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Original Article

Feasibility of Percutaneous Pedicle Screw Fixation in The Treatment of Thoracolumbar Fractures

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ABSTRACT

Background: Percutaneous pedicle screw fixation [PPSF], where screws are inserted through small holes in the skin, has become a popular approach for treating thoracolumbar and lumbar fractures. It has been shown to produce satisfactory outcomes.

Aim of the work: The aim was to examine the procedure and assess the practicality, safety and results of using PPSF to treat thoracolumbar fractures.

Patients and Methods: A prospective cohort study included 20 patients with thoracic or lumbar spine fracture, without neurological deficit, whom were operated upon by percutaneous screw fixation, and were assessed clinically [for improvement and development of complications] and radiologically [for healing and correction of deformity] by follow up over 6 months after surgery.

Results: All cases achieved full radiological union by 3 months. The mean union time in our cohort was 2.1±0.5 months. Postoperatively, a statistically significant improvement in the vertebral kyphotic angle to a mean value of 4.7 ± 2.3 was observed [Bonferroni post-hoc test, P = 0.001]. The correction was maintained till last follow-up. Two patients [10%] developed incomplete paraplegia [Frankel grade D]. Misplacement of the pedicle screws was recorded in 6 of 90 screws in six patients.

Conclusion: The PPSF is a valuable surgical procedure for patients with thoracic and lumbar vertebral fracture.

Keywords: Fracture Fixation; Lumbar Vertebrae; Pedicle Screws; Spinal Fractures; Thoracic Vertebrae.

INTRODUCTION

Thoracolumbar [TL] fractures are among the most common types of spine injuries [1, 2]. The majority of thoracolumbar fractures occur at a young age, with motor vehicle accidents being the most typical reason [3]. The primary aims of treating thoracolumbar fractures are to protect the neural tissue, maintaining/restoring nervous utility, preventing or correcting segmental breakdown and deformity, preventing spinal instability and pain, allow for early movement and return to normal activity, and reestablish typical spinal mechanics [4].

There is a consensus that vertebral fractures associated with neurological impairment require surgical decompression, fixation, and fusion [5]. Nevertheless, there is ongoing debate regarding the surgical management of patients with fractures in the absence of neurological deficits [6]. Traditional treatment approaches of TL fractures frequently include open internal fixation [OIF], which might lead to excessive surgical damage and bleeding and hence extend the duration of healing [7, 8].

Percutaneous pedicle screw fixation [PPSF] has gained significant popularity as a treatment method for TL fractures, showing favorable results [9, 10]. In contrast to OIF, the PPSF eliminates the need for extensive stripping and prolonged traction of the paraspinal muscles. This approach has been linked to a reduced occurrence of postoperative refractory back pain and lumbar stiffness, decreased postoperative bleeding, and faster recovery [11]. The utilization of PPSF allows for the creation of a sturdy framework that enhances stability and facilitates fusion in various spinal conditions such as trauma, tumors and deformities [12].

Over the past two decades, there has been a surge of interest in spine fractures due to the emergence of novel and advanced surgical interventions [13]. However, certain drawbacks and complications associated with percutaneous transpedicular systems and conventional pedicle screw applications have been recorded, such as mis-placement of screws, nerve root injury, spinal cord injury, pedicular fractures, and cerebrospinal fluid [CSF] leakage [14].

The objective of this study is to investigate the technique and assess the viability, safety, and results of using PPSF for the treatment of TL fractures.

PATIENTS AND METHODS

This prospective cohort study conducted at the Orthopedic Department of Al-Azhar University Hospital in Damietta, during the period from August 2021 to August 2022. It included 20 patients with thoracic and lumbar spine fracture that was operated upon by percutaneous screw fixation and assessed clinically and radiologically by follow up over 6 months after surgery.

Inclusion criteria: Skeletally mature patients with traumatic fracture occurring in the thoracic and/or lumbar spine that necessitates dorsal instrumentation. The fracture should not cause considerable damage to the anterior column, thus eliminating the need for anterior reconstruction. This includes any level of thoracolumbar injury classification and severity [TLICS] score, as long as the load-sharing score is six or lower and there is no associated neurological impairment.

Exclusion criteria: Neuropsychiatric and other disorders that may render patients unable to comply with instruction, retro pulsed segment occupying over 50% of the spinal canal, prior spinal surgery performed at the same level, uncorrected coagulopathy during the time of surgery, substantial posttraumatic segmental kyphosis equal to or exceeding 10°, and fracture dislocation in the thoracolumbar spine

Ethical consideration: Informed consent was taken from every patient to be involved in this study. Approval of Institutional Review Board [IRB] of Damietta Faculty of Medicine, Al-Azhar University was obtained.

Preoperative assessment: Personal data [age and gender], mechanism of injury, time since the occurrence of fracture and past medical and surgical history was recorded. General condition of the patient regarding associated injuries, vital signs assessment and skin condition. Local examination included deformity of the back, swelling and skin condition, tenderness, soft tissue compromise or open injuries, neurological sensory, motor and sphincter affection. X-ray [anteroposterior view, lateral view of the dorso lumbar spine, pelvic], CT [thoracolumbar spine], and MRI [thoracolumbar spine] were done for each patient. Denis classification [15] was used to evaluate and classify fractures.

