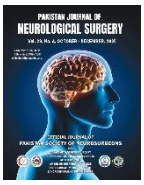

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Original Research

Transpedicular Screw Fixation and Its Surgical Outcomes In The Management of Lumbar Instability: A Case Series of 107 Patients

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ABSTRACT

Objective: Lumbar instability is a predominant pathology characterized by excessive and abnormal movement between two or more segments and is a significant cause of disability. In recent years, the transpedicular screw fixation system has been found to be successful in the management of spinal instabilities. The study aims to find out the surgical outcomes of TPF in radiological lumbar instability.

Materials & Methods: This study was conducted on 107 patients at Ali Institute of Neurosciences, Irfan General Hospital, from June 2018 to December 2021, with a one-year follow-up period. Patients were recruited through non-probability convenience sampling. Inclusion criteria consisted of patients diagnosed with radiological lumbar instability evident on investigation findings. Exclusion criteria consisted of patients who were diagnosed with functional or non-radiological instability and those undergoing any procedure other than transpedicular screw fixation.

Results: A total of 107 patients were treated for radiological lumbar instability through transpedicular screw fixation, out of which the majority of the participants were males (62%), followed by females (38%). The majority of the participants (75%) stated that the back pain was diminished completely or had minor episodes. Mean improvement on the visual analogue scale was observed to be 6 points (Pre-op VAS=8, Post op VAS=2). Neurological symptoms, including sensory and motor, demonstrated improvement in 90% of the patients.

Conclusion: Transpedicular screw fixation (TPF) is a safe, effective surgical procedure associated with significant clinical outcomes. However, the procedure is associated with minor surgical and post-op complications. Postoperative physiotherapy may further enhance recovery in lumbar instability patients.

Keywords: Radiological Lumbar Instability, Radiographic lumbar instability, Screw Fixation, Transpedicular Screw Fixation.

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INTRODUCTION

Lumbar instability is a predominant pathology characterized by excessive and abnormal movement between two or more segments and degeneration of the intervertebral joints, which can also affect the neural structures and lead to significant disability. The prevalence of lumbar instability is up to 57% in patients suffering from chronic low back pain.[1] Lumbar instability is classified based on etiology into radiological (structural) and clinical (functional) instability. Radiological or structural instability is characterized by excessive vertebral movements, i.e translation or rotation due to loss of integrity of passive structures such as bones and ligaments.[2] While functional or clinical instability, the architecture of structural elements of the lumbar spine is intact, and the clinical symptoms of instability are attributed to poor motor control and weakness of core and lumbar stabilizer muscles.[3] Lumbar instability is diagnosed radiologically when excessive mobility is noted between the lumbar segments on flexion/extension plain radiographs. Different studies suggest that the diagnosis of lumbar instability should be made on the basis of clinical tests and signs and symptoms correlating with the radiographic findings, i.e. X-ray, CT and MRI.[4] For many conditions affecting the spine, which result in instability (degenerative, traumatic or insidious), the minimal invasive approach is becoming the treatment of choice as conventional procedures carry significant risks of increased intra- and post-operative complications along with increased hospital stay. In the late 1970s, the technique of transpedicular screw placement was first performed for temporary external fixation of the spine. Due to the advancements made in surgical instruments and approaches, transpedicular screw placement is now also used as an internal fixation and is mainly used in the treatment of lumbar spine instabilities and is described as a successful procedure according to different studies.[5-6] Transpedicular screw fixation gained rapid popularity among spine surgeons and is now routinely used in various spinal disorders to increase stabilization and fusion in the spine.[7] Transpedicular screw fixation is associated with early mobilization of the patient, which leads to decreased postoperative complications associated with prolonged immobilization.[8]

This case series aimed to determine the surgical outcomes of transpedicular screw fixation for radiological lumbar instability in terms of pain relief, hospital stay, intra- and postoperative complications and postoperative radiological findings demonstrating the architecture of the lumbar spine.

MATERIALS & METHODS

Study Design & Study Setting:

A prospective case series study was conducted on 107 patients at Ali Institute of Neurosciences, Irfan General Hospital, from June 2018 to December 2021, with a one-year follow-up period. Ethical approval was obtained from the institutional research committee (Ref:46/AINS/2018). Patients were recruited through non-probability convenience sampling.

Inclusion Criteria:

Our inclusion criteria consisted of patients diagnosed with radiological lumbar instability evident on investigation findings.

Exclusion Criteria:

All those patients were excluded from our study who were diagnosed with functional or non-radiological instability, and those undergoing any procedure other than transpedicular screw fixation. All those patients having vertebral subluxation of greater than 10mm, greater than 30 angulations of

vertebral angle and loss of height of vertebral body (>50%) with improvements in symptoms after external support such as bracing were operated without a trial of conservative treatment.

