Pedicle Screw Fixation In Fracture of Thoraco-lumbar Spine

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To Whom It May Concern

I do hereby declare that all references cited in the Thesis and all the records have been solely prepared by me and it has not been previously accepted for any higher degree. If someone has done the same type of study for his own purpose that is simply coincidental.

17/06/2011

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**Introduction**

The thoracolumbar injuries are the commonest spinal injuries. The treatment of unstable fractures and fracture dislocations of thoracolumbar spine remains controversial. The goal of the treatment of unstable thoracolumbar injuries is optimising neural decompression while providing stable internal fixation over the least number of spinal segments. Either anterior posterior or both approaches can be used to achieve fusion. 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. The aim of this study was to evaluate the use of pedicle screw fixation for preservation of remaining spinal cord function, restoration of spinal alignment, achievement of pain-free fracture site, early mobilization and maximization of neurological recovery in Spinal Injury Patients.
The technique of pedicle screws and plates has been routinely used to stabilize the lumbar spine since 1963. With the use of this technique, it is now possible to treat without problem lumbar instabilities, fractures in the lumbar spine, resection of tumors in the vertebral bodies including metastasis and correction of gross spondylolisthesis. To consider the technique it is important to study the salient features of the lumbar spine carefully.
Materials and Methods

Sixty Two patients with posttraumatic instability of lower thoracic or upper lumbar spine were surgically managed at the Department of Orthopaedics, Jai Hospital, Agra. All those patients who were operated for thoracolumbar junction injuries with pedicle screw fixation were included. The patients with pre-existing systemic illness or associated extra spinal injuries significant enough to result in increased morbidity or mortality were excluded from the study. A detailed history and examination was carried out especially evaluating the mode of trauma, Frankel grading (Table-1), sensory level and any spinal deformity. Plain x-rays, in anteroposterior and lateral views were done and the instability of the spine was confirmed using White and Panjabi criteria of spinal instability (Table-2). MRI/CT scan was done to further evaluate the important relationships and instability of spine. Those patients with unstable spine were then explained pros and cons of the surgical treatment. Patients willing for surgery were included in this study.
All patients underwent closed/open reduction and internal fixation by posterior approach. Laminectomy to decompress spinal cord was carried out at the involved level and bone was saved to be used as bone graft. Pedicles were localized using detailed anatomical landmarks and intraoperative image intensifier. Polyaxial screws were inserted through pedicles into vertebral bodies’ one level above and one level below fractured vertebra under fluoroscopy. The rod was coupled to polyaxial screws. Distraction of anterior elements was produced by compressing the heads of Polyaxial screws by which annulotaxis was used for reduction of spinal deformity. The rotational movement was prevented by transverse traction device.

The cortical bone was roughened using high-speed drill to make suitable for bone graft. The bone already saved while doing laminectomy was broken into small fragments free of soft tissue and was placed over roughened cortical bone. The wound was then closed in layers. The patients were kept on broad-spectrum antibiotics and analgesics for 10 days. Check x-rays were done on the next postoperative day.
Thoracolumbar support was given to the patients for initial 2 months. Aggressive physiotherapy was started to mobilize patients. The neurological status of the patients and any other complications were noted up to one-and-a-half years.

Total of 62 cases aged from 10-70 years (mean: 36 years) with Thoraco-lumbar fractures were treated by pedicle screw system. According to AO classification of Thraco-lumbar vertebrae fracture, there are 48 cases of Type A, 8 cases of Type B and 6 cases of Type C.

<table>
<thead>
<tr>
<th>Table 1: Frankel Grading for completeness of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>Complete (No sensory or motor function is preserved)</td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td>Incomplete (Sensory, but motor function is preserved below the neurological level)</td>
</tr>
<tr>
<td><strong>C</strong></td>
</tr>
<tr>
<td>Incomplete (Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle power grade of &lt;3 )</td>
</tr>
<tr>
<td><strong>D</strong></td>
</tr>
<tr>
<td>Incomplete (Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle power grade of &gt; or =3 )</td>
</tr>
<tr>
<td><strong>E</strong></td>
</tr>
<tr>
<td>Normal (Sensory and motor function is normal)</td>
</tr>
</tbody>
</table>
Table 2: White and Panjabi criteria for spinal instability (Quantitation of acute instability in sub-axial, cervical, thoracic, and lumbar injuries)

