Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i8.7375

MANAGEMENT AND OUTCOME OF SHORT SEGMENT TRANSPEDICULAR SCREW FIXATION AT JPMC KARACHI

Dr Pirah Korai[1], Dr Sajid Hussain[2*], Dr Muhammad Ali Jamali[3], Dr Muhammad Salah Jamali[4], Dr Usamah Bin Waheed[5], Dr Waqas Mughis[6], Dr Um E Rubab Sandano[7], Dr Veengus Baloch[8]

[1]MBBS, FCPS Neurosurgery, Consultant Neurosurgeon, Chandka Medical College Hospital, Larkana, Pakistan
[2*]MBBS, FCPS Orthopaedic surgery, Consultant Orthopaedic Surgeon, Chandka Medical College Hospital, Larkana, Pakistan
[3]FCPS Neurosurgery, Assistant Professor People's University of Medical and Health Sciences, Pakistan
[4]MBBS.FCPS Neurosurgery, Senior Registrar, Shaheed Mohtarma Benazir Bhutto Medical College, Karachi, Pakistan
[5]Senior Registrar Neurosurgery, Liaquat College of Medicine and Dentistry, Karachi
[6]MBBS FCPS Neurosurgery, Senior Registrar Neurosurgery, Jinnah Medical and Dental College, Karachi, Pakistan
[7]FCPS General Surgery, Lecturer, Bibi Aseefa Dental College, Larkana, Pakistan
[8]MBBS, Medical Officer, Chandka Medical College Hospital, Larkana, Pakistan

***Corresponding author:** Dr Sajid Hussain
*Email: sajidgaad@gmail.com

ABSTRACT

Objective: To evaluate the management and outcome of lower thoracic and upper lumbar fractures and Spondylolisthesis with short segment transpedicular screw fixation at JPMC Karachi.

Methods: This was a prospective type of study, conducted from April 2023 to March 2024 in Department of Neurosurgery, Jinnah Postgraduate Medical Centre Karachi. All patients admitted with thoracolumbar fractures and went under fixation with short arm transpedicular screw in that period were included and analysed.

Results: In this prospective study of 54 patients (63% males, 37% females; mean age 33.22 years), vertebral fractures were primarily caused by falls from height (44.4%) and road traffic accidents (29.6%). Most patients (70.4%) had fracture-only injuries, predominantly at the thoracolumbar junction (T12-L2) and presented with wedge compression fractures (48.0%) or burst fractures (20.0%). Postoperatively, 59.3% of patients were pain-free, with 60.0% achieving ASIA Grade E neurological status. Physiotherapy was undertaken by 52.4% of patients, with 15.8% returning to their previous job post-surgery. Overall, 7.4% of patients expired. The study findings were statistically significant ($p < 0.05$).

Conclusion: Short arm Transpedicle Screw fixation has modified the management and outcome of lower thoracic and lumbar fractures with spondylolisthesis. It has improved neurologic status and quality of life of patients.

Keywords: Short-segment, fixation, pedicle screw instrumentation, thoracolumbar fracture.

Introduction

Vertebral column injuries and spontaneous spondylolisthesis represent significant sources of morbidity in spine wards, necessitating meticulous management strategies [1]. Within the spectrum of treatment options, clinicians must navigate between nonoperative and operative modalities, tailoring interventions based on injury severity and associated complications [2]. While stable one-column fractures often find resolution through nonoperative measures, such as Thoracolumbosacral Orthosis (TLSO) corset application and strict bedrest, more complex injuries involving two or three columns, significant kyphosis, neurological deficits, or spondylolisthesis of Meyer's Grade two or greater warrant surgical consideration [3,4].

The fixation of spinal fractures encompasses various approaches, including anterior, posterior posteriolateral, and combined techniques [5]. Among these, the posterior approach employing transpedicular fixation has emerged as a preferred method in many centers due to its safety profile and ability to achieve reduction stability while facilitating early mobilization and minimizing morbidity [6,7]. Particularly, transpedicular fixation with short-segment constructs has gained prominence owing to its reduced invasiveness, limited segmental fixation, shorter hospital stays, expedited recovery periods, and decreased incidence of surgical complications [8].

