



Original Article (SPINE)

## Comparison of Open Versus Percutaneous Transpedicular Screw Fixation in Thoracolumbar Fractures

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### ABSTRACT

**Background/Objective:** In traumatic lumbar spine injury, we expected that there is a difference in the meantime to return to work following percutaneous transpedicular fixation versus open pedicle screw fixation. We evaluated the average time required to return to work following percutaneous transpedicular fixation versus open pedicle screw fixation in traumatic lumbar spine injury.

**Material and Methods:** A randomized controlled trial included 60 patients. At study entry baseline demographics (age, gender, & duration of injury) were recorded. 30 patients were in the percutaneous transpedicular fixation group (A), while 30 patients were in the open pedicle screw fixation group (B). All the patients were followed every month time taken to return to work (TTRW) was noted on a proforma.

**Results:** Mean time taken by patients to return to work after surgery in Group A was 2.9 days, while in group B it was 5.1 days in group B. The difference between the two groups was significant (p-value 0.001). Within Group A, male and female genders showed a significant difference (p-value 0.032) in the TTRW after surgery. However, Group B did not show a similar difference between male and female patients. Duration of procedure had a significant effect on the TTRW (p-value 0.001).

**Conclusion:** We found 'time is taken to return to work' was  $2.93 \pm 0.82$  in group A and  $5.10 \pm 0.71$  in group B (P-value 0.001). There was a significant difference in both groups. Percutaneous transpedicular fixation is a fast, safe and effective method as compared to other methods.

**Keywords:** Spinal Cord Injury (SCI), Percutaneous Transpedicular Fixation, Conservative Method, Time Taken to Return to Work (TTRW).

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### INTRODUCTION

Trauma resulting in fractures may also cause

concomitant spinal cord injuries (SCI) with varying degrees of neurologic dysfunction. These can be treated conservatively with bed rest, closed reduction of fractures with functional bracing, or surgically with open reduction and internal fracture fixation. In traumatic lumbar spine injury, we expected that there is a difference in the meantime to return to work following percutaneous transpedicular fixation versus open pedicle screw fixation. The purpose of the study was to evaluate the average time required to return to work following percutaneous transpedicular fixation versus open pedicle screw fixation in traumatic lumbar spine injury. Spinal cord injury (SCI) is a debilitating neurological illness that has a substantial cost impact on those who suffer from it. National Spinal Cord Injury mentioned that 1212500 new cases of SCI were reported in the northern USA per year. Ninety percent of SCI cases are traumatic and prevalent due to traffic accidents, violence, and falls. SCI affects adults more commonly than children. Men are more affected in their early and late adulthood, whereas women are more vulnerable throughout youth. People of age more than 60 years have considerably worse outcomes than younger patients with SCI, and their injuries are mainly caused by falls and age-related bone abnormalities.<sup>1-2</sup>

Thoracolumbar spinal fractures are most common (60%) after trauma.<sup>3</sup> The popular method employs pedicle screw fixation of one vertebra above and one below the fracture. Short-segment spinal open instrumentation has resulted in the treatment of kyphotic deformities, enhanced initial stability, early painless movement, and indirect spinal canal decompression.<sup>4</sup> Despite these benefits, this method has been linked to a higher infection rate, increased blood loss, paraspinal injury to muscles, a longer operation time, and a longer hospital stay. Furthermore, this approach has the potential to generate long-term deleterious consequences such as muscle denervation, atrophy, and

discomfort.<sup>5</sup> The average duration to return to work following percutaneous transpedicular fixation was 2.13 months, compared to 4.789 months after open pedicle screw fixation in traumatic lumbar spine injury, according to Patil et al.<sup>6</sup> Wang et al.<sup>4</sup> reported in another research that in traumatic cases, the meantime to recovery with percutaneous transpedicular fixation was 9.73 months compared to 17.6 months with open pedicle screw fixation. We conducted this study to evaluate the time necessary to return to work after traumatic lumbar spine damage using percutaneous transpedicular fixation with open pedicle screw fixation. This study's findings will not only provide local evidence but will also aid in the selection of better management in our community.

