Section: Orthopaedic

Original Research Article

COMPARISON OF CONVENTIONAL OPEN SPINE PEDICLE SCREW FIXATION SURGERY VERSUS MINIMALLY INVASIVE PERCUTANEOUS SCREW FIXATION IN THE MANAGEMENT OF THORACOLUMBAR SPINE FRACTURES

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ABSTRACT

Background: Degenerative lumbar spine disease or fracture of the lumbar spine tends to increase globally. Several treatment options are available to treat, such as conventional open surgeries and minimally invasive percutaneous pedicle screw fixation, to reduce morbidity, and even older and weak patients can avail themselves of these techniques with minimal complications. **Material and Methods:** Out of 60 (sixty) patients, 30 patients had conventional open spine pedicle screw fixation surgery, and 30 were treated with minimally invasive percutaneous pedicle screw fixation in the management of thoracolumbar spine fracture in the adult. **Results:** The duration of surgery was less in percutaneous minimally invasive technique, with the least blood loss; post-drain was more in conventional open technique. **Conclusion:** Minimally invasive percutaneous pedicle screw fixation in the management of thoracolumbar spine fracture was associated with the least morbidity and helpful to weaker and old patients.

INTRODUCTION

With the increase in life expectancy and consequent aging of the population, degenerative lumbar spine diseases tend to increase in number exponentially. Furthermore, the daily life impact of degenerative spinal disease or fracture of the vertebral spine is not only negative impact of these conditions. It is estimated that low back pain, trauma, and other pathologies impair normal daily life.[1]

Several treatment options are available to treat degenerative or traumatic spinal disease, such as laminectomies, posterior fusions, and interbody fusion, depending on their locations, correction necessities, and surgeons' approaches.[2] Traditional techniques were made an open fashion, which allowed a great visualization of the surgical field. However, it led to more morbidity and tissue-damaging procedures. Therefore, with advances in technologies and surgical knowledge, minimally invasive techniques (MIS) reduced the surgical morbidity while maintaining the same benefits of traditional/open surgeries.[3] Moreover, it allowed older and weakened patients to have access to the benefits of minimally invasive surgeries with reduced risk of complications.[4]

Hence, an attempt is made to compare and evaluate the conventional open spine pedicle screw surgery versus minimally invasive percutaneous screw fixation in the management of thoracolumbar spine fractures.

MATERIALS AND METHODS

60 (sixty) adult patients aged between 20 and 58 years admitted to the orthopaedic department of MNR Medical College and Hospital, Sangareddy-502294, Telangana, India, were studied.

Inclusive Criteria: The patients above 20 years of age with unstable dorsolumbar fractures. All closed dorsolumbar injuries between T10 and L5. Duration of injury less than 1 – 7 days: fractures were confirmed by CT/MR. The patients who gave their consent in writing for the study were selected.

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Exclusion Criteria: The patients are below 18 years old and have multilevel injuries. The patients are unable to co-operate because of psychosis, mental retardation, head injury or cerebrovascular injury. Poor anaesthetic, refusal for surgery, angulations >30^{O} degree. Canal compromise >50%. The patients with kyphotic deformity were excluded.

- Indication for surgical stabilisation.
- The patient with one of the following was considered to have an indication for surgical stabilisation of the spine.
- Presence of neurological involvement caused by fracture.
- All neurologically stable patients within instability criteria.
- Loss of 50% body height of vertebras
- Angulations >30
- Kyphotic deformity > 20°
- Canal compromise > 50%
- Failure of at least 2 columns

Method: Detailed history related to fracture was recorded, including mode of injury, associated injuries, and treatment taken before reporting to the hospital.

General and systemic examination, blood examination, and radiological examination. A local examination of the spine to study any visible deformity over the back and local tenderness over the back was ruled out.

- Blood examination included haemogram, blood sugar, blood urea, and serum creatinine.
- Complete urine examination
- X-ray chest, PA view
- ECG

Neurological examination – Tone, bulk, power at different joints, co-ordination, any abnormal movements, superficial and deep tendons, reflexes, sensory deficit, bowel and bladder involvement, and perianal sensation and bulbocavernosus reflex were tested in every patient to differentiate between complete and incomplete cord lesions. After a thorough neurological examination, patients were categorised according to ASIA score (American Spinal Injury Association).