The management of thoracolumbar spine fractures and spondylolisthesis represents a multifaceted endeavor, necessitating a nuanced understanding of injury characteristics and tailored treatment approaches [9, 10]. In the context of this prospective study, we sought to evaluate the efficacy of short segment transpedicular screw fixation and posterior fixations in addressing the complexities of unstable lower thoracic and upper lumbar fractures and spondylolisthesis.

Our investigation involved a comprehensive analysis of preoperative and postoperative parameters, including Cobb's angle measurements, anterior and posterior vertebral body heights, neurological recovery indices, levels of pain relief, and enhancements in quality of life. By scrutinizing these outcomes, our study endeavors to shed light on the effectiveness of transpedicular screw fixation techniques in correcting kyphosis, maintaining correction, and averting fixation failures in the challenging clinical landscape of thoracolumbar spine fractures and spondylolisthesis. Through our prospective study, we aim to contribute valuable insights into the utility of short segment transpedicular screw fixation, offering clinicians evidence-based guidance in optimizing patient outcomes and mitigating the burdens associated with these debilitating spinal conditions.

Objective: to evaluate the management and outcome of lower thoracic and upper lumbar fractures and Spondylolisthesis with short segment transpedicular screw fixation at jpmc Karachi.

MATERIALS AND METHODS

It was a prospective type of study, conducted from April 2023 to March 2024, at Department of Neurosurgery, Jinnah Postgraduate Medical Center, Karachi, Pakistan. All patients older than 18 years, who admitted with fractured Lower thoracic and Lumbar vertebrae with and without Listhesis and patients having non-traumatic Spondylolisthesis, with or without neurologic deficits, who undergone short segment Transpedicle screw fixation were included in the study. Patients younger than 18 years, with severe osteoporotic spine (T-value < -2.5 S.D below young adult mean on Bone scan), patients having preexisting spinal deformity (e.g: scoliosis) polytrauma, patients having previous history of spinal surgery (e.g.: spinal Tumor removal), patients having more than 2 unstable vertebral body fractures, and who undergone long segment transpedicle screw fixation were excluded. A total nuber of 54 patients were enrolled in study. Informed and written consent was taken from all the patients. A proforma was made and parameters were filled preoperatively, immediate postoperatively and on two recent follow-ups, first after two weeks, second after 6 weeks. Data was compiled and analyzed using SPSS version 22.0.0.

Surgical Technique:

All the patients underwent surgery under general anesthesia. Endotracheal intubation was done and surgery was performed in prone position. A midline incision was given and paraspinal muscles were

dissected and retracted. Pedicles were exposed and fixation was done under C arm guidance. One level above the fractured vertebra and one below, were fixed with four screws. Then rods of appropriate length were contoured and inserted into the end screw extender sleeve. Reduction was performed with the help of interbody distractor or compressor and counter torque reduction tube. Then surgical site was closed in layers.

Postoperative management:
Patients were given intravenous antibiotic for 1 to 3 days.
They were advised for bedrest for one week after surgery, after one week they were advised for sit up exercised with Lumbar support. After two weeks they were advised for walking exercises with the help of clutches.
Radiological assessment was carried out by postoperative x-rays, one after 12 hours then on 2 weeks follow-up.

RESULTS

- **Demographic distribution**

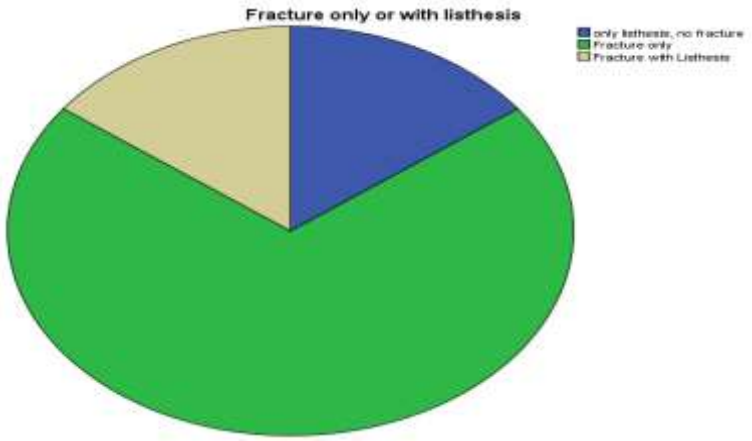
54 patients were included in this study. Out of them 43 (63%) males and 20 (37%) female patients. The mean age was 33.22+ 10.45years (range 18-58 years).

