need for medication, 20% had moderate pain with occasional need for medication and 5% had moderate to severe pain with occasional absence from work and change in activities of daily living.

**Comparision with Other Studies**

The use of posterior instrumentation without fusion following indirect reduction have been increasing in recent years. The use of pedicle screw have decreased the use of anterior approach. [17]

For manual workers, where motion segment function is required, prevent long segment fixation and fusion. Short segment posterior fixation is preferred if PLC (posterior ligament complex) is intact. Load sharing classification can be effectively used for choosing the surgical approach.

**Score**

<table>
<thead>
<tr>
<th>Score</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal collapse</td>
<td>30%</td>
<td>&gt;30%</td>
<td>60%</td>
</tr>
<tr>
<td>displacement</td>
<td>1mm</td>
<td>2mm</td>
<td>&gt;2mm</td>
</tr>
<tr>
<td>Correction</td>
<td>3 degrees</td>
<td>9 degrees</td>
<td>10 degrees</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>6</td>
<td>9</td>
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Posterior approach preferred if score equal to or less than 6; anterior approach preferred if score >6. [18]

In another literature review, if PLC is intact, anterior vertebral height loss >50%, kyphosis >25-35 degrees, posterior only approach was preferred. [19]

In a meta analysis of 220 patients, it was resulted that the fusion was not necessary when the thoracolumbar burst fracture was treated by posterior pedicle screw fixation. [20]

In a study comparing anterior versus posterior surgery, it was found that posterior surgery is as effective as anterior surgery with less complications. [21]
Figure 1: Pre-operative MRI

Figure 2: Immediate post operative x-ray

Figure 3: 6 months post-operative X-ray

Figure 4: 1 year post-operative X-ray

Figure 5: sitting at 6 months

Figure 6: SLRT at the end of 6 months
Limitations of our study
The percentages could not be calculated as the total number of patients in our study were less than 50.

CONCLUSION
There is restoration of vertebral body height, mean regional angle and mean anterior wedge angle with posterior instrumentation in thoracolumbar fractures. Neurological recovery was seen significantly when all cases with neurological deficits were clubbed together as per ASIA grading. Improved clinical outcome, in terms of work capacity and decrease in pain according to Denis work scale and Denis pain scale respectively.

CONFLICT OF INTEREST
The authors declared no conflict of interest.

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REFERENCES