

# Functional Outcome of Transpedicular Screw Fixation in patients with unstable Thoracolumbar Spine Injury

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## ABSTRACT

**Background:** Thoracolumbar spine fractures are usually caused by motor vehicle accidents but in our country they usually occur after fall from height. Fractures of spine are serious injuries and young peoples are the most common victims at the peak of their productive working age. Spine injuries are leading cause of morbidity. Different methods and instrumentation systems are used for stabilization of thoracolumbar spine fractures which includes anterior stabilization and posterior stabilization with transpedicular screws.

**Aim:** To assess the functional out come of transpedicular screw fixation in thoracolumbar spine fractures regarding improvement in pain control, in neurology and complications.

**Study design:** Quasi experimental study.

**Settings:** The study was carried out in the Department of Orthopaedics Ghurki Trust Teaching Hospital Lahore.

**Duration:** The duration of study was 1 year from 10-02-2007 to 09-02-2008.

**Methods:** The study was based on 40 patients of either sex from 20-50 years age with post traumatic unstable thoracolumbar spine fractures. Pre-operative assessment of pain and neurology was done and recorded. The functional out come in terms of pain control and improvement in neurology was assessed and recorded at 1<sup>st</sup> month and 3<sup>rd</sup> month follow up in OPD.

**Results:** Functional outcome was much better in terms of pain relief and partial neurology had a potential for recovery.

**Conclusion:** Transpedicular screw fixation in thoracolumbar spine fractures gives best results in terms of pain control and spine injury with partial neurological injury has a potential for neurological recovery.

**Keywords:** Spine injuries. Thoracolumbar injuries. Spine instability. Transpedicular instrumentation.

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## INTRODUCTION

The incidence of spine injury is on rise in the developing countries<sup>1</sup>. Fractures and dislocation of the spine are serious injuries that occur most commonly in young people and the most common causes of spine trauma are motor vehicle accidents, falls and gunshot injuries<sup>2</sup>.

There are different classifications of the Thoraco-lumbar spine injuries but the most popular is Denis classification based on three column theory<sup>3</sup>. Involvement of two or more columns makes the fracture unstable. Denis classifies these injuries into six different types<sup>2</sup>.

Neurological injuries in thoracolumbar fractures result from two basic mechanisms i.e., compression and distraction<sup>4</sup>. The gross functional assessment of the patients with spinal cord injury is made by Frankel Classification and ASIA Impairment Scale<sup>5</sup>. Radiographic evaluation of the patient starts with the Anteroposterior and Lateral radiographs of

thoracolumbar spine, because of the prevalence of associated spinal injuries at other areas, similar two views of cervical spine should be done. Computed tomography scanning is done to evaluate the fracture pattern and degree of canal compromise. Magnetic resonance imaging is performed in case of neurological deficiency<sup>5</sup>. The treatment of the unstable fractures and fracture dislocation of thoracolumbar spine has controversies<sup>2</sup>. Numerous internal devices for fixation of the thoracolumbar spine are available including anterior plates and screws, posterior instrumentation by Harrington and Luque instrumentation systems and posterior transpedicular screw systems<sup>2</sup>.

All the unstable spinal fractures need to be stabilized by internal fixation for achieving early stability, immediate pain control and better nursing care<sup>6</sup>.

The goal of treatment of unstable spine is an attempt to restore a normal, pain free, static & protective function of the spine<sup>7</sup>. Pedicle screw fixation provides a three column fixation to spinal column as the screws go well in to body of the vertebrae<sup>8</sup>.

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The role of transpedicular screw fixation in spine injuries has been studied in many parts of world but in Pakistan minimum data is available. So there was a need to collect the data regarding transpedicular screw fixation in spine injuries in terms of safety of procedure, pain control and neurological improvement.