Table 1: *Patient characteristics/Etiology.*

Variables		Frequency/ Percentages
Gender	Male	(62%)
	Female	(38%)
Age	Mean age (Range)	42 (Range 20-65)
Symptoms Reported	Low back pain	107 (100%)
	Neurological symptoms	(27%)
Previous surgery	Lumbar spine laminectomy	(34%)
Etiology of Lumbar Instability	Spondylolisthesis	(35%)
	Fractures	(27%)
	Previous failed lumbar surgeries	(20%)

Procedure

Informed consent was taken from all the patients included in the study. A predesigned proforma including demographic variables such as gender, previous surgeries, level of instability and occupation was recorded. Pre-operative outcome measures were recorded, including pain (visual analogue scale) and radiological status. The standard procedure of transpedicular screw fixation was carried out, and outcome measures were obtained post-surgery at different follow-up periods of 1 year.

Analysis

Data was analyzed descriptively. As this was a case series without a control group, descriptive statistics were deemed appropriate for summarizing the data. Frequencies and percentages were calculated for categorical variables, while means and ranges were reported for numerical variables.

RESULTS

Patient Characteristics and Demographics

During the three years, a total of 107 patients were treated for radiological lumbar instability through transpedicular screw fixation, of which the majority of the participants were males (62%), followed by females (38%). Loss to follow-up was 16 patients, and results were recorded for 91 patients. The age of the participants ranged from 20 to 65 years, with a mean age of 42 years.

Clinical Presentation

Low back pain (moderate to severe) was the symptom reported by every patient (100%), and neurological signs and symptoms were present in 27% of the included participants, while others had no neurological symptoms associated.

Previous Surgery

(34%) Patients underwent a previous surgery of spine surgery at the time of examination.

Etiology of Lumbar Instability

When evaluated and assessed for the etiology of lumbar instability, the results demonstrated that (35%) had degenerative or isthmic spondylolisthesis, (27%) attributed to fractures, (20%) due to previously failed lumbar surgeries, and fractures, while the remaining were attributed to other nonspecific causes.

Back Pain and Neurological Function

Relief of back pain among participants was assessed both subjectively and through a visual analogue scale. The majority of the participants

(75%) stated that the back pain was diminished completely or had minor episodes, (20%) reported the pain to be of moderate intensity, and they could continue their normal daily life activities, while only 5% reported no improvement in symptoms. Mean improvement on the visual analogue scale was observed to be 6 points. (Pre op VAS=8. Post op VAS=2). Neurological symptoms, including sensory and motor, demonstrated improvement in 90% of the patients.

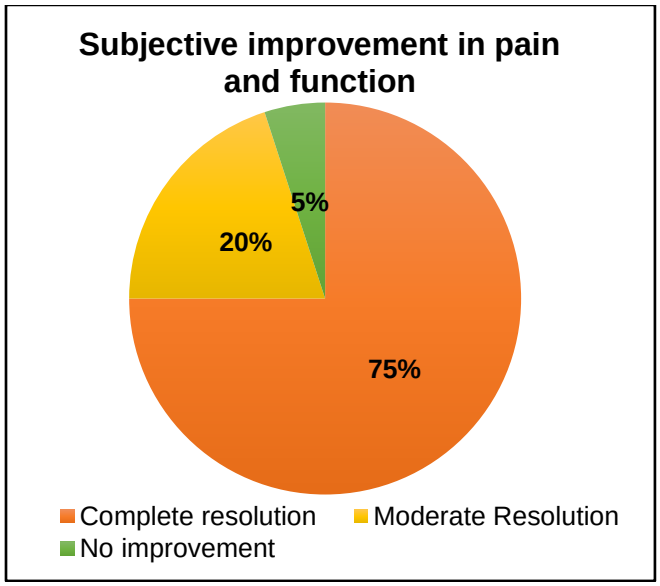

Figure 1: *Showing subjective Improvement in pain and function.*

Fusion Rates

Excellent results in terms of fusion rates were reported in longer follow-ups, with 97% of the participants demonstrating complete osseous union on radiological investigations without any clinical or radiological signs or symptoms of instability. Only 3% rate of pseudoarthrosis was observed.

Complications of the Procedure

Complications associated with the procedure were complications were nonunion in (3%), CSF leak (2%), delayed wound healing (2%), wound infection (1%) and epidural hematoma in one patient at L4/L5 level causing bilateral mild paresis was reported in one patient which was completely reversed after conservative management.