Surgical technique

After the patient was given general anesthesia, they were placed in a prone position on a lumbar frame. Under lateral fluoroscopic imaging from a C-arm, the correct level was identified using a guide wire localizer. A guide wire was placed perpendicular to the spine axis at the targeted level on the patient's back. Using A-P fluoroscopy, the guide wire was adjusted to intersect the center of both pedicles in a cephalocaudal direction. A surgical marker was used to mark that plane on the patient's back. Guide wires were placed parallel to the spine axis on the patient. Using A-P fluoroscopy, the guide wire position was adjusted to align with the lateral pedicle wall of the targeted level and adjacent levels. A surgical marker was used to mark this plane on the patient. The skin incision for each level should be at least 1 cm lateral to the intersection of the two marked lines.

Once the skin was incised, the fascia was also incised using the pointed end of a scalpel blade to make it easier to pass the tap cannula. The tap cannula was then inserted through the incision in the skin, following a slightly inward direction, until it reached a bony structure. With the help of fluoroscopy, the position of the tap cannula's tip was examined and adjusted to a 9 o'clock position for left pedicles and a 3 o'clock position for right pedicles. The tap cannula was used to tap the pedicles, starting from the outer edge and moving towards the inner edge of the pedicle in an anteroposterior [AP] view [figure 1].

At this point, the position of the tip was confirmed on a side view to have crossed the junction where the pedicle and body meet. The cannula was inserted into the 7-mm dilator, and pressure was applied while rotating it until the two parts securely locked together. The combined instrument was then moved forward along the guide wire until the distal tip of the instrument made contact with the pedicle, which was verified using an X-ray. The cannula was pushed further down until it separated from the dilator and made contact with the bone. The dilator was removed while ensuring that the guide wire remained in place, and the cannula remained in position. A properly sized cannulated self-drilling tap was advanced along the guide wire and into the cannula. While controlling the cannula, the self-drilling tap was rotated in a clockwise direction to advance it over the guide wire inside the pedicle. The markings on the proximal end of the tap were used to determine its depth and the appropriate length of the screw. Care had to be taken during tapping to avoid unintentional displacement of the guide wire.

Fluoroscopy was used to monitor how far the tap advanced and ensure the guide wire was not pushed in too far. The appropriate length, diameter and type of screw were selected. After inserting the suitable poly axial driver into the assembly [figure 2], the combined instrument was threaded into the screw head by rotating it clockwise until it stopped. The combined instrument with the screw was guided over the guide wire to the pedicle and the poly axial screw was threaded into the pedicle. Once the screw passed through the pedicle and entered the body, the guide wire was removed. The markers on the guide wire were monitored while inserting the screw into the pedicle to avoid unintentional displacement. Once the screw was inserted to the desired depth, the poly axial driver was removed by turning the handle in a counterclockwise direction while holding the extended tab assembly firmly. The poly axial function was verified by manipulating the screw extension. The length of each screw was set correctly and verified using lateral fluoroscopy. The length of the rod was measured by reading the caliper at the top. Depending on the spine curves, a straight, lordosed, or kyphosed rod was selected. The rod holder was parallel to the skin and the rod was perpendicular to the skin surface [parallel to the slots of the extension]. The rod was inserted into the cephalad slot of the extension and its tip put within the closed screw extension. The distal end of the rod was advanced straight down to go below the fascia and touch the top of the screw head.

The rod holder was rotated upwards at an angle of approximately 45° and directed by the tip of the rod during each subsequent extension [figure 3]. To ensure proper alignment, the extension was rotated around its axis. The nuts were then positioned. Before removing the rod holder, radiological confirmation was performed to ensure that the proximal end of the rod was fully inserted into the screw head, with approximately 5 mm extending beyond the head. For the final tightening or counter-torque, the screw extension was removed, and the fascia and skin were closed.

To calculate radiation time, we considered the duration of fluoroscopy usage during the surgery. Fluoroscopy time refers to the total duration that the fluoroscope was active and emitting radiation. The radiation time was determined by recording the start and end times of each instance when the fluoroscopy was used. By summing up the durations of all these instances, you can calculate the total radiation time.