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>POINTS ASSIGNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of integrity of anterior (and middle) column</td>
<td>2</td>
</tr>
<tr>
<td>Loss of integrity of posterior column(s)</td>
<td>2</td>
</tr>
<tr>
<td>Acute resting translational deformity</td>
<td>2</td>
</tr>
<tr>
<td>Acute resting angulation deformity</td>
<td>2</td>
</tr>
<tr>
<td>Acute dynamic translation deformity exaggeration</td>
<td>2</td>
</tr>
<tr>
<td>Acute dynamic translation deformity exaggeration</td>
<td>2</td>
</tr>
<tr>
<td>Neural element injury</td>
<td>3</td>
</tr>
<tr>
<td>Acute disk narrowing at level of suspected pathology</td>
<td>1</td>
</tr>
<tr>
<td>Dangerous loading anticipated</td>
<td>1</td>
</tr>
</tbody>
</table>

A score of 5 points or more implies the presence of instability
Outcomes

There were 62 patients who were managed with pedicle screws for thoracolumbar injuries. There were 14 females and 48 males (2:7 ratio). The age range was 10 to 70 years (mean age of 36 years). McAfee’s classification of thoracolumbar injuries was used in our study. Wedge compression was the commonest in 41 patients (66%) whereas Fracture subluxation was seen in 10 patients (16%). There were 5 burst fractures (8%), 6 translational injuries (9.67%) and no distraction injuries. Two patients had an infected lacerated wound at back pre-operatively and we operated it also. This patient did well post-operatively. No patient deteriorated after surgery.

The neurological status of the patients (Frankel grading) and subsequent improvement is shown in Table-3. The Table-3 shows that the patients are progressively moving from worse grade to a better grade. Five patient in Frankel A (complete neurological deficit), who had a wedge fracture of L1 vertebra showed maximum improvement post operatively and moved to Frankel E (no neurological deficit). Overall Frankel improvement occurred in 80% cases. 1 patient in Frankel E
remained in the same grade on subsequent follow-ups. Almost complete removal of vertebral body was done to get satisfactory alignment of spine in one case. There were no patients with wound infection and implant failure. One patient developed DVT but improved with management of DVT. One patient became severely depressed and required long term antidepressants. One patient developed bedsores. No other complications of recumbency were found. All the paraplegics could mobilize with frame independently and could pass urine using crede manoeuvre.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>As Presented</strong></td>
<td>51</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>At Follow-up</strong></td>
<td>8</td>
<td>14</td>
<td>18</td>
<td>16</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 3: Frankel Grading of the patients
Patient Name: Mr. Chhunna.  
Age: 35 Yrs.  
Sex: Male.  
Hospital No: 7062/02/2011.

Address: S/o Shri Rajendra Pal Singh, Vill - Fakirpur, Ozia, Mainpuri.

Date of Admission: 18/02/2011.  
Date of Operation: 18/02/2011.  
Date of Discharge: 22/02/2011.

History: Roadside accident - 5 days back.  
Unable to Stand & Walk - after Injury  
Previously treated at Sri Ram Hospital.

O/E: Powers in Lower Limbs (R) (L)  
Hip gr.o gr.o  
Knee gr.o gr.o  
Ankle gr.o gr.o  
Planters Not elicitable Not elicitable  
Sensory level absent below L1 Level.

Investigations:  
X-ray: _________  
Blood: Hb% - 10.8 gm %  
Blood Sugar - 141 mg %  
Blood Urea - 32.92 mg %  
H.I.V. - - Ve  

Diagnosis: TRAUMATIC PARAPLEGIA CAUSE FRACTURE D12 VERTEBRA WITH BLADDER & BOWEL INVOLVEMENT.

Pre Operative M.R.I.

Management: PEDICLE SCREW FIXATION D11 & L1 LEVEL.

Post Operative X - rays
Patient Name: Mahaveer Singh Baghel  
Age: 52 Yrs.  
Sex: Male  
Hospital No: 7154/03/2011.