CHARACTERISTICS	FREQUENCY
MALE	43 (63%)
FEMALE	20 (37%)
MEAN AGE	33.22+ 10.45years (range 18-58 years).

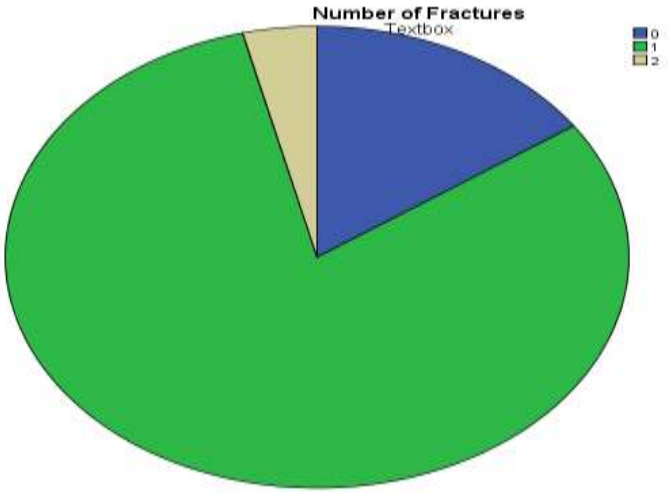
- Cause of injury was fall from height in 24 patients (44.4%), Road traffic accident in 16 (29.6%), Fall of heavy objects in 4 (7.4%), pathologic fracture in 2 (3.7%) and Miscellaneous in 8 (14.8%) patients.

CAUSE OF INJURY		
CAUSES	**NUMBER OF PATIENTS**	**PERCENTAGE**
Fall from height	24	44.4%
Road traffic accident	16	29.6%
Fall of heavy object	4	7.4%
Pathologic Fractures	2	3.7%
Miscellaneous	8	14.8%

- 38 patients (70.4%) had fracture only, 8 (14.8%) had Listhesis only and 8 patients (14.8%) had Fracture with listhesis.



8 patients (14.8) had no unstable fracture, 42 patients (77.8%) has one unstable fracture and 2 patients (3.7%) had more than 1 unstable fractures.



- Level of fracture was T11 in 2 patients (3.7%), T12 in 16 patients (29.6%), L1 in 8 patients (14.8%), L2 in 16 patients (29.6%) and L3 in 4 patients (7.4%).

LEVEL OF FRACTURE	NUMBER OF PATIENTS	PERCENTAGE
T11	2	3.7%
T12	16	29.6%
L1	8	14.8%
L2	16	29.6%
L3	4	7.4%

- 24 patients (48.0%) had wedge compression fracture, 10 patients (20.0%) had burst fracture. 2 patients (4.0%) had Flexion Distraction, 4 patients (8.0%) has Fracture Subluxation and 2 patients (4.0%) had chance fracture.

Fracture type	Number of patients	Percentage
wedge compression fracture	24	48.0%
burst fracture	10	20.0%
Flexion Distraction	2	4.0%
Fracture Subluxation	4	8.0%
chance fracture	2	4.0%

- 2 patients (3.7%) had one column injury, 12 patients (22.2%) had two column injury, 34 patients (63.0%) had three column injury and 6 patients (11.1%) had no column injury.

Column Injury	Number of patients	Percentage
No column injury	6	11.1%
One column injury	2	3.7%
Two column injury	12	22.2%
Three column injury	34	63.0%

- Out of them 33 patients (81.5%) had anterior column injury, 46 patients (85.6 %) had middle column injury and 38 patients (70.4%) had posterior column injury.

Column injury	Number of patients	Percentage
Anterior column	33	81.5%

Middle column	46	85.6%
Posterior column	38	70.4%

- 38 patients (70.4%) had no Listhesis, 2 patients (3.7%) had listhesis at T12-L1 level, 4 patients (7.4%) had at L1-L2 level, 2 patients (3.7%) had at L3-L4 level and 8 patients (14.8%) had at L5-S1 level.