Table 2: *Complications of the procedure.*

Complications	Frequency/ Percentages
Non-union	(3%)
CSF leak	(2%)
Delayed wound healing	(2%)
Wound infection	(1%)
Epidural hematoma causing paresis	1 patient

DISCUSSION

In patients suffering from chronic low back pain, lumbar instability has been diagnosed through X-rays in 57% of patients, demonstrating the increased frequency of the disorder among the general population.[9] The summarized outcomes presented in Table 1 and Table 2 demonstrate the clinical and radiological improvements observed following transpedicular screw fixation. Usually, patients are managed through conservative treatment options such as physical therapy and medications, but if not respond to these conservative measures, then surgical procedures are incorporated. Lumbar fusion and decompression surgeries are mostly used in lumbar disorders requiring surgical intervention.[10] Rods and pedicle screws are instruments used to restore the normal disc height and regain structural stability.[11] In this study, we incorporated transpedicular screw fixation for managing lumbar radiological instability in 107 patients and yielded satisfactory results. Studies have shown that in the past, rods and hooks were used for spondylolisthesis, Instability, fractures and scoliosis, but these were associated with compromising the mobility of the spine.[12] Evidence has supported that transpedicular fixation is associated with only rigid fixation of the segments involved for stability and fusion while allowing

maximum optimal movements in the spine.[13] However, post-operative vascular or neurological complications and sometimes graft failures can occur due to inappropriate placement or selection of the screw.[14] The geometry of the skeleton is variable in different ethnic groups, depending on certain factors such as geographical area, genetics, and socioeconomic status.[15] Therefore, Pre-operative assessment of various variables along with pedicle angulations is of great importance to reduce or avoid post-operative complications. The findings of a 5-year review study conducted by Roberto Masferrer and coauthors demonstrated that all patients diagnosed with lumbar instability presented with moderate to severe low back pain, while 40 patients had unilateral lumbar radiculopathy. Ten of the patients presented with clinical signs and symptoms of cauda equina.8 These findings are in accordance with our study in terms of symptomatology of back and radiating pain. But in contrast, no case of cauda equine was reported in our study. Clinical outcomes of transpedicular fixation in our study showed excellent results, as 75% of the participants had complete resolution of symptoms while only 5% reported no improvement. A study conducted on 104 patients to determine the outcomes of the procedure also showed satisfactory results, as twenty patients out of the total collected data of 96 patients demonstrated that their pain was completely resolved with some minor intermittent episodes.[16] The number of participants having complete resolution of symptoms is less as compared to our study. Overall, the procedure is associated with improved pain and function status after the procedure. A fusion rate of 97% was reported in our study, with only 3% patients requiring pseudarthrosis in a one-year follow-up time. A prospective comparative Study conducted in 2018 to evaluate the fusion rates of pedicular screw demonstrated 85% fusion rates, which are less than compared to our study.[17] Certain factors are associated with pseudarthrosis, including the type of approach (usually anterior), smoking, hypertension, number of fused vertebrae, long-term use of steroids and rheumatoid arthritis.[18] In our study, the complications observed were CSF leak in (2%) patients, delayed wound healing (2%), Wound infection (1%), and Epidural hematoma causing paresis in one patient. A study conducted by P. C. Jutte and R. M. Castelein evaluated the complications associated with transpedicular screw fixation in 105 consecutive patients. The complications reported preoperatively were 36, which were neuropraxia in one patient and a malposition screw in 35 patients, while post-operative complications reported were deep infections in 5 patients, screw breakage in 18, loss of corrections in 28, breakage of rod in 1 and migration of rod in 4 patients.[19] The study was limited by the absence of a control or comparison group. Future studies using randomized or comparative designs are recommended to strengthen the evidence regarding transpedicular screw fixation outcomes. Our study only assessed the outcomes of transpedicular fixation in one group of the population without comparing the effects with another group that had been administered another type of surgical intervention. Also, the follow-up period was 1 year. Future studies incorporating higher study designs with randomization into two different groups and having a longer follow-up period will increase our knowledge of the subject. This study has certain limitations, including its single-center design, relatively small sample size, and a one-year follow-up period, which may not fully capture long-term outcomes. Despite these limitations, the findings provide valuable local evidence on the safety and efficacy of transpedicular screw fixation.

CONCLUSION

The results of our study concluded that transpedicular screw fixation is a safe, effective surgical procedure associated with excellent clinical outcomes in terms of pain relief and resolution of neurological symptoms in

radiologically evident lumbar instability. However, the procedure is also associated with minor surgical and post-surgical complications. Incorporating structured physiotherapy after surgery may further improve functional outcomes in patients with lumbar instability.

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Additional Information

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Human Subjects: Consent was obtained from all patients 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.
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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
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2.	Mumtaz Ali, Yasir Ashraf & Hanif Ur Rahman	2. Paper writing
3.	Ramzan Hussain & Akram Ullah	3. Data collection and calculations
4.	Yasir Ashraf, Hanif Ur Rahman & Ramzan Hussain	4. Analysis of data and interpretation of results
5.	Mumtaz Ali & Amjad Ali	5. Literature review and referencing
6.	Ramzan Hussain, Amjad Ali & Hanif Ur Rehman	6. Editing and quality insurer