Address: C/o Shri Daya Prasad, 6/257 A, Prakash Nagar, Bhogipura, Sadabad.

Date Of Admission: 02/03/2011.  
Date Of Operation: 03/03/2011.  
Date Of Discharge: 06/03/2011.

History: Fall on floor on 01/03/2011.  

History of Fall on the ground 01-03-2011.  

Sensations: No Sensation below D10 Level.

Investigations:
- X-ray:  
- Blood: Hb% - 12.8 gm %  
- Blood Sugar - 104 mg %  
- Blood Urea - 36.0 mg %  
- H.I.V. - - Ve

Diagnosis: Traumatic Paraplegia Cause Fracture D11 Vertebra with Bladder & Bowel Involvement with Comminuted Fracture Shaft Femur (L).

Management: Spine Pedicle Screw Fixation D10 & D12 Level with Laminectomy D11 Level with Interlocking Nailing (L) Femur.

Pre Operative X-rays
Pre Operative M.R.I.
Post Operative X-rays
Patient Name : Kaliram.  
Age : 20 Yrs.  
Sex : Male.  
Hospital No 7265/03/2011.

Address : S/o Mr. Kedar Nath, Kalindi Bihar, Agra.

Date Of Admission : 21/03/2011.  
Date Of Operation : 21/03/2011.  
Date Of Discharge : 25/03/2011.

History : Fall from roof on 20/03/2011.  
Unable to Stand & Walk - after Injury.

Powers in Lower Limbs  
(R) gr.o gr.o  
(L) gr.o gr.o

Hip Knee Ankle

Planters: Not elicitable Not elicitable
No Sensation below D12 Level.

Investigations :  
X-ray: D-L Spine AP / Lat.-Fracture D12 & L3 Vertebra.

Blood: Hb% - 11.9 gm %  
MRI: * FRACTURE D12 & L3 VERTEBRA WITH CORD COMPRESSION.

Blood Sugar - 93.9 mg %
Blood Urea - 30.5 mg %
H.I.V. - - Ve

Diagnosis : TRAUMATIC PARAPLEGIA CAUSE FRACTURE D12 AND L3 VERTEBRA WITH BLADDER & BOWEL INVOLVEMENT.

Management : SPINE PEDICLE SCREW FIXATION D11/L1/L2/L4 FIXATION WITH LAMINECTOMY D12 & L3 LEVEL.
Patient Name: Suresh.  
Age: 24 Yrs.  
Sex: Male.  
Hospital No.: 2050/12/2010.

Address: S/o Shri Sher Singh, Vill: Aabu Aturra, Jasrana, Firozabad.

Date Of Admission: 03/12/2010.  
Date Of Operation: 03/12/2010.  
Date Of Discharge: 16/12/2010.


Investigations:
- Blood: Hb% - 11.0 gm %
- Blood Sugar - 99 mg %
- Blood Urea - 29.5 mg %
- H.I.V. - —

Diagnosis: TRAUMATIC PARAPLEGIA WITH B/B INVOLVEMENT.

Management: SPINE PEDICLE SCREW FIXATION D12 - L2 LEVEL.
Patient Name: Suryakant Dixit.  
Age: 55 Yrs.  
Sex: Male.  
Hospital No: 7937/06/2011.

Address: S/o Shri Siyaram Dixit, Agra Road, Adda Gopi Nath, Mainpuri.

Date Of Admission: 15/06/2011.  
Date Of Operation: 15/06/2011.  
Date Of Discharge: 17/06/2011.

History: Slipped on floor on 15.06.2011. Unable to Stand & after injury.

Power in Lower Limbs: 
- Hip: gr.iii  
- Knee: gr.iii  
- Ankle: gr.iii  
- Planters: Sluggish  
No Sensory deficit.

Investigations:
- Blood: Hb% - 12.6 gm %  
  Blood Sugar - 149 mg %  
  Blood Urea - 39.5 mg %
  H.I.V. - - Ve

AGRA MRI
Dated: 15.06.2011
MRI ANTERIOR WEDGE COMPRESSION FRACTURE L2 VERTEBRA WITH CORD COMPRESSION.

Diagnosis: TRAUMATIC PARAPARESIS CAUSE ANTERIOR WEDGE COMPRESSION FRACTURE L2 VERTEBRA.