Spondylolisthesis	**Number of patients**	**Percentage**
No Spondylolisthesis	38	70.4%
T12-L1 Spondylolisthesis	2	3.7%
L1-L2 Spondylolisthesis	4	7.4%
L3-L4 Spondylolisthesis	2	3.7%
L4-L5 Spondylolisthesis	28	14.8%

- 2 patients (3.7%) had Meyerding's Grade 1, 6 patients (11.1%) had Grade ii, 2 patients (3.7% had grade iii, 4 patients (7.4%) had grade iv Spondylolisthesis.

Meyerding's Grade	**Number of patients**	**Percentage**
Grade i	2	3.7%
Grade ii	6	11.1%
Grade iii	2	3.7%
Grade iv	4	7.4%

- Out of all, 48 patients (88.9%) had first surgery.
- The mean time lapse between injury and surgery was 38.05 days (Range: 3-365 days).
- 6 patients (11.1%) had revision surgery.
- Mean Time lapse between first surgery and revision surgery was 62.67 weeks (Range: 22-110 weeks).
- 48 patients (88.9%) had their first surgery.
- The mean time lapse between injury and surgery was 38.05 days (Range: 3-365 days).
- 6 patients (11.1%) had revision surgery.
- Mean Time lapse between first surgery and revision surgery was 62.67 weeks (Ranging from 22 to 110 weeks
- Level of Fixation was D11-L11 in 20 patients (37.0%), D12-L2 in 8 patients (14.8%), L1-L3 in 14 patients (25.9%), L2-L4 in 8 patients (14.8%) and L5-S1 in 4 patients (7.4%).

Level of Fixation	**Number of patients**	**Percentage**
D11-L1	20	37.0%
D12-L2	8	14.8%
L1-L3	14	25.9%
L2-L4	8	14.8%
L5-S1	4	7.4%

Neurological recovery

- Preoperative 4 patients (7.4%) had ASIA Grade A, 14 patients (24.9%) had Grade B, 8patients (14.8%) had Grade C, 12 patients (22.2%) had Grade D and 16 patients (29.6%) had Grade E on presentation.
- Postoperatively, 4 patients (8.0%) had ASIA Grade A, 4 patients (8.0%) had Grade B, 6 Patients (12.0%) had Grade C, 6 patients (12.0%) had Grade D and 30 patients (60.0%) had Grade E.
- Mean postoperative Gardner's Angle was 15.22 degrees+4.493 (Range: 10 to 22).

ASIA Grade	A	B	C	D	E
Preoperative	4 (7.4%)	14 (24.9%)	8 (14.8%)	12 (22.2%)	16(29.6%)
Postoperative	4 (8.0%)	4 (8.0%)	6 (12.0%)	6 (12.0%)	30(60.0%)
Difference					

Radiographic result:

- Mean Preoperative Gardner's Angle was 16.07+ 6.248 degrees (Range: 8-27 degrees).
- Mean preoperative anterior vertebral body height was 12.06+5.808 mm (Range: 4-25mm).
- Mean preoperative Posterior vertebral body height was 17.63+5.667 mm (Range: 5- 29mm).
- Mean postoperative Gardner's Angle was 15.22 degrees+4.493 (Range: 10-22). Mean Postoperative Anterior Vertebral Height was 15.0+5.407mm (Range: 8-22 mm). Mean Posterior Vertebral Body Height (in mm) was 15.0+5.407mm (Range: 12-22 mm).

Measurements	Gardner's Angle	AVBH	PVBH
Preoperative	16.07+ 6.248 degrees	12.06+5.808 mm	17.63+5.667 mm
Postoperative	15.22 degrees+4.493	15.0+5.407mm	15.0+5.407mm
Improvement			

Pain relief

- Preoperative Dennis pain score was P2 in 2 patients (3.7%), P4 in 14 patients (25.9%) and P5 in 38 patients (70.04%).
- Postoperatively, 32 patients (59.3%) were pain free (P1), 16 patients (29.6%) had occasional mild pain (P2), 6 patients (11.1%) had moderate to severe pain (P4).