The objective of this study was to determine the functional out come of transpedicular screw fixation in unstable thoracolumbar spine fractures regarding Improvement in neurology, control of pain and observation of complications of transpedicular screw fixation. Where unstable spine injury means unusual movements can take place between vertebrae, making the spinal cord at risk of injury or causes pain and deformity under physiological loads and fails to maintain relationship between the vertebrae. Usually the spine becomes unstable when the fracture involves two or more columns diagnosed on the basis of radiographs and C.T. scan of the vertebral column. In the study, the outcomes was measured by neurological recovery of the individual depending on Frankel scale, pain control after fixation on Denis pain scale and to look for any complication of the procedure like dural leak, nerve root damage, worsening of neurology, implant malposition, fracture of the pedicle during screw insertion and implant failure

This experimental study was designed to test the hypothesis that in spine fractures, the transpedicular screw fixation with contoured rods using a stiff construct provides a three column stable fixation. Stable fixation of spine leads to early mobilization and better pain control in patients of spine injury and provides an environment for healing of damaged spinal cord.

## MATREIALS AND METHODS

This Quasi experimental study was done for a period of one year at Department of Orthopaedic and Spinal surgery, Ghurki Trust Teaching Hospital, Lahore Medical & Dental College, Lahore.

Forty cases of unstable thoraco-lumbar spine injury reporting with in a week after injury was collected using purposive (nonprobability) sampling. 20 to 50 years aged patients of both gender with post-traumatic unstable thoraco-lumbar spine fractures and fracture dislocations and fractures with more than 50% of vertebral height loss were included. Open fractures, pathological thoraco-lumbar fractures, unconscious patients and patients with pressure sores and marked osteoporosis were excluded.

Patients were diagnosed on radiographs and C.T.scan of the spine. The purpose, procedure, risks

and benefits were explained before taking written informed consent. Demographic information like name, age and gender were recorded. History revealing the mode and duration of injury was taken. Patient's examination for assessment of neurology and pain characterization and grading was done. Investigations like X-rays and C.T.scan was carried out to confirm the level of injury. All the patients were immobilized by spine immobilizers and the patient was moved as single piece.

The patient were shifted to the operation theater after thorough resuscitation and surgery was performed under general anesthesia. The major steps in surgery included: Patient's position prone. Midline posterior skin incision. Dissection of tissues for exposure of the vertebral column. Identification of the fractured vertebra. Transpedicular screw fixation under image intensifier, usually one level above and one below the fracture site. Closure of the wound. External support in the form of Boston Brace was given for added support.

The collected data was transferred and analyzed using SPSS version 11. The variables to be analyzed included demographic information, improvement in neurology by Frankel classification and control of the pain by Denis pain scale. The variables were analyzed using simple descriptive statistics using mean and standard deviations for quantitative data like age, frequency percentage of qualitative data like gender, recovery in neurology, control of pain and complications like CSF leakage, nerve root damage, implant mal-position and wound infection.

The pre-operative findings of neurology on Frankel Scale and pain on Denis Scale were compared with the post operative findings and frequency of distribution table was made. Using the Chi-square test, pre-operative and post operative findings were analyzed as these variables are qualitative in nature. The P value  $\leq 0.05$  was taken as significant.

## RESULTS

The study was conducted in Orthopaedics Department of Ghurki Trust Teaching Hospital Lahore on 40 patients during one year (February 2007 – February 2008). The mean age of the patients was 34 (Mean $\pm$ SD 34.3 $\pm$ 7.37) years (Table1).

The study was conducted on either sex. Out of 40 patients 29(73%) were male patients and 11(27%) were female patients. The male to female ratio was 2.64: 1 (Table 2).

Two different types of transpedicular implants, Moss Miami System and Fixateur Internae were used. Moss Miami System was used in 23 (58%)

while Fixateur Internae was used in 17 (42%) patients (Table 3).

Regarding the mode of trauma, fall from height was commonest mode of spine trauma 22 (55%) out of 40 patients, while 10 (25%) presented with history of injury after road traffic accidents and 8 (20%) suffered spine injury from other modes like fall of heavy object, slip while carrying heavy load (Table 4).

The most common level of injury was 1<sup>st</sup> lumbar vertebra (L<sub>1</sub>) in 12(30%) patients, followed by 12<sup>th</sup> thoracic vertebra (T<sub>12</sub>) in 9(23%) then 2<sup>nd</sup> lumbar vertebra (L<sub>2</sub>) in 6(15%) patients. The distribution of vertebral fracture level is shown in (Table 5).