Pre Operative M.R.I.

Pre Operative X-ray  
Post Operative X-rays

Management: SPINE PEDICLE SCREW FIXATION L1-L3 LEVEL.

Address: Shri Bijendra Singh, Vill: Sangpur, Sirsaganj.


History: Tractor Trolley Collapse over the body on 07.06.2011.
Unable to Stand & Walk - after Injury.

O/E: Powers in Lower Limbs
- Hip gr.iii gr.iii
- Knee gr.ii gr.ii
- Ankle gr.ii gr.ii
- Planters Not elicitable Not elicitable

Sensory level decreased below L5 Level.

Blood: Hb% - 12.8 gm %
- Blood Sugar - 107 mg %
- Blood Urea - 30.1 mg %
- H.I.V. - - Ve

Investigations:
X-ray: D-L Spine - AP / Lat.- Anterior compression Fracture D12 Vertebra.

MRI No.6
Dated: 09.06.2011
* FRACTURE D11 SPINE PROCESS & ? LAMINA WITH MARROW EDema & D11-12 DISCIJURY.
* D12 BODY COMPRESSION FRAC Ree & MILD ANTERIOR WEDGE COLLAPSE WITH MARROW EDEMA, MINIMAL LEFT PARAVERTEBRAL FLUID HEMATOMA AT D12 LEVEL.
* DIFFUSE HEMORRHAGIC & EDEMATOUS CHANGES IN LOWER DORSAL REGION OF BACK SOFT TISSUE & MUSCLES.
* FRACTURED POSTERIOR ELEMENTS OF D11 & MINIMAL D11-12 DIFFUSE DISC BULGE CAUSING MILD CANAL STENOSIS, SEVERE THECAL SAC COMPRESSION AT D11-12 LEVEL, WITHOUT CORD COMPRESSION OR CONTUSIONS/EDema.
* EARLY MILD DEGENERATIVE CHANGES IN LUMBAR SPINE.
* L4-5 DIFFUSE MILD DISC BULGE WITH MILD THECAL SAC INDENTATION & B/L FORAMINA MILD TO MODERATE STENOSIS.

Diagnosis: TRAUMATIC PARAPARESIS WITH B/B INVOLVEMENT CAUSE FRACTURE D12 VERTEBRA.

Pre Operative M.R.I.

Management: SPINE PEDICLE SCREW FIXATION D11-L1 LEVEL.

Post Operative X - rays
Patient Name: Mr. Mahaveer.  Age: 35 Yrs.  Sex: Male.  Hospital No: 7636/05/2011.

Address: S/o Mr. Param Chand, Mohalla: Ram Nagar, Pathak Wali Gali, Firozabad.

Date of Admission: 06/05/2011.  Date of Operation: 06/05/2011.  Date of Discharge: 09/05/2011.

History: Roof collapse over the body on 05/05/2011. O/E: Powers in Lower Limbs (R) gr.o  (L) gr.o
Knee (R) gr.o  (L) gr.o
Ankle (R) gr.o  (L) gr.o
Planters  Not elicitable  Not elicitable
Sensory level absent below L1 Level.

Investigations:

Blood: Hb% - 8.7 gm %
Blood Sugar - 137 mg %
Blood Urea - 33.4 mg %
H.I.V. - Ve

Diagnosis: TRAUMATIC PARAPLEGIA CAUSE FRACTURE DISLOCATION L1 VERTEBRAL WITH B/B INVOLVEMENT WITH CRUSH INJURY (R) WRIST & FOREARM WITH CHIP FRACTURE L.E. RADIUS (R) WITH FRACTURE CALCANEUM (L).

Management: SPINE PEDICLE SCREW FIXATION D12-L2 LEVEL.

Pre Operative X-rays

Pre Operative C. T. Scan & M.R.I.

Post Operative X-rays
Analysis And Discussion

The management of fractures in the thoracolumbar region is a controversial subject. Disadvantages of conservative treatment include deterioration in neurological status in 17% of the patients, progressive kyphotic deformity in 20%, persistent backache, decubitus ulcer and deep venous thrombosis. Most of these complications can be avoided by early mobilization and decreased hospital stay by early surgery. The pedicle offers a strong point of attachment of the posterior elements to the vertebral body and pedicle screw instrumentation has revolutionized spine surgery. Pedicle screw fixation is considered biomechanically superior to other stabilization constructs or parapedicular screws and are exceptionally rigid.

