

Original Research

Transpedicular Fixation for the Alleviation of Neurogenic Claudication and Backache in the Management of Spondylolisthesis

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ABSTRACT

Objective: To evaluate the surgical outcome of transpedicular fixation for degenerative spondylolisthesis in terms of alleviation of neurogenic claudication and backache.

Materials & Methods: This prospective observational study was carried out at the Department of Neurosurgery, Medical Teaching Institute, Bacha Khan Medical Complex, Swabi over two years. Patients presenting with backache and neurogenic claudication and having spondylolisthesis on radiological investigations were subjected to transpedicular fixation and evaluated for improvement in symptoms and fusion rate at 6 months follow-up.

Results: 60 patients participated in the study. The mean age was 41.42 ± 7.29 years and 63.3% were females. L5-S1 was the most common level involved in 40% of the patients and 50% of the patients had Grade 2 spondylolisthesis. There was a significant reduction in mean back pain score on NRS post-operatively (Pre-op was 6.73 ± 1.94 Vs. post-op was 1.57 ± 1.34 , P value = 0.00). The neurogenic claudication reduced from 88.3% Vs. 10% (P value = 0.00). The fusion rate was 90% at 6-month follow-up.

Conclusion: Transpedicular fixation for degenerative spondylolisthesis is the most effective procedure in terms of relief of neurogenic claudication and backache.

Keywords: Spondylolisthesis, Transpedicular Fixation, Neurogenic Claudication, Backache.

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INTRODUCTION

Spondylolisthesis is a combination of two Greek words, *Spondyl* meaning vertebra and *Olisthesis* meaning slippage; hence, can be defined as a disease entity of the spine diagnosed radiologically in which one vertebra slips over

another vertebra leading to the manifestation of clinical symptoms.^{1,2,3} The incidence is around 5-10% in adults and prevalence is estimated to be 6%.^{4,5,6} Wiltse et al,⁷ have categorized it into six types: Type 1 or dysplastic; Type 2 or isthmic; Type 3 or degenerative; Type 4 or traumatic; Type 5 or pathological and Type 6 or iatrogenic.^{8,9}

Degenerative spondylolisthesis is more common in adults with a high prevalence over 50 years of age.¹⁰ The incidence ranges from 2.1% to 19.1% in males to 8.1% to 25% in females, with a female-to-male ratio of 6:1.^{11,12} Various risk factors like age, gender, occupation, lifestyle, body mass index, etc. have been studied and found contributory to the condition.¹³ Majority of the patients are found incidentally on plain X-rays without any symptoms; however, in symptomatic patients, backache and neurogenic claudication are the most common presenting symptoms.¹⁴ Degenerative changes responsible for the slippage of the vertebra are disc degeneration; facet joints arthritis; laxity of the ligamentum flavum; and poor stabilization of the paraspinal muscles.¹⁵

Regarding the management of the condition, there are no clear-cut guidelines, varying from conservative medical management to various surgical options including decompression, fusion, and transpedicular fixation, depending upon the severity of the presenting symptoms and the treating physician's preferences.¹⁶ Surgical indications include neurogenic claudication, severe radiculopathy, intractable backache, neurological deficit, and failure of conservative management.¹⁷

One of the surgical options is transpedicular fixation, with or without posterior interbody fusion.¹⁸ Transpedicular fixation has been found to have a better segmental stabilization effect than laminar hook-rod or wire-rod techniques and leads to the improvisation in symptoms of backache and neurogenic claudication.¹⁹ This study was carried out to find out the effects of transpedicular fixation in the alleviation of

symptoms like neurogenic claudication and back pain in patients with spondylolisthesis.

MATERIAL AND METHODS

Study Design and Setting

This prospective observational study was carried out at the Department of Neurosurgery, Medical Teaching Institute, Bacha Khan Medical Complex, Swabi over two years i.e. from 1st July 2021 to 30th June 2023.

Inclusion Criteria

Patients aged 30-60 years of both genders, with a history of low backache and neurogenic claudication and evidence of degenerative spondylolisthesis on imaging, were included.