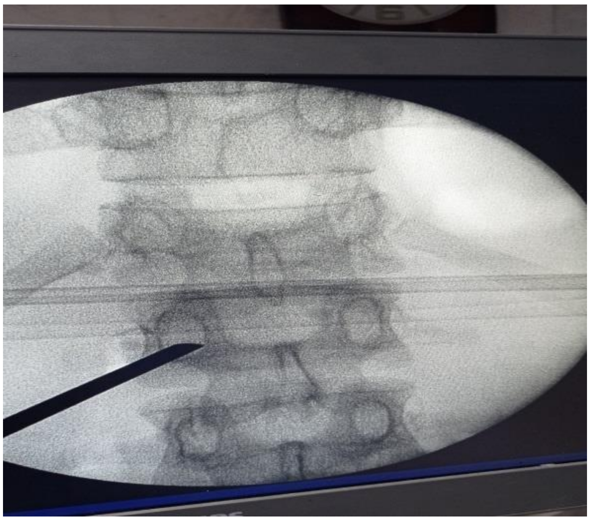

Figure (1): Tap cannula on pedicle in AP view

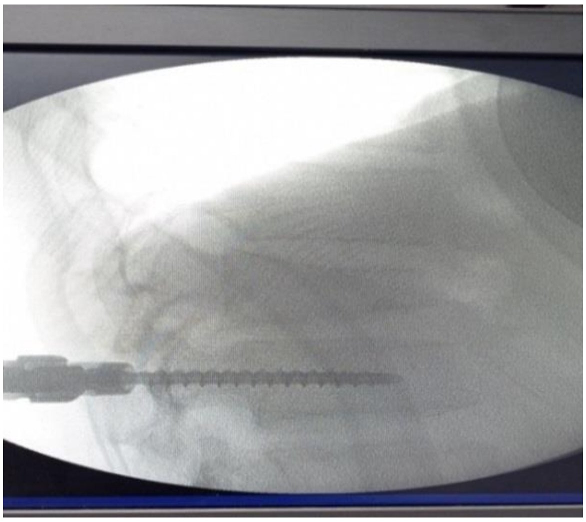

Figure (2): Insertion of screw

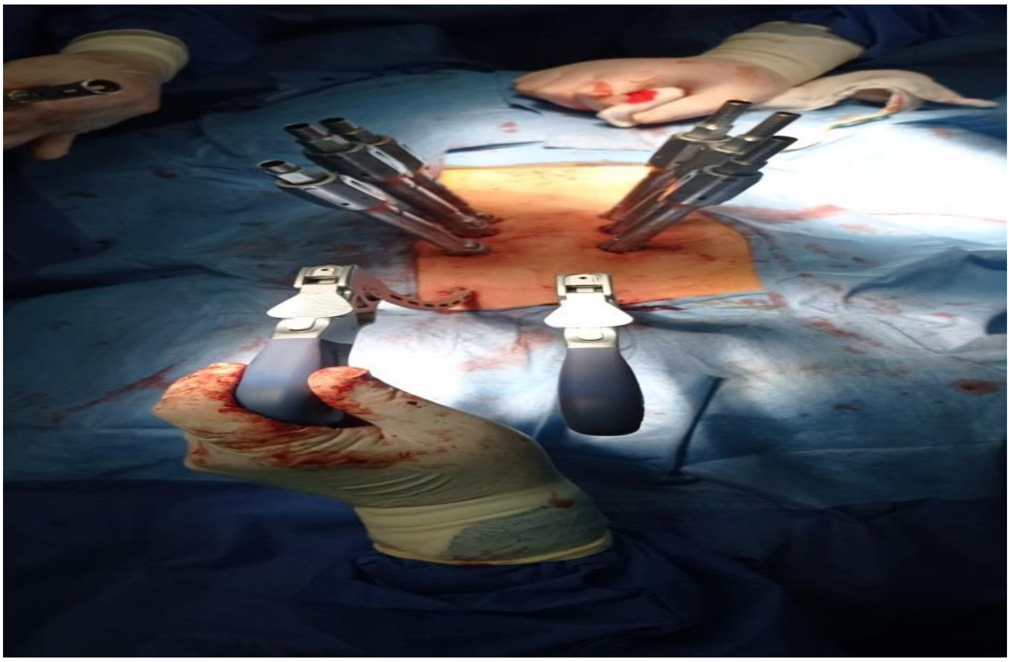

Figure (3): Overall view of rods holder and screw extension

Post-operative assessment: All patients received intravenous antibiotics and analgesia. Patients were started on oral intake as soon as they could tolerate it and when bowel function returned. Patients were discharged after being afebrile for 48 hours and after they could tolerate a normal diet and had a decrease in their white blood cell count to the normal level. The patients were followed up in the outpatient clinic within 1 week, 2 weeks and within 1-month intervals for 6 months. The following data were collected and recorded at each visit:

Clinical manifestations: included pain, range of motion and neurological deficit. For assessment of pain the 10-grades visual analogue scale was applied. In addition, the Oswestry Disability Index [16] was conducted. The ODI assesses symptoms in ten areas, which include pain intensity, personal care, lifting, walking, and sleeping. For neurological assessment, Frankel neurological classification was used [17].

Radiological assessment: included healing of fracture, screws in place or not, loosening of screws. Time to union was reported and the injured vertebral kyphotic [Cobb] angle was measured and recorded at each visit.

Postoperative complications: including fever, wound infection, neurological deficits, screw displacement, delayed union and non-union.

Statistical Analysis: Quantitative variables were analyzed using SPSS Version 22.0 [IBM Corp, Armonk, NY] to determine the means and standard deviations. For qualitative variables, frequencies and percentages were calculated using the same software. To compare pre-operative and postoperative data, Chi-square test was used for categorical variables, while paired sample t-test was used for numerical variables. A general linear model [repeated measures ANOVA] and post-hoc analysis was used to compare results at different follow-up intervals. P value less than 0.05 was considered to declare statistical significance.