Recent advances in SCI medical care have significantly improved SCI diagnosis, stability, survival rates, and patient well-being.<sup>7</sup> Central cord syndrome is the commonest SCI caused by hyperextension in the context of underlying cervical stenosis, resulting in sensory and motor dysfunction in the upper extremities. Complications include muscle atrophy, loss of voluntary motor control, stiffness, pressure sores, infections, and breathing issues. SCI may also be caused by nontraumatic reasons including infection, insufficient blood flow, or tumors.<sup>8</sup> Depending on the severity of their SCI, patients may develop paraplegia or Tetraplegia.<sup>9-10</sup> Depending on the particular position and degree of the damage, the limited function may be retained.<sup>8</sup> Trauma is a major risk factor for many types of vertebral fractures. After very little trauma, asymptomatic congenital defects might cause substantial neurological deficits such as hemiparesis.<sup>1-8</sup>

## **MATERIALS AND METHODS**

### **Study Design and Setting**

A randomized controlled trial was performed at the Lahore General Hospital, Lahore. The study

was conducted for 6 months from 11-09-2020 to 11-03-2021.

### **Sampling**

The sample size was calculated using the following assumptions: level of significance: 5%, power of test: 80%, and using mean duration of time taken to return to work (TTRW) of  $2.13 \pm 1.457$  months after percutaneous transpedicular fixation as compared to  $4.789 \pm 2.838$  months after open pedicles screw fixation in traumatic lumbar spine injury. The total sample size calculated was 50 patients, with 30 patients in each group. A non-probability, consecutive sampling was considered.

### **Inclusion Criteria**

Patients of both genders between 18 – and 50 years of age having a traumatic lumbar spinal injury and presenting to a hospital within 72 hours were included. Patients who were neurologically intact having a TELIS  $\geq 4$  were included.

### **Exclusion Criteria**

Patients with multilevel spinal injury or having a complete spinal cord injury, or multi-organ trauma were included. Unstable patients or those who refused consent were not included.

### **Patients' Groups**

Following approval from the institution's ethics committee, 60 patients (30 in each group) who met the inclusion criteria were enrolled. Both groups were randomly assigned using the lottery technique. The group assignments were written on paper and placed in an opaque jar to be chosen when the patient was in for the treatment. Thirty patients were included in the percutaneous transpedicular fixation group (A), while thirty patients were included in the open pedicle screw

fixation group (B).

### **Data Collection**

All patients were followed up every month, and the time it took them to return to work was recorded on a specifically developed proforma. At the start of the trial, baseline demographics (age, gender, and length of illness) were collected.

### **Surgical Procedure**

All patients in the percutaneous transpedicular fixation group (A) were treated with a free hand method under fluoroscopy, utilizing the equipment designed for percutaneous pedicle screw fixation. All patients had 2 g of Cefacidal as antibiotic prophylaxis before being operated on in a facedown position and under general anesthesia, with thoracic and pelvic supports used to achieve postural fracture reduction. Stabbing incisions were made to ascertain the right vertebral and pedicular levels using C-arm fluoroscopy. Following the fracture, Jamshidi bone needles and K-wires will be inserted into the pedicles of the spinal bodies. Screws were inserted into the pedicles and bonded to the screw lengtheners by drilling above the K-wires. Pedicle screws with diameters ranging from 5.0 to 7.5 mm and lengths ranging from 30 to 50 mm were utilized. The surgeon will calculate the slopes of the rods and prepare them accordingly. With given stabilizations, the rods were inserted from cephalic to caudal. The rods were immobilized after installation, the implant placement was corrected and verified. Suture material was then used to seal the skin. After postural reduction, in instances with multi-sectional displaced fractures, the specified technique and the reduction with balloon (BAER-brainstem auditory evoked responses) technique were combined for fracture reduction and spinal body gap filling.