Exclusion Criteria

Patients having grade V spondylolisthesis or traumatic spondylolisthesis were not included. Those who had a previous history of lumbar spine surgery, neurogenic claudication for more than 10 years, or congenital spinal deformity on evaluation were also excluded. Patients with signs and symptoms of vascular claudication were identified and removed from the study. Patients who lost to follow-up at 6 months were also dropped out of the study.

Data Collection and Clinical Management

Before the commencement of the research, approval was obtained from the hospital's ethical and research approval committee. The patients in the study were recruited via OPD considering the above criteria and consent was obtained from them. Backache was quantified and the presence of neurogenic claudication was ascertained with the scales. Presence of neurological deficit if any was also documented. Pre-operative work including lumbar spine X-ray, anteroposterior and lateral view (flexion/extension view), MRI, and CT

lumbosacral spine were performed. Grading of spondylolisthesis was done utilizing the Meyerding classification system (Grade 1 to Grade 5). Subsequently, the patients were subjected to transpedicular fixation and lumbar decompression. Post-operatively the patients were mobilized on 2nd post-operative day and kept in a lumbosacral brace for 3 months. The patients were re-assessed at a 6-month follow-up for backache, neurogenic claudication, and neurological status accompanied by plain X-ray and CT scan of the lumbosacral spine for the assessment of fusion. The pre-operative and post-operative X-rays shown in Figures 3 and 4 of the results are shared after obtaining informed consent from the patient.

Assessment of Backache and Neurogenic Claudication

The pre-and post-operative backache at 6 months follow-up was quantified with the help of a Numeric rating scale (NRS) where a patient was asked to score the patient from 0 to 10 (0 means no pain and 10 means the worst pain that one can imagine). The presence of neurogenic claudication was ascertained with (1) Resting pain of < 4 out of 10 on NRS and (2) walking pain of > 4 out of 10 on NRS after 15 15-minute' walk.

Data Analysis

Data including age, gender, pain score, neurogenic claudication, complications, and the presence or absence of fusion were collected with a proforma and analyzed with SPSS 26. Student T-test was utilized to compare means of pre-and post-operative backache. Neurogenic claudication was compared with the help of a chi-square test.

RESULTS

Age Distribution

The total number of participants was 60. The mean age was 41.42 ± 7.29 years (range 31-58 years).

Gender Distribution

38 (68.3%) of the patients were females and 22 (36.7%) were males.

Pre-Operative Backache Score

The mean pre-operative back pain score on NRS was 6.73 ± 1.94 . The pain was further divided into mild (0-3), moderate (4-7) and severe (8-10) categories and distribution was as shown in Table 1.

Table 1: Pre-Operative Back Pain Distribution.

Pain Score on NRS	No. of Patients	Percentage
No Pain	0	0.00%
Mild (0-3)	2	3.33%
Moderate (4-7)	35	58.33%
Severe (8-10)	23	38.34%

Pre-Operative Neurogenic Claudication

Utilizing the above-mentioned criteria, 53 (88.3%) of the patients were found to have neurogenic claudication while 7 (11.7%) did not qualify for the criteria.

Grades of Spondylolisthesis

The pre-operative grades of spondylolisthesis on the Meyerding classification system are shown in Figure 1.

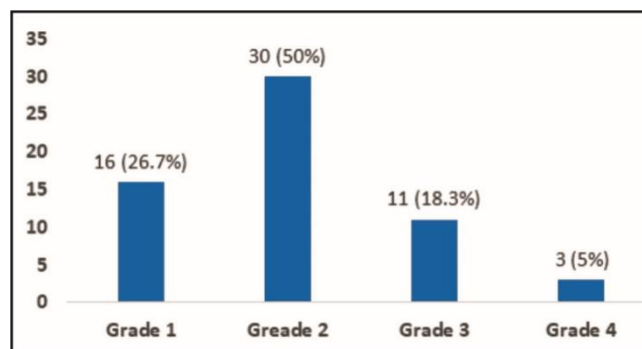


Figure 1: Grades of Spondylolisthesis.

Pre-operatively, no patients have neurological deficits or sphincteric dysfunction.

Level of the Spine Involved in Spondylolisthesis

The level of the spine involved is shown in Figure 2.