In terms of neurological involvement on Frankel Classification, 24(60%) patients out of total 40 patients presented with complete neurological injury below the level of spinal fracture i.e., no motor or sensory function was preserved below the level of injury Frankel A, 6(15%) patients were in Frankel B i.e. they have no motor function but have preserved sensory function below the level of injury, 3(7.5%) patients were in Frankel C i.e., some motor function was present but not useful, 2(5%) patients presented at Frankel D i.e., motor function was present but some what weak and 5(12.5%) patients presented at Frankel E i.e., have intact sensory and motor functions (Table 6).

Regarding pain on Denis Pain Scale, 18(45%) patients out of 40 patients presented in Denis P-5 i.e., had constant pain, 12(30%) patients were Denis P-4 i.e., had moderate to severe pain, 8(20%) patients were at Denis P-3 i.e., had moderate pain and 2 (5%) patients were at Denis P-2 i.e., they had minimal pain (Table-7).

After operation, in our study none of the patients deteriorated in neurology on Frankel Classification, post operatively and on follow up at 1 & 3 months (Table 8-9-10).

While 24(60%) patients out of total 40 patients presented with complete neurological injury below the level of spinal fracture i.e. Frankel A, 4 improved to Frankel B leaving 20 in Frankel A group in post operative period, 8 more patients improved at 1 month follow up and at 3 month follow up there were only 8 (20%) patients at Frankel A (Table 8-9-10).

Similarly there were 6 (15%) patients at Frankel B pre operatively which on post operative period increased to 10 (25%) patients and there were 17 (42.5%) patients at Frankel B after 1 & 3 month follow up (Table 8-9-10).

3 (7.5%) patients in Frankel C pre-operatively increased to 4 (10%) patients after 1<sup>st</sup> month and at 3<sup>rd</sup> month there were 8 (20%) patients at Frankel C (Table 8-9-10).

Regarding the pain control, Denis Pain Scale shows marked improvements i.e. there was no

patient at P-1 pre operatively but after 1 month there were 20 (50%) patients at P-1. Patients further increased to 28(70%) after 3 months (Table 11-12-13).

There were 2 (5%) out of 40 patients at Denis P-2 i.e., minimal pain pre operatively which increased to 12(30%) at post operative period, 13(32%) after 1 month leaving 8(20%) patients after 3 months.

There were 8 (20%) out of 40 patients at Denis P-3 pre operatively which increased to 10 post-operatively. There were only 4(10%) patients left in this group after 1 month which further reduced to 2 (5%) patients at 3 months. There were 12(30%) patients were at P-4 pre operatively which were reduced to 2(5%) at 3<sup>rd</sup> month and there were 18(45%) patients were at P5 pre operatively and none was at 3<sup>rd</sup> month (Table 11-12-13).

During operation 02(5%) patients had pedicle breakage & procedure was carried by involving one level above. Post operatively 2(5%) patients developed infection which settled down by wound debridement & antibiotics. Despite fluoroscopically assisted pedicle screw fixation 4(10%) patients had mal- position of screws.

Table 1: Age distribution of patients (n=40)

Age in Years	Frequency	%age
20-30	11	27.0
31-40	19	48.0
41-50	10	25.0

Age range = 20 to 50 years Mean±SD = 34.30±7.37

Table 2: Sex distribution of patients (n=40)

Gender	Frequency	%age
Male	29	73.0
Female	11	27.0

Male to female ratio: = 2.64:1

Table 3: Types of implants used in study (n=40)

Type of Implants	Frequency	%age
Moss Miami	23	58.0
Fixator Internae	17	42.0

Table 4: Mode of trauma of patients (n=40)

Trauma Mode	Frequency	%age
Fall from height	22	55.0
Road Traffic Accident	10	25.0
Others	8	20.0

Table 5: Level of injury of patients (n=40)