Patients in the open pedicle screw fixation group (B) underwent standard open pedicle screw instrumentation, including bone grafting and

BAER procedures as needed, while receiving bacterial prophylaxis. While all patients in the open pedicle screw fixation group were braced for 6 and 8 weeks postoperatively. Most patients in the percutaneous transpedicular fixation group did not require bracing.

### Data Analysis

The data were examined using a statistical analysis tool (SPSS version 25). For quantitative characteristics such as age, fracture duration,

operation duration, and time to return to work, mean SD was reported. Qualitative factors such as gender, frequency, and percentage were calculated. The differences in the time it took for both groups to return to work were statistically assessed using the student t-test. The time it took to return to work was divided based on age, gender, fracture duration, and operation length. Post-stratification using the student t-test for both groups.

Group B 0.71197

**Table 1:** Distribution of age (N = 60). Group A (n = 30): percutaneous transpedicular fixation group; Group B (n = 30): pedicle screw fixation group.

Age Groups	Counts and Percentages	Groups		Total (n = 60)
		Group A	Group B	
18 – 40 years	Count	27 (45%)	23 (38.3%)	50 (83.3%)
41 – 50 years	Count	3 (5%)	7 (11.7%)	10 (16.7%)
Mean ± SD (group A) = 33.30 ± 7.64 years				
Mean ± SD (group B) = 33.27 ± 8.97 years				

**Table 2:** Distribution of gender (N = 60).

Gender	Counts & Percentages	Groups		Total (n = 60)
		Group A	Group B	
Male	Count	21 (35%)	21 (35%)	42 (70%)
Female	Count	9 (15%)	9 (15%)	18 (30%)

**Table 3:** Distribution of duration of fractures, procedures, time taken to return to work (N = 60).

Duration	Group A (mean ± SD)	Group B (mean ± SD)
Duration of fractures	23 ± 11.01	36.50 ± 19.11
Duration of procedures	62.13 ± 11.62	36.50 ± 17.11
Time taken to return to work	2.93 ± 0.82	5.10 ± 0.71

**Table 4:** Comparison of both groups for TTRW using independent sample t-test (N = 60).

Parameter	Groups	Number of samples	Mean ± SD (Days)	p-value
Time is taken to return to work (TTRW)	Group A	30	2.9333 ± 0.82768	0.001* (significant result)
	Group B	30	5.1000 ± 0.71	

## RESULTS

### Age Distribution

Mean age was 33.0 years in group A, and 33.27 years in group B. In group A, 27 (45%) were in the age group of 18 – 40 years and 3 (5%) were in the age group of 41 – 50 years. In group B, 23 (38.3%) were in the age group of 18 – 40 years and 7 (11.7%) were in the age group of 41 – 50 years (Table 1).

### Gender Distribution

In both groups, 35% were male and 15% were female patients (Table 2).

### Comparison of 'TTRW in Both Groups

The mean time taken by patients to return to work after surgery in Group A was 2.9 days, while in group B it was 5.1 days in group B. The difference between the two groups was significant (p-value 0.001) See Table 4.

### Stratification of the Effect of Age Groups on 'TTRW' in

## Groups

Time is taken by patients of different age groups to return to work after surgery. The differences between the patients from two age groups within group A or B were insignificant. However, Group A and B had a significant difference in their P values (0.886 vs. 0.440), see **Table 5**.

## Stratification for 'TTRW Concerning Gender

Within Group A, male and female genders showed a significant difference (p-value 0.032) in the time taken to return to work after surgery. However, Group B did not show a similar difference between male and female patients. See **Table 6**.

## Stratified Values for the Effect of Duration of Fracture on the TTRW

Duration of fracture had little effect (p-value 0.743 vs. 0.640) on the time taken to return to work in both Group A and B respectively. See **Table 7**.