Radiological examination – Anterior, posterior and lateral views of the injured spine were done to evaluate and classify dorso-lumbar injuries. The lateral X-ray was used to measure Cobb's kyphosis angle, and an anterior vertebral MRI scan was carried out in every patient to evaluate the extent of the canal compromised from the retropulsed fragment and assess the degree of communication of the vertebral body. Status of spinal cord and posterior ligament surgical blood loss, surgical time, and postoperative complications were recorded.

The duration of the study was March 2025 to April 2026.

Statistical Analysis: Analysis was done in comparing the patients with the percutaneous pedicle fixation group and patients in the convectional (open) or traditional group, with percentage. The statistical analysis was carried out in SPSS software; the ratio of male and female was 2:1.

RESULTS

Table-1: Comparison of preoperative neurological status (ASIA's score).

- D score – 4 (13.3%) in patients with percutaneous fixation and 5 (16.6%) in the conversation group.
- E score – had 26 (86%) in the percutaneous fixation group and 25 (83.3%) in the conventional pedicle fixation.

Table-2: Distribution of cases according to fractured vertebrae.

- T11-5 (8.3%), T12-22 (36.6%), L1-24 (40%), L2-7 (11.6%), L3-2 (3.3%).

Table-3: Internal injury and surgery.

- < 2 days – 24 (40%)
- 3-7 days – 29 (48.3%)
- 8-21 days – 5 (8.3%)
- 21 days – 2 (3.3%)

Table-4: Study of associated injuries.

- 5 (8.3%) chest injury,
- 14 (23.3%) lower limb,
- 5 (8.3%) fracture of femur
- 10 (16%) fracture of calcaneus,
- 3 (5%) fracture of pelvis.

Table-5: Study of changes in neurological status of patients treated with percutaneous pedicle screw fixation.

- 4 (13.3%) in grade D, 26 (86.6%) in grade E, ASIA'S score

Table-6: Study of changes in neurological status in patients treated with conventional pedicle screw fixation of ASIA grade

- Grade D had 5 (16.6%), and grade E had 25 (83.3%).

Table-7: Comparison of complications in both groups

- Infection 2 (3.3%) in the percutaneous pedicle screw fixation group and 5 (16.6%) in the conventional group.
- Hardware failure – 2 (3.3%) in percutaneous pedicle screw fixation and 2 (3.3%) in the conventional group.
- Bed scores—4 (13.3%) in the conventional pedicle screw fixation group.

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Table 1: Comparison of pre-operative neurological status (ASIA's score)
[Total no of patients = 60]

ASIA''s scoring	Patients in percutaneous fixation group (30)	Patients in conventional pedicle in fixation group (30)
A	0	0
B	0	0
C	0	0
D	4 (13.3%)	5 (16.6%)
E	26 (86.6%)	25 (83.3%)
Total	30	30

Table 2: Distribution of cases according to fractured vertebrae
[Total no of patients = 60]

Vertebral level	No. of patients (60)	Percentage (%)
T10	0	0%
T11	5	8.3%
T12	22	36.6%
L1	24	40%
L2	7	11.6%
L3	2	3.3%

Table 3: Internal between injury and surgery

Duration	No. of patients (60)	Percentage (%)
< 2	24	40%
3-7 days	29	48.3%
8-21 days	5	8.3%
> 21 days	2	3.3%

Table 4: Study of Associated Injuries

Associated injury	No. of patients (60)	Percentage (%)
Chest injury	5	8.3%
Lower limb	14	23.3%
Fracture of Femur	5	8.3%
Fracture of calcaneum	10	16.6%
Fracture of Pelvis	3	5%

Table 5: Study of changes in neurological status in patient treated with percutaneous pedicle screw fixation