Post-Operative Backache Score

Post-operatively, at 6-month follow up the mean back pain score was 1.57 ± 1.34 which differed significantly from the pre-operative back pain score (6.73 ± 1.94 Vs. 1.57 ± 1.34 , P value = 0.00). The post-operative back pain was categorized as shown in Table 2.

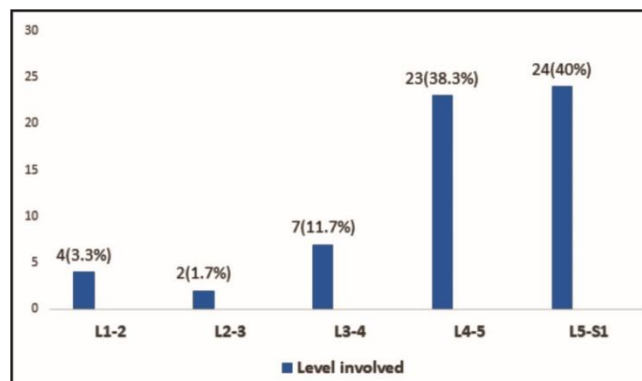


Figure 2: Level of the spine involved by spondylolisthesis.

Table 2: Post-Operative Back Pain Distribution.

Pain Score on NRS	No. of Patients	Percentage
No Pain	12	20.00%
Mild (0-3)	44	73.34%
Moderate (4-7)	4	6.66%
Severe (8-10)	0	0.00%

Table 3: Improvement in Neurogenic Claudication.

		Status		Total	P-value
		Pre-operative	Post-operative		
Claudication	Present	53	6	59	0.00
	Absent	7	54	61	
Total		60	60	120	

Post-Operative Neurogenic Claudication

Post-operatively, neurogenic claudication was relieved in 54 (90%) patients and 6 (10%) of patients had no improvement in their claudication status. The pre-and post-operative neurogenic claudication was compared with the chi-square test as shown in Table 3.

Post-Operative Fusion Rate

At 6-month follow up 54 (90%) of the patients had radiological signs of fusion on plain X-ray or CT scan lumbosacral spine.

Post-Operative Complications

The postoperative complications as shown in Table 4 were managed accordingly.

Table 4: Post-Operative Complications.

Complications	No. of Patients	Percentage
Surgical site infections	5	4.20%
CSF leak	1	0.80%
Implant failure	2	1.70%
Fusion failure	2	1.70%
Neurological deficit	0	0.00%

Pre- and Post-Operative X-ray Images

Figure 3 and Figure 4 show the pre-and post-operative X-ray lumbosacral spine of a patient who underwent transpedicular fixation for spondylolisthesis (These images are included after obtaining informed consent from the patient).



Figure 3: Pre-Operative X-ray. The flexion, extension lumbosacral spine X-ray and lateral view shows degenerative spondylolisthesis at L4-L5 level (images included with the permission of the patient).

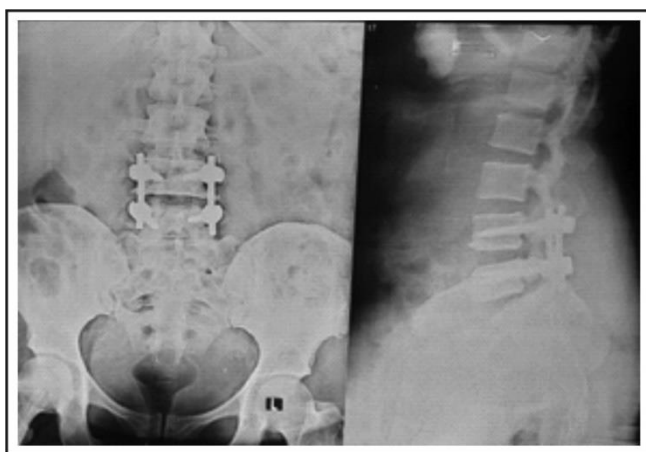


Figure 4: Post-operative X-ray. The post-operative lumbosacral spine AP and a lateral view showing L4-L5 transpedicular screw *in-situ* and reduction of L4-L5 spondylolisthesis (images included with the permission of the patient).