## Stratified Values for TTRW W.R.T. duration of Procedure

Duration of procedure had a significant effect on the time taken to return to work (p-value 0.001). See **Table 8**.

## DISCUSSION

Recent breakthroughs in SCI medical care have considerably improved SCI diagnosis, stability, survival rate, and patient well-being.<sup>7</sup> In the

present study, we found that the average time it took patients in Group A to return to work following surgery was 2.9 days, whereas it was 5.1

**Table 5:** Stratification for TTRW concerning age using independent sample t-test (N = 60).

Parameter	Groups	Age Groups (Years)	Mean ± SD	p-value
Time taken to return to work (TTRW)	A	18 – 40	2.9259 ± 0.82	0.886
		41 – 50	3.0000 ± 1.00	
	B	18 – 40	5.0435 ± 0.76	
		41 – 50	5.2857 ± 0.48	

**Table 6:** Stratification for TTRW concerning gender using independent sample t-test (N = 60).

Parameter	Groups	Gender	Mean ± SD	p-value
Time taken to return to work (TTRW)	A	Male	3.1429 ± 0.79	0.032 (significant result)
		Female	2.4444 ± 0.72	
	B	Male	5.0476 ± 0.74	0.548
		Female	5.2222 ± 0.66	

**Table 7:** Stratification for TTRW concerning the duration of the fracture using independent sample t-test (N = 60).

Parameter	Groups	Duration of Fracture Group	Mean ± SD	p-value
Time taken to return to work (TTRW)	Group A	1 – 20 hours	2.8947 ± 0.80	0.743
		> 20 hours	3.0000 ± 0.89	
	Group B	1 – 20 hours	5.1818 ± 0.75	
		> 20 hours	5.0526 ± 0.70	

**Table 8:** Stratification for TTRW concerning the duration of the procedure using independent sample t-test (N = 60).

Parameter	Duration of Procedure Group	Mean ± SD	p-value
Time taken to return to work	< = 90 min	3.5476 ± 1.27	0.001 (significant result)
	> 90 min	5.1111 ± 0.67	

days in Group B. There was a considerable difference between the two groups ( $p$ -value 0.001). The male and female genders in Group A had a significant difference ( $p$ -value 0.032) in the time it took to return to work following surgery. However, there was no difference between male and female patients in Group B. The length of the treatment had a substantial impact on the time it took to return to work ( $p$ -value 0.001). The average time to return to work following percutaneous transpedicular fixation versus open pedicle screw fixation in traumatic lumbar spine injury is compared in this study. Time to return to work was determined to be 2.930.82 in group A and 5.100.71 in group B. In both groups, there was a substantial difference. As a result, Wang et al (2017)<sup>4</sup> found that in traumatic lumbar spine damage, percutaneous transpedicular fixation was superior to open pedicle screw fixation. Percutaneous transpedicular fixation is a quick, painless, and efficient procedure.<sup>4</sup>

There has been recent evolution in PPSF (percutaneous pedicle screw fixation). When compared to OIF (open internal fixation), it may have similar curative results, but it is linked with less trauma, less bleeding, and a faster recovery. In a study by Yang et al (2018),<sup>11</sup> the radiographic and clinical outcomes were similar between the two groups in a prospective study; however, the patients treated with PPSF had a significantly shorter operative time, and less loss of blood, and better pain control. However, as compared to OIF, PPSF has several disadvantages. For example, because of the confined operating space, PPSF lacks anatomical indicators, which might raise the risk of facet capsule damage. Because PPSF necessitates the use of specialized equipment, surgical difficulties and the potential of problems such as screw misplacement may be considerable, particularly for surgeons with little expertise. X-ray dosage is high, and the educational curve is steep. In conclusion, PPSF has the advantages of reduced surgical stress and faster recovery in the treatment of thoracolumbar and lumbar

