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CLINICAL OUTCOMES OF TRANSPEDICULAR FIXATION IN DEGENERATIVE SPONDYLOLISTHESIS: EVALUATION OF BACK PAIN RELIEF

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ABSTRACT

Background: Degenerative spondylolisthesis is a spinal condition associated with aging, primarily occurring at Lumber 4–Lumber 5 (L 4-L 5) in women over the age of 50. Although conservative treatment is typically the first option, surgery is required for ongoing symptoms. Pedicle screw fixation, with or without fusion and decompression, enhances stability, alleviates nerve compression, and boosts pain relief and function, with instrumented fusion typically favored in unstable situations. **Objective:** This study was done to observe the clinical outcomes of Transpedicular Fixation in degenerative spondylolisthesis. **Materials and Method:** This observational study was carried out from 2020 to 2024 at Dhaka Medical College Hospital and Green Life Hospital, Dhaka, Bangladesh, involving 175 patients with degenerative spondylolisthesis who underwent transpedicular fixation. Pain and function were evaluated using Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) before surgery and at 3 and 6 months after surgery. Both ethical approval and informed consent were secured. **Results:** In total, 175 patients (average age 57.2 ± 10.1 years; 61.7% female) with mainly Grade I spondylolisthesis were recruited. After transpedicular fixation, pain and function showed notable enhancement, with VAS decreasing from 7.7 ± 1.2 to 2.2 ± 0.9 and ODI declining from 59.1 ± 9.3 to 19.6 ± 6.2 at the 6-month mark ($p< 0.001$). At the final follow-up, 88% of patients reached good to excellent results. Postoperative complications were observed in 12.6%, with superficial wound infection being the most frequent, and no deaths recorded. **Conclusion:** Transpedicular fixation for degenerative spondylolisthesis offers substantial pain alleviation and enhancement in function, yielding high rates of favorable to excellent results. It is a reliable and efficient choice with manageable complications in chosen patients.

Keywords: Degenerative spondylolisthesis, Transpedicular Fixation, Clinical Outcomes, Visual Analogue Scale (VAS) , Oswestry Disability Index (ODI).

INTRODUCTION

Degenerative spondylolisthesis (DS) is a widespread spine disorder associated with aging, characterized by a vertebra shifting forward, a term derived from Greek in the 1960s that means "vertebra" and "slip." [1]. It typically impacts individuals over the age of 50, is approximately four times more prevalent in women, and most often affects the L4–L5 region. The causes are multifactorial, encompassing pregnancy, joint laxity, and oophorectomy, along with anatomical factors such as sagittal facet orientation and a greater pedicle-facet angle also playing a role [2].

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DS is clinically diagnosed and validated through imaging: X-ray (standing lateral ± flexion–extension), Magnetic Resonance Imaging (MRI) for stenosis, and Computed Tomography (CT) if MRI cannot be performed or is inconclusive[3,4]. Initial treatment for degenerative spondylolisthesis is conservative; however, surgical intervention is required if symptoms continue or escalate. Pedicle screw fixation, whether accompanied by decompression and fusion or not, reinstates stability, alleviates nerve pressure, and enhances pain relief and function[5]. Transpedicular fixation stabilizes the spine through the placement of pedicle screws to regulate segmental movement. It is frequently paired with decompression and fusion to encourage a strong bony connection. Research indicates enhanced fusion rates and clinical results in cases of low-grade degenerative spondylolisthesis[6,7].

Low back pain is the primary symptom in degenerative spondylolisthesis and is typically mechanical because of segmental instability. Surgical stabilization greatly enhances pain relief and functionality, with research indicating lower VAS and ODI scores following transpedicular fixation [8]. The best approach for degenerative spondylolisthesis is still under discussion, particularly the comparison between decompression alone and fusion. Nevertheless, evidence supports instrumented fusion for enhanced stability and symptom relief in unstable situations, establishing pedicle screw fixation as an essential standard treatment [9]. Surgery for degenerative spondylolisthesis seeks to alleviate pain and neurological issues by providing stability to the spine. Transpedicular fixation reinstates alignment, restricts movement, and encourages fusion, with research indicating enhanced pain relief and functionality [10].

The global research indicated that using pedicle screw fixation with posterolateral fusion for lumbar and lumbosacral spondylolisthesis led to substantial pain relief and enhanced functional outcomes, showing notable postoperative decreases in disability scores and primarily good to excellent clinical results in the majority of patients [11]. Another research found that interbody fusion along with transpedicular fixation serves as an effective remedy for spondylolisthesis, offering robust spinal stabilization, elevated fusion rates, and marked enhancements in pain relief and functional results [12].