RESULTS

Basic characteristics: The mean age was 41.5 ± 6.3 years, ranging from 18 to 60 years old. In all, six [30%] patients were females, whereas 14 [70%] were males. The mechanism of injury was falling from height in 55% of patients, road traffic accident in 25%, and direct impaction by hard object in 20%. The level of vertebral fractures varied across patients. According to the Denis classification system, 13 [65%] fractures were classified as type I. Type II and III fractures were demonstrated in 5 [25%] and 2 [10%] cases, respectively. No cases of fracture-dislocation [type IV] injury was included in our study [table 1].

Intraoperative Outcomes: Short segment fixation was carried out in 15 patients and an extra screw at the level of fracture in 5 patients. The total number of placed screws was 90 screws. The average surgery time was 71 ± 12 minutes [54 - 130 minutes]. The mean duration of hospitalization was 2.0 ± 0.5 days [1-4 days]. The mean radiation time was 33 ± 5 seconds [range, 25 – 60 seconds] [table 2].

Clinical outcomes

Visual analogue scale: The mean preoperative VAS for back pain was 7.8 ± 1.5, ranging from 6 to 9 points. Postoperatively, there was a dramatic decline in the VAS to a mean of 2.8 ± 1.2 [range, 1 – 5]. There was a statistically significant improvement in pain level postoperatively [Bonferroni post-hoc test, P = .003]. At 3-month follow-up, further significant improvement in back pain was reported to a mean of 1.9 ± 0.7 [range, 1 – 4] [Bonferroni post-hoc test, P = .043]. At 6-month follow-up, the mean VAS was 1.5 ± 0.3 [range, 1 – 3]. No statistically significant difference between 3-month and 6-month follow-up in the pain level was found [Bonferroni post-hoc test, P = .074] [table 3].

Oswestry disability index: The mean preoperative VAS for back pain was 7.8 ± 1.5, ranging from 6 to 9 points. Postoperatively, there was a dramatic decline in the VAS to a mean of 2.8 ± 1.2 [range, 1 – 5]. There was a statistically significant improvement in pain level postoperatively [Bonferroni post-hoc test, P = .003]. At 3-month follow-up, further significant improvement in back pain was reported to a mean of 1.9 ± 0.7 [range, 1 – 4] [Bonferroni post-hoc test, P = .043]. At 6-month follow-up, the mean VAS was 1.5 ± 0.3 [range, 1 – 3]. No statistically significant difference between 3-month and 6-month follow-up in the pain level was found [Bonferroni post-hoc test, P = .074] [table 3].

Frankel neurological classification: Two patients [10%] developed incomplete paraplegia [Frankel grade D] post-operatively [table 3]; one patient improved completely at six months, and one did not.

Radiological outcomes: All cases achieved full radiological union by 3 months. The mean union time in our cohort was 2.1 ± 0.5 months. The preoperative kyphotic angle of the injured vertebra was 13.7 ± 5.3 degrees. Post-operatively, a significant improvement in the vertebral kyphotic angle to a mean value of 4.7 ± 2.3 was observed [Bonferroni post-hoc test, P = 0.001]. The correction was maintained till last follow-up. No significant changes were found in the vertebral correction angle between postoperative, 3-month and 6-month follow-up [table 4; figure 4].

Complications: Two patients [10%] got incomplete paraplegia [Frankel grade D]. One patient [5%] experienced a superficial wound infection, which resolved completely within two weeks through daily dressing and the use of suitable antibiotics. Among the 90 screws implanted in six patients, misplacement was observed in six screws. Specifically, two screws breached the inner side of the pedicle, while four screws breached the outer side. No neurological consequences were reported with these violations postoperatively except for the previous two cases of paraplegia. No revision surgery was required for any of these patients. No cases of delayed union or nonunion were reported as well [table 5].

Table [1]: Basic characteristics of the studied cases

Parameter		Value
Age [years], mean ± SD [range]		41.5 ± 6.3 [18 – 60]
Gender	Males Females	14 [70%] 6 [30%]
Mechanism of injury	Falling from height Road traffic accident Impaction by hard object	11 [55%] 5 [25%] 4 [20%]
Level of fracture	T10	1 [5%]
	T11	2 [10%]
	T12	4 [20%]
	L1	3 [15%]
	L2	3 [15%]
	L3	2 [10%]
	L4	2 [10%]
	L5	3 [15%]
Denis Classification	Type I Type II Type III	13 [65%] 5 [25%] 2 [10%]
Time to surgery [days], mean ± SD [range]		3.2 ± 1.5 [1-8]

Table [2]: Intraoperative Outcomes

Parameter		Value
Mode of Fixation	SSF SSF [with intermediate screw]	15 [75%] 5 [25%]
Number of Screws		90
Surgical time [min.], mean ± SD [range]		71 ± 12 [54 – 130]
Radiation time [sec], mean ± SD [range]		33 ± 5 [25 – 60]
Hospital stay [days], mean ± SD [range]		2 ± 0.5 [1 – 4]