Pre-operative ASIA grade (30)	Post- Operative ASIA grade				
	A	B	C	D	E
Grade A (0)	0	---	---	---	---
Grade B (0)	---	0	---	---	---
Grade C (0)	---	---	0	---	---
Grade D (4)	---	---	---	4 (13.3%)	---
Grade E (26)	---	---	---	---	26 (86.6%)

Table 6: Study of changes in neurological status in patient treated with conventional pedicle screw fixation

Pre-operative ASIA grade (30)	Post- Operative ASIA grade				
	A	B	C	D	E
Grade A (0)	0	---	---	---	---
Grade B (0)	---	0	---	---	---
Grade C (0)	---	---	0	---	---
Grade D (5)	---	---	---	5 (16.6%)	---
Grade E (25)	---	---	---	---	25 (83.3%)

Table 7: Comparison of complications in both groups

Complication	Percutaneous pedicle screw fixation (30)		Conventional pedicle screw fixation (30)	
	No	%	No	%
Neurological worsening	0	0	0	0%
Infection	2	3.3%	5	16.6%
Hardware failure	2	3.3%	2	3.3%
Chest infection	0	0	0	0%
DV T/ Thrombo embolism	0	0	0	0%
Worsening of UTI	0	0	0	0%
Bed scores	0	0	4	13.3%

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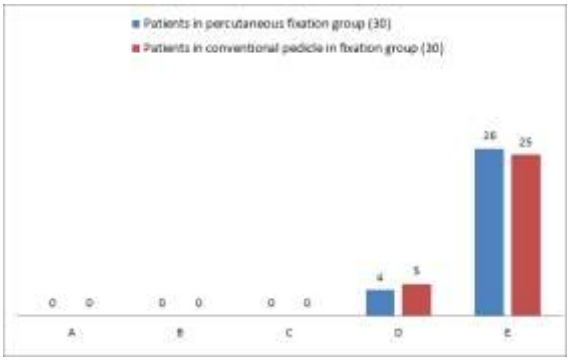


Figure 1: Comparison of pre-operative neurological status (ASIA's score)
[Total no of patients = 60]

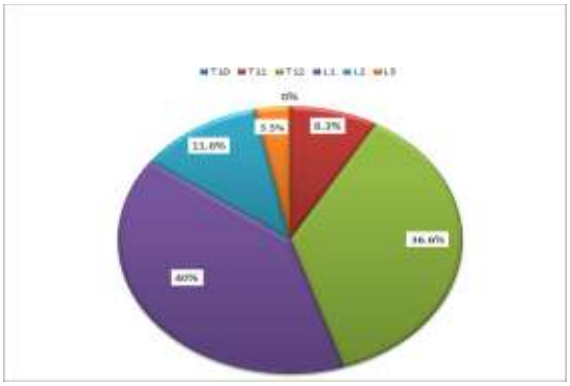


Figure 2: Distribution of cases according to fractured vertebrae
[Total no of patients = 60]