The research in Bangladesh indicated that lumbar interbody fusion accompanied by posterior instrumentation for spondylolisthesis led to considerable improvements in pain, disability, and functional outcomes, achieving high fusion rates and generally positive postoperative clinical results [13]. Another study indicated that posterior decompression combined with transforaminal lumbar interbody fusion (TLIF) utilizing both a cage and bone graft in cases of spondylolisthesis resulted in effective spinal stability, high rates of fusion, and considerable enhancements in pain relief and functional outcomes, yielding overall positive clinical results and dependable surgical effectiveness [14].

In Bangladesh, research on transpedicular fixation for degenerative spondylolisthesis is scarce, limited, and of short duration, with varying outcome measures and insufficient emphasis on alleviating back pain. This study thus seeks to assess the efficacy of transpedicular fixation in alleviating back pain and enhancing functional results in Bangladeshi patients through standardized evaluation methods.

MATERIALS AND METHOD

Study Design and Setting

This was a prospective observational study conducted in the Department of Neurosurgery at Dhaka Medical College Hospital (DMC) and Green Life Hospital, Dhaka, Bangladesh**.** The study period was from January 2020 to December 2024**.**

Study Population

The study included patients diagnosed with degenerative spondylolisthesis who underwent transpedicular fixation during the study period. A total of 175 patients were enrolled consecutively based on eligibility criteria.

Inclusion Criteria

Patients were included if they met the following criteria:

- Diagnosed cases of degenerative spondylolisthesis confirmed by clinical and radiological evaluation
- Patients undergoing transpedicular fixation
- Age ≥ 40 years
- Willingness to participate and provide informed consent
- Availability for follow-up for at least 6 months

Exclusion Criteria

Patients were excluded if they had:

- Traumatic, congenital, or isthmic spondylolisthesis
- Previous lumbar spine surgery
- Spinal tumor, infection, or inflammatory spinal disease
- Severe comorbid conditions precluding surgery or follow-up
- Incomplete clinical data or loss to follow-up

Sampling Technique

A purposive consecutive sampling technique was used to recruit all eligible patients meeting the inclusion criteria during the study period.

Data Collection Procedure

Data were collected using a structured proforma. Preoperative assessment included detailed history, clinical examination, and radiological evaluation (X-ray and MRI of the lumbosacral spine). Baseline pain and functional status were assessed using:

- Visual Analog Scale (VAS**)** for back pain
- Oswestry Disability Index (ODI) for functional disability

All patients underwent standard transpedicular fixation surgery performed by experienced spine surgeons following institutional protocols.

Postoperative Follow-up

Patients were followed up at:

- 3 months postoperatively
- 6 months postoperatively

At each follow-up, VAS and ODI scores were recorded, and patients were assessed for clinical improvement and complications.

Outcome Measures

The primary outcome was change in back pain severity, measured by VAS score. Secondary outcomes included:

- Functional improvement assessed by ODI score
- Overall clinical outcome categorized as excellent, good, fair, and poor based on 6-month VAS score
- Postoperative complications

Statistical Analysis

Data were analyzed using SPSS version 25.0**.** Descriptive statistics were expressed as mean ± standard deviation for continuous variables and frequency with percentage for categorical variables. Paired t-test was used to compare preoperative and postoperative VAS and ODI scores. A *p*-value of <0.05 was considered statistically significant.

Ethical Consideration

Ethical approval was obtained from the Institutional Review Board (IRB) of Dhaka Medical College and Green Life Hospital prior to the study. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment. Patient confidentiality and anonymity were strictly maintained by using coded data, and participation was voluntary without affecting standard treatment.

RESULTS

Baseline Characteristics of the Patients

Table 1 shows total of 175 patients were included in this study, with a mean age of 57.2 ± 10.1 years. Females constituted the majority of the study population (61.7%). Most patients had Grade I spondylolisthesis (67.4%) and a symptom duration of ≥6 months (70.3%).