Dennis pain score	P1	P2	P3	P4	P5
Preoperative	0	2 (3.7%)	0	14(25.9%)	38(70.04%)
Postoperative	32 (59.3%)	16 (29.6%)	0	6 (11.1%)	0
Improvement					

Quality of life

- Out of all, 20 patients (52.4%) underwent physiotherapy while 22 patients (47.6%) did not go for any physiotherapy.

Patients who underwent physiotherapy	20	52.4%
Patients who did not go for physiotherapy	22	47.6%

- Postoperatively, 6 patients (15.8%) have joint their previous job, 2 patients (5.3%) have changed their job to more comfortable one, 6 patients (15.8%) are house wives, 20 patients (37%) are jobless and 4 patients (7.4%) are expired. P value 0.05 level.

	Number of patients	Percentage
Patients who joint their previous job	6	15.8%
Who changed their job to comfort	2	5.3%
House wives	6	15.8%
Jobless	20	37.0%
Expired	4	3.7%

Discussion

The treatment of vertebral fractures aims to achieve early neurological restoration, anatomical realignment of damaged spinal segments, and stable fixation to facilitate early rehabilitation. Pedicle screw fixation has emerged as a fundamental treatment for thoracic and lumbar vertebral fractures and posterior-lateral synostosis in many hospitals. Clinical comparisons by Sasso et al. highlighted

the superiority of pedicle screw fixation over other posterior fixation tools, attributing its effectiveness to its applicability in shorter segments, as demonstrated in their study with 70 patients [11].

In contrast to our findings, several authors have reported limitations of short-segment pedicle screw instrumentation in achieving and maintaining reduction in thoracolumbar fractures, often leading to an unacceptable rate of failure. The inadequacy of short-segment fixation has been attributed to factors such as biomechanical instability and increased stress at the fracture site [12]. To address this challenge, some studies have proposed placing screws at the fracture site to extend the instrumentation level and distribute the load more effectively, potentially reducing the risk of failure.

However, our study demonstrates promising outcomes with short-segment transpedicular screw fixation in achieving these treatment goals. Despite concerns raised by some reports regarding the incurability of sagittal plane kyphosis with pedicle screw fixation due to bone breakdown, our findings contradicted these notions, showing satisfactory results with no neurological deterioration postoperatively. This aligns with previous research, emphasizing the efficacy of pedicle screw fixation in stabilizing fractures and preserving neurological function [13].

Moreover, the use of pedicle screws offers versatility, being applicable to both lumbar and thoracic vertebrae and useful in severe fractures such as fracture dislocation. While infection rates following posterior fixation and synostosis have been documented in previous studies, our study observed no infections, highlighting the robustness of our surgical approach.

The advantages of surgical internal fixation over temporary treatments, such as early mobilization and prevention of nerve damage by stabilizing the spine, were evident in our study. Surgical methods were found to be superior in overcoming fractures, restoring nervous functions, and decreasing complications, consistent with findings by Jacobs et al. in their comparative studies [14].

Burst fractures, characterized by violation of the endplates, may lead to progressive kyphosis if left untreated. However, our study demonstrated effective correction and prevention of kyphosis progression, emphasizing the importance of timely intervention. While challenges exist, particularly in elderly osteoporotic patients, principles such as multiple segment fixations and careful instrumentation length selection can help mitigate risks and optimize outcomes.

Additionally, individual patient characteristics, including age, play a significant role in the occurrence of adjacent segment degeneration. Our study corroborates previous observations, underscoring the need for tailored treatment approaches, especially in older patients, to minimize post-fusion complications.

In our study contributes to the growing body of evidence supporting the efficacy of short-segment transpedicular screw fixation in the management of vertebral fractures. By addressing treatment goals and demonstrating favorable outcomes, our findings support the adoption of this surgical approach to improve patient outcomes and advance the field of spinal fracture management.

Conclusion

Short arm Transpedicle Screw fixation has modified the management and outcome of lower thoracic and lumbar fractures with spondylolisthesis. It has improved neurologic status and quality of life of patients.

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