SSF: Short segment fixation

Table [3]: Clinical Outcomes

	Preoperative	Postoperative	3 months	6 months	P value
Visual analogue scale					
Mean ± SD	7.7 ± 1.4	2.8 ± 1.2	1.9 ± 0.7	1.5 ± 0.3	**< 0.001** [a]
Range	6 – 9	1 – 5	1 – 4	1 – 3	
Oswestry disability index					
Mean ± SD	68.9 ± 8.4	-	10.3 ± 3.1	8.9 ± 4.5	**< 0.001** [a]
Range	50 – 88	-	5 – 20	4 – 15	
Frankel Classification					
Grade D	0 [0]	2 [10%]	2 [10%]	1 [5%]	**> 0.05** [b]
Grade E	20 [100%]	18 [90%]	18 [90%]	19 [95%]	

[a] Repeated measure ANOVA; [b] Chi-square test

Table [4]: Radiological outcomes

Parameter	Value	
Time to union [months], mean ± SD [range]	2.2 ± 0.52 [1.5 – 3]	
Cobb Angle [degree]		**P value*** = 0.043
Preoperative	13.7 ± 3.3	
Postoperative	4.7 ± 2.3	
Three months	5.3 ± 1.6	
Six months	5.8 ± 2.1	

* Repeated measure ANOVA

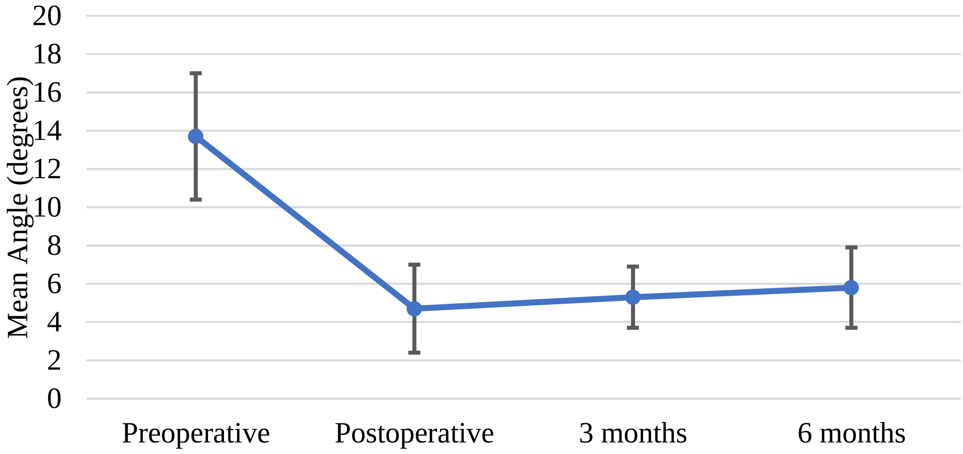

Figure [4]: injured Vertebral Kyphotic Angle

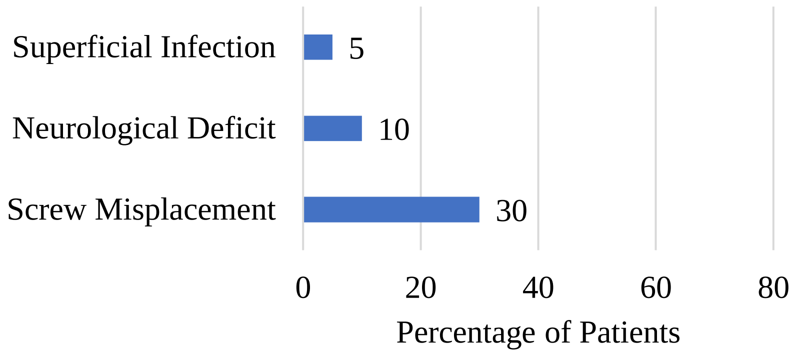

Figure [5]: Postoperative complications

DISCUSSION

Although surgeons have become ever more interested in using PPSF to treat conditions like spinal degeneration problems, its usefulness for treating spinal injuries remains uncertain because there aren't enough research studies to prove how well it works [18].

In the present study, the mean age was 41.5 ± 6.3 years, ranging from 18 to 60 years old. The level of vertebral fractures varied across patients. Our results were supported by study of **Ni *et al.*** [19] as they reported an average age of 43.2 years [ranged 19 to 58] among 36 adult patients. T11 had four fractures, T12 had eight, L1 had seventeen, and L2 had seven. The mechanism of injuries includes a fall from a height in 24 patients and motor vehicle accident in 12 patients. Similarly, **Zhu *et al.*** [20] revealed that there were 108 patients in all, including 68 males and 40 females [mean age 43.1 years; 24-60 years]. Injuries were caused by falls from great heights in 55 patients, traffic accidents in 30 patients, and falls from low heights in 23 patients.