Table 1: Socio-demographic and Clinical Characteristics of the Patients (n = 175)

Variable	Frequency	Percentage (%)
Age (years)		
40–50	42	24.0
51–60	68	38.9
61–70	46	26.3
>70	19	10.9
Sex		
Male	67	38.3
Female	108	61.7
Grade of Spondylolisthesis		
Grade I	118	67.4
Grade II	57	32.6
Duration of Symptoms		
<6 months	52	29.7
≥6 months	123	70.3

n=number of subjects

Preoperative and Postoperative Pain and Functional Scores

Table 2 presents that there was a statistically significant improvement in both pain and functional outcomes following transpedicular fixation. The mean VAS score decreased from 7.7 ± 1.2 preoperatively to 2.2 ± 0.9 at 6 months postoperatively ($p< 0.001$). Similarly, the ODI improved from 59.1 ± 9.3 preoperatively to 19.6 ± 6.2 at 6 months ($p< 0.001$), indicating substantial functional recovery.

Table 2: Comparison of Preoperative and Postoperative Pain and Functional Scores

Parameter	Preoperative (Mean ± SD)	3 Months (Mean ± SD)	6 Months (Mean ± SD)	*p*-value*
VAS Score	7.7 ± 1.2	3.4 ± 1.1	2.2 ± 0.9	<0.001
ODI Score	59.1 ± 9.3	30.2 ± 7.1	19.6 ± 6.2	<0.001

*Paired t-test comparing preoperative and 6-month postoperative values.VAS=Visual Analog Scale; ODI=Oswestry Disability Index.

Clinical Outcomes

Table 3 shows, at 6 months follow-up, more than half of the patients achieved excellent outcomes (n = 94, 53.7%). A further 34.3% (n = 60) of patients had good outcomes, while 10.3% (n = 18) and 1.7% (n = 3) of patients had fair and poor outcomes, respectively. Overall, the majority of patients (88.0%) experienced favorable outcomes (excellent to good), indicating a high rate of clinical improvement following transpedicular fixation.

Table 3: Outcome Based on VAS Score at 6 Months (n = 175)

Outcome Category	VAS Score	Frequency	Percentage (%)
Excellent	≤2	94	53.7
Good	3–4	60	34.3
Fair	5–6	18	10.3
Poor	≥7	3	1.7

n=number of subjects

Postoperative Complications

Table 4 presents postoperative complications occurred in 12.6% of patients. The most common complication was superficial wound infection (6.3%), followed by implant-related complications (3.4%) and dural tear (2.9%). All complications were managed appropriately, with no mortality reported during the follow-up period.

Table 4: Postoperative Complications of the Patients (n = 175)

Complication	Frequency	Percentage (%)
Superficial wound infection	11	6.3
Dural tear	5	2.9
Implant-related complications	6	3.4
Total	22	12.6

n=number of subjects

DISCUSSION

The current study showed that the majority of patients were older females, primarily with Grade I spondylolisthesis and symptoms lasting ≥6 months. These results align with earlier evidence indicating that degenerative spondylolisthesis occurs more frequently in older women and is generally linked to mild vertebral slippage arising from ongoing degenerative alterations in the facet joints and intervertebral discs [15].

Transpedicular fixation demonstrated substantial enhancement in pain relief and functionality, as VAS decreased from 7.7 ± 1.2 to 2.2 ± 0.9 and ODI from 59.1 ± 9.3 to 19.6 ± 6.2, reflecting notable clinical improvement. Comparable enhancements have been noted in research indicating that fusion combined with decompression yields superior pain alleviation and functional results compared to decompression by itself or non-surgical treatment in degenerative spondylolisthesis [16,17].

In this study, 88% of patients achieved good to excellent outcomes at 6 months after transpedicular fixation, indicating significant clinical improvement. Similar results were reported by Ishaq et al., who found that pedicle screw fixation for degenerative spondylolisthesis provides marked pain relief and favorable functional outcomes in most patients [18].

Complications after surgery were observed in 12.6% of patients, with the most frequent being superficial wound infection, followed by issues related to the implant and dural tear, while no deaths were recorded. Comparable results were observed by Amir et al., who indicated that transpedicular fixation for spondylolisthesis presents manageable complication rates, while delivering considerable back pain relief and favorable overall outcomes [19].

Overall,transpedicular fixation for degenerative spondylolisthesis is a reliable and efficient treatment, offering considerable pain alleviation, enhanced functionality, high rates of favorable to outstanding results, and an acceptable rate of complications.

CONCLUSION

Transpedicular fixation for degenerative spondylolisthesis results in considerable and lasting pain relief, accompanied by significant functional enhancements and high percentages of favorable to excellent clinical results. It is a secure, efficient, and dependable surgical choice with a tolerable complication profile, justifying its application in suitably chosen patients for prolonged stability and recuperation.

CONFLICT OF INTEREST

There is no conflict of interest.

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