fractures.<sup>11</sup>

Kocis et al. (2020)<sup>12</sup> examined the efficacy of percutaneous and open pedicle screw fixation without fusion in the treatment of type A3 and A4 thoracolumbar fractures. Traumatic thoracolumbar burst fractures are prevalent, although there is no agreement on the best treatment strategy. Thoracolumbar burst fractures were successfully treated with both open and percutaneous short-segment pedicle fixations. Percutaneous or open pedicle screw implantation can be used to treat patients with type A3 and A4 thoracolumbar fractures. Although there was less intraoperative blood loss in the PPSF group, the radiation exposure dosage was two times higher than in the OPSF group. In terms of postoperative Cobb angle and loss of correction, no differences were identified between the groups. None of the patients in their research underwent extra ventral stabilization using cages or plates. There was no distinction between the A3 and A4 fractures. It is well recognized that when two discs rupture, there is a greater loss of reduction than when only one-disc ruptures. Their research backs up the idea that percutaneous spine fixation can be used to treat a subset of thoracolumbar spine fractures (types A3 and A4) without causing neural compression. Blood loss was lower in the percutaneous group, which might be beneficial, especially in the polytraumatized patient<sup>12</sup>. According to Li et al,<sup>13</sup> for patients with type A thoracolumbar fracture, percutaneous screw fixation combined with intermediate screws at the fractured vertebra may more efficiently repair and maintain compromised vertebral height and is a suitable, less intrusive surgical approach.

The surgical strategy of reducing the slipping vertebra is still disputed. After posterior decompression and interbody fusion, the author compared the effectiveness of a percutaneous reduction fixation device to standard open pedicle screw fixation for the treatment of lumbar spondylolisthesis. The patients in a study by Heo et al,<sup>14</sup> had lumbar spondylolisthesis and were

treated with either open transpedicular screw fixation and posterior lumbar interbody fusion or PPSF with a reduction system after PLIF. During the follow-up, there were no significant differences in VAS values for back pain and radiculopathy between the two groups, although the final ODI (Oswestry Disability Index) score in the PPSF group was considerably lower than the OTPSF group.<sup>14</sup> In circumstances where the outcomes are good, percutaneous short-segment pedicle instrumentation might substitute for lengthy open surgery without increasing associated problems.<sup>15</sup>

It has been recommended that the minimally invasive percutaneous treatments in instances that accomplish good results might be replaced in many cases with substantial open surgery and not increased related problems. However, more high-quality comparative RCTs are required to examine the prognosis of patients treated with PPSF as opposed to open instrumented procedures.<sup>15</sup>

## CONCLUSION

In this study, we compare the mean time taken to return to work after percutaneous transpedicular fixation versus open pedicle screw fixation in traumatic lumbar spine injury. We found that Time taken to return to work was  $2.93 \pm 0.82$  in group A and  $5.10 \pm 0.71$  in group B. Difference was significant in both groups. So we concluded that percutaneous transpedicular fixation was better than open pedicle screw fixation in traumatic lumbar spine injury. Percutaneous transpedicular fixation is a fast, safe and effective method. More high-quality RCTs are needed, however, to compare the long-term results of patients utilizing the two treatments.

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### Additional Information

**Disclosures:** Authors report no conflict of interest.

**Ethical Review Board Approval:** The study was conformed to the ethical review board requirements.

**Human Subjects:** Consent was obtained by all patients/participants in this study.

**Conflicts of Interest:**

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

**Financial Relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

**Other Relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

### AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of;
1.	Syed Ahmad Faizan	Study Design, Methodology, and Paper Writing.
2.	Muhammad Jahanzeb	Data Calculation and Data Analysis.
3.	Zubair Mustafa Khan	Interpretation of Results.
4.	Tariq Imran	Statistical Analysis.
5.	Abdul Majid	Literature Review.
6.	Asif Bashir	Literature Review and Quality Insurer.