The present study showed that the total number of screws inserted percutaneously was 90 screws. The mean surgical time was 71 ± 12 minutes [range, 54 - 130 minutes]. The average hospital stay was 2.0 ± 0.5 days [range, 1 - 4 days]. The mean radiation time was 33 ± 5 seconds [range, 25 – 60 seconds]. Our results were supported by study of **Cimatti *et al.*** [21] as they reported that the mean duration of surgery was about 60 min [range 40–120 min]. While in the study of **Tamburrelli *et al.*** [22], 182 screws were inserted, 170 in thoracic and 12 in lumbar pedicles. The upper and lower equipped levels were T2 and L2, respectively. The mean operation time was 134.7 minutes [89 - 193]. The period of hospitalization was 13.4 [6 - 31] days post-operatively. They did not report any perioperative problems. In the study of **Wang *et al.*** [23], Sextant SPPSF group showed significantly briefer hospitalization [P<0.0001] and significantly lengthier surgery time than OPSF group [P<0.0001].

The decrease in surgical trauma leads to a low rate of approach-related complications, and may facilitate earlier spinal stabilization and mobilization, resulting in shorter hospital stays [24]. The current procedure may be a possible choice for treating fractures in thoracic and lumbar regions while the pedicles allow for minimally invasive placement of screws. However, physicians have to carefully choose the right patients for this surgery because putting in screws this way relies heavily on medical imaging like x-rays during the procedure to make sure the correct area of the spine is targeted [25].

Thus, enhancing surgeons' awareness in this regard is crucial for ensuring accurate targeting of the correct area of the spine during percutaneous pedicle screw fixation procedures. Some key considerations to improve surgeons' awareness during imaging assessments include encouraging surgeons to participate in regular activities focused on medical imaging, promoting collaboration between surgeons and radiologists, emphasizing the significance of thorough preoperative planning, the utilization of advanced image-guided navigation systems and implementing quality assurance programs within surgical departments.

In the current study, there was a dramatic decline in the VAS Postoperatively. At 6-month follow-up, the mean VAS for back pain was 1.5 ± 0.3 [range, 1 – 3]. Similar improvements for the ODI were reported. Similar results were found by **Huang *et al.*** [26], as they reported that there were noteworthy advancements in the visual analogue scale [7.61 ± 1.41 vs. 1.17 ± 0.80, P < 0.001] and the ODI [89.82 ± 7.44 vs. 15.71 ± 13.50, P < 0.001].

This percutaneous method requires making only one cm incisions at each point where a screw will be inserted. These small incisions are enough to insert the access needle, guidewire and series of expanding tubes used. The expanding tubes gently separate the muscles on either side of the spine instead of cutting through them, which can reduce pain after surgery, blood loss during surgery, and lead to better functional outcomes after surgery [27, 28].

The first meta-analysis that compared PPSF to the open approach for thoracolumbar fractures found that the percutaneous method provided benefits like faster recovery and recovery with fewer complications, though it achieved similar results in correcting spinal issues seen on imaging studies compared to the open fixation approach [24].

In the study in our hands, all cases achieved full radiological union by 3 months. The mean union time in our cohort was 2.1 ± 0.5 months. Postoperatively, a significant improvement in the vertebral kyphotic angle to a mean value of 4.7 ± 2.3 was observed. In accordance with our results, **Wang *et al.*** [29] found that the sagittal Cobb angle, body angle, and anterior height of the broken vertebrae improved significantly from baseline.

Regarding complications, two patients developed incomplete paraplegia. Superficial wound infection developed in one patient. Misplacement of the pedicle screws was recorded in 8 of 90 screws.

While, in the study of **Wang *et al.*** [29], in the PPSF group, one case of wound infection was identified, while the OPSF group had two cases of wound infection. None of the patients in either group experienced pseudarthrosis, recurrence, or significant kyphosis. There was no notable disparity in postoperative complications between the PPSF group and OPSF group [P > .05]. Patients diagnosed with wound infection received treatment involving surgical debridement in conjunction with antibiotics.

Ni *et al.* [19] demonstrated that all patients remained neurologically normal. One patient acquired a superficial wound infection that was treated with intravenous antibiotics. One patient had a loosened screw, however no implant broke.

In a study conducted by **Tamburrelli *et al.*** [22], there were no surgical complications or hardware failures. Six screws [3.2%] out of 182 suffered a partial pedicle breach, with no neurological damage or the need for surgical revision. Furthermore, **Wang *et al.*** [23] revealed that in the OPSF group, screw malposition [3 pedicle screws, 2.1%] was seen in two patients without clinical symptoms and necessity for revision.

Surgeons should be very careful when choosing patients for PPSF because there are several drawbacks to this approach. First, surgeons need to recognize how difficult it is to master this technique. They must be very familiar with using imaging technology, like x-rays, during the operation in order to place the screws accurately [18, 28]. Since surgeons have limited experience with the percutaneous procedure, they may place the screws through the pedicle bone into nearby nerves and nerve structures that pass below and beside the pedicle. Pedicle breaches and resulting neural injuries can occur due to the steep learning curve associated with this technique [30]. Unlike conventional open pedicle screw placement where surgeons can feel their way, the percutaneous procedure does not allow for tactile feedback, further complicating the technique and lengthening the learning curve for surgeons. The need for more x-rays or fluoroscopy to guide screw placement during the procedure also exposes patients and surgical staff to higher levels of radiation, which is another downside of the minimally invasive percutaneous approach [25]. Since screws are placed through the skin with this procedure, it is difficult to deliver bone graft material to the surfaces where vertebrae join to encourage the vertebrae to fuse [24].