Injury Level	Frequency	%age
9 <sup>th</sup> Thoracic vertebra	1	2.5
10 <sup>th</sup> Thoracic vertebra	1	2.5
11 <sup>th</sup> Thoracic vertebra	4	10.0
12 <sup>th</sup> Thoracic vertebra	9	23.0
1 <sup>st</sup> Lumbar vertebra	12	30.0
2 <sup>nd</sup> Lumbar vertebra	6	15.0
3 <sup>rd</sup> Lumbar vertebra	4	10.0
4 <sup>th</sup> Lumbar vertebra	3	7.0

Table 6: Preop Frankel Classification of neurological injury

Frankel Classification	Preoperative
Complete ( A )	24 (60%)
Sensory only ( B )	6 (15%)
Motor useless ( C )	3 (7.5%)
Motor useful ( D )	2 (5%)
Intact ( E )	5 (12.5%)

Table 7: Preoperative Denis pain scale

Denis pain scale	Preoperative
P1	0
P2	2 (5.0%)
P3	8 (20.0%)
P4	12 (30.0%)
P5	18 (45.0%)

Table 8: Comparison of preoperative and postoperative Frankel Classification of neurological injury

Frankel Classification	Preop	Postop	Chi-square	P value
Complete (A)	24(60%)	20 (50%)	0.00	>0.05
Sensory only (B)	6(15%)	10 (25%)	1.00	>0.05
Motor useless(C)	3(7.5%)	3 (7.5%)	1.00	>0.05
Motor useful (D)	2(5%)	2 (5%)	0.00	>0.05
Intact E)	5(12.5%)	5 (13%)	0.00	>0.05

Table 9: Comparison of preoperative and after 1 month of Frankel Classification for neurological improvement

Frankel Classification	Preop	After 1 month	Chi-square	P value
Complete (A)	24(60%)	12 (30%)	4.10	<0.05
Sensory only (B)	6(15%)	17 (42.5%)	5.26	<0.05
Motor useless (C)	3(7%)	4 (10%)	0.14	>0.05
Motor useful (D)	2(5%)	2 (5%)	0.20	>0.05
Intact (E)	5(13%)	5 (12.5%)	0.33	>0.05

Table 10: Comparison of preoperative and 3 months of Frankel Classification for neurological improvement

Frankel Classification	Preoperative	After 3 months	Chi-square	P value
Complete (A)	24 (60.0%)	8 (20.0%)	8.00	<0.005
Sensory only (B)	6 (15.0%)	17 (42.5%)	5.26	<0.05
Motor useless (C)	3 (7.0%)	8 (20.0%)	2.72	<0.05
Motor useful (D)	2 (5.0%)	2 (5.0%)	0.00	>0.05
Intact (E)	5 (13.0%)	5 (12.5%)	0.00	>0.05

Table 11: Comparison of preoperative and postoperative Denis pain scale

Denis pain scale	Preoperative	Postoperative	Chi-square	P value
P1	0	0	0	0
P2	2 (5%)	12 (30%)	7.14	<0.05
P3	8 (20%)	10 (25%)	0.22	>0.05
P4	12 (30%)	16 (40%)	0.57	>0.05
P5	18 (45%)	2 (5%)	12.80	<0.05

Table 12: Comparison of preoperative and after 1 month Denis pain scale at Follow-up

Denis pain scale	Preoperative	After 1 month	Chi-square	P value
P1	0	20 (50.0%)	-	-
P2	2 (5.0%)	13 (32.5%)	8.06	<0.05
P3	8 (20.0%)	4 (10.0%)	1.33	>0.05
P4	12 (30.0%)	3 (7.5%)	5.40	<0.05
P5	18 (45.0%)	0	-	-

Table 13: Comparison of preoperative and after 3 months Denis pain scale at Follow-up

Denis pain scale	Preoperative	After 3 months	Chi-square	P value
P1	0	28 (70.0%)	-	-
P2	2 (5.0%)	8 (20.0%)	3.60	<0.05
P3	8 (20.0%)	2 (5.0%)	3.60	<0.05
P4	12 (30.0%)	2 (5.0%)	7.14	<0.005
P5	18 (45.0%)	0	-	-

## DISCUSSION

Traumatic spinal fractures with or without associated neurological injury is a leading cause of morbidity and mortality<sup>1</sup>. Patients who survive the original trauma have high residual morbidity, when they have spinal cord injury. Patients may have paraparesis, paraplegia, bowel or urinary incontinence and chronic pain. Spinal cord injury has devastating effect on one's life.