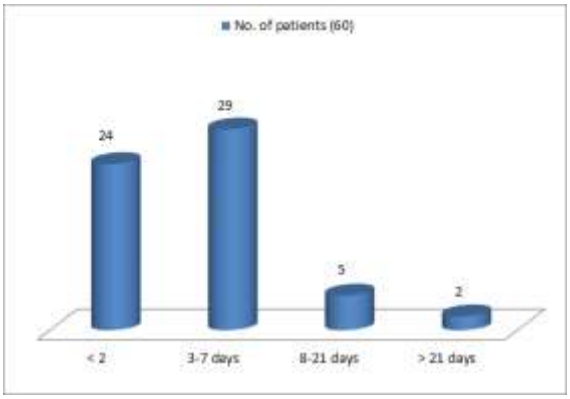


Figure 3: Internal between injury and surgery

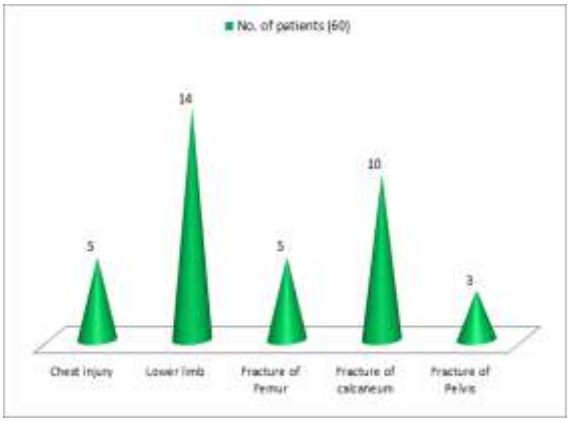


Figure 4: Study of Associated Injuries

DISCUSSION

Present a comparative study of conventional open spine pedicle screw fixation surgery versus minimally invasive percutaneous screw fixation in the management of the thoracolumbar spine in the Telangana population. The ASIA's score was 4 (13.3%) in the percutaneous fixation group and 5 (16.6%) in the conventional group in D scoring and 26 (86.6%) in the conventional of ASIA's E scoring (table-1). In the distribution of fractured vertebrae, the highest was 245 (40%) in L1, followed by 22 (36.6%) in T12, and the least was 2 (3.3%) in L3 (Table-2). In the study of the interval between injury and surgery, 29 (48.3%) patients were 3-7 days, followed by 24 (40%), <2 days, and 2 (3.3%) were more than 21 days (Table-3).

The associated injuries were 14 (23.3%) lower limb, followed by 5 (8.3%) chest injuries, 5 (8.3%) fractures of the femur, 10 (16.6%) fractures of the calcaneus, and the least was 3 (5%) fractures of the pelvis (table-4). The postoperative ASIA's score D was 4 (13.3%) and E was 26 (86.6%) in the percutaneous pedicle screw group (Table-5). In the conventional group, ASIA's score grade D had 5 (16.3%), and grade E 25 (83.3%) was noted (Table-6). Post-surgical complications were highest in the conventional group as compared to the percutaneous; moreover, 4 (13.3%) bedsores were observed only in the conventional pedicle screw group (Table-7). These findings are more or less in agreement with previous studies.[5,6,7]

Percutaneous screw fixation in the management of thoracolumbar spine fractures is a minimally invasive technique and is one of the greatest revolutions in spinal surgery, as those techniques allowed surgeons to treat patients that usually require but are too weakened to receive an open or conventional procedure and face its complications. However, the minimally invasive techniques are not without pitfalls, such as pricey materials and steep learning curves.[8] It is also reported that minimally investigated surgery (MIS) technology to treat spondylolisthesis showed a significant reduction in length of stay but not in the complication rates.[9]

In the recent study comparing the MIS versus conventional open screw fixation surgery, it had reduced blood loss and reduced hospital stay. In the patients receiving MIS or open had similar leg MIS, they had a lower chance to achieve back pain in minimal clinically important difference (MCIP) at 12 months. It is also reported that MIS and open (conventional) surgeries have similar outcomes at two years of follow-up when treating degenerative lumbar diseases.[10]

One of the most controversial aspects of the MIS versus open corundum is the cost-effectiveness of the minimally invasive techniques and whether the reduction in blood loss and hospitalization times compensates for the costlier materials needed to perform MIS surgeries.[11]

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CONCLUSION

Present a comparative study of conventional open spine pedicle screw fixation surgery versus minimally invasive percutaneous screw fixation in the management of thoracolumbar spine fractures. The percutaneous pedicle fixation surgery had a minimal incision as compared to the conventional method. Blood loss was more in conventional surgery, and post-drain was also more in conventional surgery. The conventional pedicle fixation group time duration was more than that of percutaneous pedicle screw fixation. It certainly confirms that minimally invasive percutaneous screw fixation is an ideal technique to perform, as weak and older patients can be treated, and they also can lead a normal quality of life. Ultimately it is the surgeon who decides the techniques' benefits for patients, keeping in view the health conditions and prognosis of other associated comorbidities.

Limitation of study: Owing to the remote location of the research center, small number of patients, and lack of the latest techniques, we have limited findings and results.

- This research paper was approved by the Ethical Committee of MNR Medical College and Hospital, Sangareddy-502294, Telangana, India.
- No Conflict of Interest
- Self-Funding

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