Limitations of the study include the lack of control group and the small sample size. Also, we had a relative short duration of follow-up, which precluded the study of outcomes after removal of pedicle screws.

Conclusion: Percutaneous pedicle screw fixation, performed by inserting screws through the pedicle of the fractured vertebra, is an effective minimally invasive surgical treatment option for patients with thoracolumbar fractures. This approach has been linked to shorter operative durations, reduced hospital stays, and lower infection rates. However, due to the limited availability of strong clinical evidence, it is necessary to confirm these findings through extensive prospective registries and randomized trials

Conflict of Interest and Financial Disclosure: None.

REFERENCES

1. Skou ST, Juhl CB, Hare KB, Lohmander LS, Roos EM. Surgical or non-surgical treatment of traumatic skeletal fractures in adults: systematic review and meta-analysis of benefits and harms. Syst Rev. 2020 Aug 13;9[1]:179. doi: 10.1186/ s13643-020-01424-4.

2. Wang H, Zhou Y, Li C, Liu J, Xiang L. Comparison of Open Versus Percutaneous Pedicle Screw Fixation Using the Sextant System in the Treatment of Traumatic Thoracolumbar Fractures. Clin Spine Surg. 2017 Apr;30[3]:E239-E246. doi: 10.1097/BSD.0000000000000135.

3. Sebaaly A, Nabhane L, Issa El Khoury F, Kreichati G, El Rachkidi R. Vertebral Augmentation: State of the Art. Asian Spine J. 2016;10[2]:370-6. doi: 10.4184/asj.2016.10.2.370.

4. Sebaaly A, Rizkallah M, Bachour F, Atallah F, Moreau PE, Maalouf G. Percutaneous cement augmentation for osteoporotic vertebral fractures. EFORT Open Rev. 2017 Jun 22;2[6]:293-299. doi: 10.1302/2058-5241.2.160057.

5. Sharif S, Shaikh Y, Yaman O, Zileli M. Surgical Techniques for Thoracolumbar Spine Fractures: WFNS Spine Committee Recommendations. Neurospine. 2021 Dec;18[4]:667-680. doi: 10. 14245/ns.2142206.253.

6. Aprato A, Vergano LB, Casiraghi A, Liuzza F, Mezzadri U, Balagna A, *et al.* Consensus for management of sacral fractures: from the diagnosis to the treatment, with a focus on the role of decompression in sacral fractures. J Orthop Traumatol. 2023 Sep 4;24[1]:46. doi: 10.1186/ s10195-023-00726-2.

7. Wood KB, Li W, Lebl DR, Ploumis A. Management of thoracolumbar spine fractures. Spine J. 2014 Jan;14[1]:145-64. doi: 10.1016/j. spinee.2012.10.041.

8. Rajasekaran S, Kanna RM, Shetty AP. Management of thoracolumbar spine trauma: An overview. Indian J Orthop. 2015 Jan-Feb;49[1]:72-82. doi: 10.4103/0019-5413.143914.

9. Chin M, Camacho JE, Ye IB, Bruckner JJ, Thomson AE, Jauregui JJ, *et al.* Postoperative outcomes of minimally invasive pedicle screw fixation for treatment of unstable pathologic neoplastic fractures. J Orthop. 2022 Feb 15;30:72-76. doi: 10.1016/j.jor.2022.02.014.

10. Russo GS, Toombs C, Wijesekera AS, Wijesekera SA, Hajewski C, Boody B, Sasso R. Percutaneous Versus Open Treatment for Thoracolumbar Fracture Without Neurological Injury. Clin Spine Surg. 2023 Mar 1;36[2]:40-42. doi: 10.1097/BSD.0000000000001417.

11. Kim BG, Dan JM, Shin DE. Treatment of thoracolumbar fracture. Asian Spine J. 2015 Feb;9[1]:133-46. doi: 10.4184/asj.2015.9.1.133.

12. Elenany SA, Alkosha HA, Ibrahiem MS. Role of minimally invasive percutaneous fixation in thoracolumbar fractures: a prospective study. Egypt J Neuros. 2019 Dec;34:40. doi: 10.1186/ s41984-019-0063-6.

13. Verheyden AP, Spiegl UJ, Ekkerlein H, Gercek E, Hauck S, Josten C, *et al.* Treatment of Fractures of the Thoracolumbar Spine: Recommendations of the Spine Section of the German Society for Orthopaedics and Trauma [DGOU]. Global Spine J. 2018 Sep;8[2 Suppl]:34S-45S. doi: 10.1177/ 2192568218771668.