DISCUSSION

Spondylolisthesis developed as a result of a failure of a mobile segment of the spine, and surgical treatment with instrumentation in the form of transpedicular fixation came into consideration in the latter half of the 20th Century.²⁰ These degenerative changes are usually age-related, with slight female predominance for reasons unknown as evident from our results as well i.e. mean age

was 41.42 ± 7.29 years and 63.3% were females. Association with body mass index, lifestyle, and other relevant factors has been under discussion in the literature;¹³ however, we did not collect any relevant data to find out any such association.

Neurogenic claudication and backache are the predominant presenting symptoms in patients of spondylolisthesis^{8,10} and the mean back pain score on NRS was 6.73 ± 1.94 and 83.3% of patients had neurogenic claudication in our study.

In our study, Grade 2 spondylolisthesis was the most common i.e. 30 (50%) of the patients and L5-S1 was the most frequent level involved (40%) followed by L4-5 (38.3%). Similar findings were reported by Ishaq et al²¹ and Amir et al,²² however, Singha et al,²³ and Ewiss et al,²⁴ found L4-5 as the most common level involved (70% and 76% of cases respectively).

We found a significant reduction in backache post-operatively at follow-up (6.73 ± 1.94 Vs. 1.57 ± 1.34 , P value = 0.00). Similarly, Moussa et al,²⁵ reported a reduction of backache from 7.75 ± 0.72 to 1.35 ± 0.59 on VAS. Omidi-Kashani et al,²⁶ noticed a reduction of pain from 8.8 to 2.1 on VAS. El-karamany et al,²⁷ found that pre-operative back pain on VAS was 8.42 which reduced to 1.79, and leg pain changed from 7.46 to 1, post-operatively. They also assessed the ODI score which decreased significantly from severe disability (52.21%) to mild disability (15.71%). There was a statistically significant difference in VAS for back pain, leg pain, and ODI. El-Mor ES et al,²⁸ reported a 31.5% reduction in backache and a 67.48% reduction in leg pain after transpedicular fixation. These findings emphasize the important point that back pain reduces significantly with transpedicular fixation in cases of spondylolisthesis.

We also found that there was a significant reduction in neurogenic claudication (88.3% Vs. 10%, P value = 0.00) after undergoing transpedicular fixation for spondylolisthesis. Urakawa H et al,²⁹ followed up patients with lumbar spine stenosis with spondylolisthesis who underwent lumbar decompression only without

fusion and transpedicular fixation for 5 years and found that the rates of patients who needed subsequent fusion were 1.9%-4.3% at 1 year, 3.5%-8.9% at 2 years, and 6.7%-14.6% at 5 years. Neurogenic claudication was one of the main risk factors among others for subsequent requirements of fusion and instrumentation. Hence only decompression in patients of spondylolisthesis and neurogenic claudication is not sufficient and should be accompanied by fusion or fixation.

We found that 90% of the patients had signs of radiological fusion at 6-month follow-up. Similar findings were reported by Ishaq et al²¹ and Amir et al.²² The greater degree of fusion is associated with improvement in back pain symptoms and favorable outcomes overall. As we did not perform any interbody fusion, these findings also support the argument that transpedicular fixation alone without interbody fusion can have a higher grade of fusion rates.

We found that wound infection was the most common complication, post-operatively followed by implant failure; however, the complications were comparable to the findings in other studies and acceptable according to international standards.²¹⁻²⁶

CONCLUSION

We conclude that transpedicular fixation for degenerative spondylolisthesis is associated with a significant reduction in backache and neurogenic claudication and achieves higher fusion rates.

LIMITATIONS AND

RECOMMENDATIONS OF THE STUDY

Owing to the findings of our study, it is recommended that transpedicular fixation is a procedure of choice for patients suffering from neurogenic claudication and backache secondary to degenerative spondylolisthesis and should be done in routine; however, our study was limited by shorter follow-up of 6-month of the patients and further studies with a longer follow-up are recommended.

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Additional Information

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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.

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AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Sajjad Ahmad	1. Study design, methodology, data collection & paper writing.
2.	Mian Iftikhar ul Haq	2. Analysis of data, literature review, interpretation of results, and editing.