Every spine surgeon has to answer three fundamental questions, when facing a thoracolumbar spine fracture. First, how to treat the patient operative or non-operative? Second, if operative then how many segments should be fused, short versus long segment fusion? Third, which approach is most appropriate i.e. anterior, posterior or combined?<sup>9</sup>

The answer to these questions begins with complete evaluation of patient by comprehensive clinical examination and radiological assessment.

The radiological assessment by plain radiographs AP& lateral views of spine demonstrates the loss of vertebral height, kyphotic angle and increase in interpedicular distance. Detailed thin sliced axial CT scans together with radiographs of fracture site allow the spine surgeon to decide the extent and severity of bony injuries of vertebral column. MRI is recommended in patients with neurological injuries to determine the extent of spinal cord injuries. These three imaging modalities provide the informations about the geometry of fracture and the status of spinal cord<sup>10</sup>.

It has to be decided whether the trauma sustained has destabilized the spine to a point where the spine no longer can maintain its stability under physiological loads.

The aim of treatment is to restore the function by creating a healing environment to allow a stable pain free spinal column with minimal risk to patient. The optimum management of unstable spine fractures remains controversial, bracing, recumbency, surgery with different approaches all have been advocated.

The mechanically unstable spine needs surgery. In severely injured patients early intervention, within 72 hours results in fewer complications and shorter duration of hospital stay.

There is controversy regarding the timing of surgery but in the presence of progressive neurological deficit, emergency decompression and stabilization is indicated.

Once the decision of surgery has been made, choice of approach is made among anterior, posterior or combined. The posterior approach is easier because it can be performed rapidly without the

assistance of general or thoracic surgeon and the complications associated with thoracotomy<sup>11</sup>.

However, posterior approach has limitations such as the reduction relies on intact posterior longitudinal ligament and the intervention should be early to achieve the optimum results.

In this study most of the patients were male which is comparable with other studies<sup>12</sup>. The difference between the incidences of spine injury in genders is most likely that most of women do not go out to work and remain indoors.

This study shows the most common mechanism of injury, fall from height similar data is in study from Pakistan<sup>13</sup>. In western countries road traffic accidents are the most common mechanism of injury<sup>14</sup>. The reason can be better safety measures taken while working at height.

The most common fractured vertebra in this study is first lumbar vertebra and Sen D. study in India also shows it the most commonly fractured vertebra<sup>15</sup>. The reason is a transition zone of thoracolumbar junction between rigid thoracic spine and flexible lumbar spine.

Verloan JJ et al shows pain control after surgical management. In this study there was significant control of pain after surgical intervention<sup>6</sup>.

In this study 2(5%) patients developed infection due to post operative hematoma formation which settled down with wound debridement and antibiotics, which is comparable with study in Pakistan<sup>13</sup>.

Although in this study there is significant pain control due to better stabilization of spine fracture but improvement in neurology is not as significant, the reason can be shorter duration of study. The patients were followed for only for three months.

Similarly, there is 10% rate of implant malposition despite the use of image intensifier during the procedure which is comparable with other international studies<sup>16</sup>. The reason may be human error in judging the position of the pedicle during the procedure.

In this study there is no implant failure this can be due to extra protection given to all patients in the form external brace after surgery or this can be shorter duration of study.

As the results obtained in this study are comparable with world literature, we can safely say that transpedicular screw fixation in thoracolumbar spine fractures is the treatment of choice to control pain after thoracolumbar spine fractures for better nursing care and early ambulation. In terms of improvement in neurology the Frankel grade also improves significantly on follow up.

## CONCLUSIONS

1. Surgical approach in thoraco-lumbar spine fractures with neurological impairment is better than conservative approach.
2. Transpedicular screw fixation in thoracolumbar spine fractures is a safe procedure.
3. Transpedicular screw fixation in thoracolumbar spine fractures provides immediate stability and allows early mobilization.
4. Surgical management of thoracolumbar spine fractures provides better pain control and neurological improvement subsequently.

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