14. Zhao Q, Zhang H, Hao D, Guo H, Wang B, He B. Complications of percutaneous pedicle screw fixation in treating thoracolumbar and lumbar fracture. Medicine [Baltimore]. 2018 Jul;97[29]: e11560. doi: 10.1097/MD.0000000000011560.

15. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. Spine [Phila Pa 1976]. 1983 Nov-Dec;8[8]:817-31. doi: 10.1097/ 00007632-198311000-00003.

16. Zweig T, Enke J, Mannion AF, Sobottke R, Melloh M, Freeman BJ, *et al.* Is the duration of pre-operative conservative treatment associated with the clinical outcome following surgical decompression for lumbar spinal stenosis? A study based on the Spine Tango Registry. Eur Spine J 2017; 26:488-500.

17. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH, Vernon JD, Walsh JJ. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. I. Paraplegia. 1969 Nov;7[3]:179-92. doi: 10.1038/sc.1969.30.

18. Court C, Vincent C. Percutaneous fixation of thoracolumbar fractures: current concepts. Orthop Traumatol Surg Res. 2012 Dec;98[8]:900-9. doi: 10.1016/j.otsr.2012.09.014.

19. Ni WF, Huang YX, Chi YL, Xu HZ, Lin Y, Wang XY, Huang QS, Mao FM. Percutaneous pedicle screw fixation for neurologic intact thoracolumbar burst fractures. J Spinal Disord Tech. 2010 Dec;23[8]:530-7. doi: 10.1097/BSD. 0b013e3181c72d4c.

20. Zhu C, Wang B, Yin J, Liu XH. A comparison of three different surgery approaches and methods for neurologically intact thoracolumbar fractures: a retrospective study. J Orthop Surg Res. 2021 May 10;16[1]:306. doi: 10.1186/s13018-021-02459-6.

21. Cimatti M, Forcato S, Polli F, Miscusi M, Frati A, Raco A. Pure percutaneous pedicle screw fixation without arthrodesis of 32 thoraco-lumbar fractures: clinical and radiological outcome with 36-month follow-up. Eur Spine J. 2013 Nov;22 Suppl 6[Suppl 6]:S925-32. doi: 10.1007/s00586-013-3016-x.

22. Tamburrelli FC, Perna A, Proietti L, Zirio G, Santagada DA, Genitiempo M. The Feasibility of Long-Segment Fluoroscopy-guided Percutaneous Thoracic Spine Pedicle Screw Fixation, and the Outcome at Two-year Follow-up. Malays Orthop J. 2019;13[3]:39-44. doi: 10.5704/MOJ.1911.007.

23. Wang HW, Li CQ, Zhou Y, Zhang ZF, Wang J, Chu TW. Percutaneous pedicle screw fixation through the pedicle of fractured vertebra in the treatment of type A thoracolumbar fractures using Sextant system: an analysis of 38 cases. Chin J Traumatol. 2010 Jun 1;13[3]:137-45. PMID: 20515590.

24. Phan K, Rao PJ, Mobbs RJ. Percutaneous versus open pedicle screw fixation for treatment of thoracolumbar fractures: Systematic review and meta-analysis of comparative studies. Clin Neurol Neurosurg. 2015 Aug;135:85-92. doi: 10.1016/j. clineuro.2015.05.016.

25. Rampersaud YR, Foley KT, Shen AC, Williams S, Solomito M. Radiation exposure to the spine surgeon during fluoroscopically assisted pedicle screw insertion. Spine [Phila Pa 1976]. 2000 Oct 15;25[20]:2637-45. doi: 10.1097/00007632-200010150-00016.

26. Huang Z, Tong Y, Fan Z, Hu C, Zhao C. Retraction Note: Percutaneous pedicle screw fixation combined with selective transforaminal endoscopic decompression for the treatment of thoracolumbar burst fracture. J Orthop Surg Res. 2020 Dec 30;15[1]:607. doi: 10.1186/s13018-020-02167-7.

27. Mobbs RJ, Sivabalan P, Li J. Minimally invasive surgery compared to open spinal fusion for the treatment of degenerative lumbar spine pathologies. J Clin Neurosci. 2012 Jun;19[6]:829-35. doi: 10.1016/j.jocn.2011.10.004.

28. Mobbs RJ, Sivabalan P, Li J. Technique, challenges and indications for percutaneous pedicle screw fixation. J Clin Neurosci. 2011 Jun;18[6]:741-9. doi: 10.1016/j.jocn.2010.09.019.

29. Wang B, Fan Y, Dong J, Wang H, Wang F, Liu Z, *et al.* A retrospective study comparing percutaneous and open pedicle screw fixation for thoracolumbar fractures with spinal injuries. Medicine [Baltimore]. 2017 Sep;96[38]:e8104. doi: 10.1097/MD.0000000000008104.

30. Regev GJ, Lee YP, Taylor WR, Garfin SR, Kim CW. Nerve injury to the posterior rami medial branch during the insertion of pedicle screws: comparison of mini-open versus percutaneous pedicle screw insertion techniques. Spine [Phila Pa 1976]. 2009 May 15;34[11]:1239-42. doi: 10.1097/BRS.0b013e31819e2c5c.

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