It has rapidly become one of the most popular strategies for achieving solid fusion. So instrumentation with pedicle screws is a commonly used procedure for correcting deformity and stabilizing the spine until bony fusion occurs. These instrumentation systems may be divided into those using rods and those using plates. Now-a-days, pedicle screw system using rods is more acceptable
and it provides better stability than other implants. Operative stabilization consists of segmental distraction with pedicle screw fixation one level above and one level below the injured segment. By applying distraction, annulotaxis is exploited to aid in reduction of retro-pulsed bone and disc fragments. Similarly, pedicle screws have been shown to be superior to hooks and Hartshell fixation in spine.

Intra-operative rod contouring using a French bender reduces the fatigue life of spinal constructs. Tapping may decrease the pullout resistance of screws in osteoporotic spine but not in normal spine. We utilized rod contouring and tapping for screw placement in all our cases. Bony fusion was achieved in 56/62 (90%) of our cases whereas Sasso30 has reported a 95.6% arthodesis rate with dynamic compression plates and pedicle screws in 23 patients. Sengupta et al showed similar fusion rates with iliac crest or local bone in a single level fusion but less morbidity in case of local bone. We also used autogenous local bone as graft in all cases. Zeiller SC et al utilized intraoperative neurophysiological monitoring in addition to anatomical landmarks and intraoperative imaging.
including neuronavigation. Vougioukas VI et al suggested that the computer-aided navigation may be beneficial but does not appear to be mandatory. We localized the pedicles using detailed anatomical landmarks and use of intraoperative fluoroscopy. None of our patient required re-exploration for correction of screws. Yilmaz C et al utilized percutaneous methyl methacrylate injection around a loosened screw but it was not required in our cases. Powers CJ et al found a screw breaching the spinal canal in one out of 287 percutaneously placed pedicle screws but none of our screws breached the spinal canal. Knop C et al also found 139 out of 2264 screws (6.1%) to be misplaced with open technique but only 0.6% required revision. White reported a 23% screw fractures in a series of 76 patients.

In our series, no misplacement or breakage of screws occurred. Olumide showed 0.4, 1.09 and 0.66 Frankel grade improvements with anterior, posterior and anteroposterior approaches respectively. Nadeem M et al showed 0.9 Frankel improvement with one year follow-up while in our study the average improvement was 1.11 Frankel grade with similar one year follow-up. It is
important to note that Olumide did not study paraplegic (Frankel A) patients whereas in our series, 51 out of 62 patients (82.2%) were in Frankel A. Three patients were neurologically intact (Frankel E) preoperatively as well as on follow ups and were excluded while calculating improvement as by Olumide. Shafiq6 did not show the neurological improvement whereas significant neurological improvement was shown in our series. Two to six percent incidence of postoperative wound infection has been reported. In our series, no infection occurred. It was recommended by Sasso that infection can be managed without the removal of hardware. No life-threatening complication occurred in our series. Shafiq6 as well as Olumide used external orthosis for three months. It was used for two months only in our cases because the fixation was strong enough to bear axial loading without external bracing.
Conclusions and Recommendations

Thoracolumbar injury is a common neurosurgical problem in road traffic accidents and fall from height. Surgical treatment is a better option for early ambulation and faster recovery. Pedicle screw fixation is a useful choice, which achieves reduction and stability in both anterior and posterior column injuries, does not require anterior decompression and does not affect extra motion segments.

The vertebral pedicle screw internal fixation was technologically applicable, which can efficiently reposition and stabilize the fractured vertebrae, indirectly decompress spinal canal, maintain spine stability, scatter stress of screw system, reduce the risk of loosening or breakage of screw and loss of vertebral height, and prevent the formation of posterior convex after operation.

An early/immediate surgery in the form of pedicle screw fixation with decompression provides better relief in neurological recovery also.
References


dorsal et lombbaire. Techniques Chirurgicales, 1982; 44; 78-6


