EAS Journal of Orthopaedic and Physiotherapy
Abbreviated Key Title: EAS J Orthop Physiother
ISSN 2663-0974 (Print) | ISSN 2663-8320 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-5 | Issue-6 | Nov-Dec, 2023 | DOI: 10.36349/easjop.2023.v05i06.002

Original Research Article

Clinical & Radiological Outcomes of Posterior Decompression & Transforaminal Lumbar Interbody Fusion (TLIF) among Patients with Lumbar Spondylolisthesis – A Prospective Study

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Article History
Received: 02.11.2023
Accepted: 06.12.2023
Published: 09.12.2023

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: ***Introduction*:** Lumbar spondylolisthesis, a condition characterized by the displacement of one vertebra over another, often leads to chronic back pain and functional impairment. Posterior decompression and TLIF are used as surgical options for patients with lumbar spondylolisthesis. ***Aim of the Study*:** The aim of this study was to assess the clinical & radiological outcomes of posterior decompression & transforaminal lumbar interbody fusion (TLIF) among patients with lumbar spondylolisthesis. ***Methods:*** This prospective observational study was carried out at NITOR, Dhaka, Bangladesh, during the period from January 2020 to December 2021. Total 30 patients with degenerative lumbar spondylolisthesis were included in this study. ***Result*:** In this study, majority of participants were aged 41-50 (47%), predominantly female (60%). Clinical outcomes showed significant improvements post-treatment: low back pain and leg pain, measured by VAS, decreased substantially, and disability scores (ODI and Roland-Morris) also improved markedly. Quality of life, assessed by SF-36, showed notable enhancements in both physical and mental scores. Radiologically, there were significant improvements in disc and foraminal height, reduction in spondylolisthesis severity, and restoration of lumbar lordosis and spinal stability. The average surgery time was around 147.5 minutes, with a mean blood loss of 382.7 mL and an average hospital stay of 7.1 days. A 90% fusion rate was achieved at 1-year follow-up, with dural tears being the most common complication. Despite some complications, the majority of surgeries were completed safely. ***Conclusion*:** Posterior decompression and TLIF appear to be effective in treating lumbar spondylolisthesis, as evidenced by improved clinical and radiological outcomes.

Keywords: Clinical Outcomes, Radiological Outcomes, Posterior Decompression, Transforaminal Lumbar Interbody Fusion (TLIF), and Lumbar spondylolisthesis.

I INTRODUCTION

Lumbar spondylolisthesis, a condition characterized by the anterior displacement of a vertebra in relation to the vertebrae below it, is a significant cause of lower back pain and disability [1, 2]. It affects a considerable portion of the population, particularly the elderly, due to degenerative changes in the spine. While degenerative spondylolisthesis, which can arise independently of pars interarticularis damage and tends to manifest in female patients, predominates in adults, isthmic spondylolisthesis is the most prevalent variant in children [1, 3, 4]. The clinical manifestation of lumbar spondylolisthesis varies, ranging from mild discomfort to severe neurological deficits, including radiculopathy and claudication [5]. The pathophysiology of lumbar spondylolisthesis involves the degeneration of intervertebral discs and facet joints, leading to instability and misalignment of the vertebral column. This

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degeneration is often exacerbated by factors such as aging, mechanical stress, and genetic predisposition [6]. The resultant instability not only causes pain but also can lead to significant functional impairment. In addressing lumbar spondylolisthesis, non-surgical treatments such as physical therapy, pain management, and lifestyle modifications are initially recommended. However, for patients with severe symptoms or those who do not respond to conservative management, surgical intervention becomes necessary [7]. Among the surgical options, Transforaminal Lumbar Interbody Fusion (TLIF) combined with posterior decompression has emerged as a prominent technique. Posterior decompression has been shown to provide significant clinical benefit in the surgical treatment of degenerative spondylolisthesis (DS) [8]. On the other hand, TLIF is a more recent technique that involves the fusion of the affected vertebrae through a posterior approach. Studies have demonstrated that TLIF can lead to significant improvements in neurological recovery, pain reduction, and functional outcomes in patients with lumbar spondylolisthesis [9]. The combination involves the removal of bone or ligamentous material that is compressing the nerves in the spinal canal [10]. The efficacy of TLIF in treating lumbar spondylolisthesis has been a subject of extensive research. Clinical outcomes of TLIF have been generally favorable, with many studies reporting significant improvement in pain and function post-surgery [11]. Moreover, radiological outcomes, such as the restoration of disc height and foraminal volume, have also been documented, indicating the anatomical benefits of the procedure [12]. However, the procedure is not without its challenges and complications. Issues such as non-union, implant failure, and adjacent segment disease have been reported, necessitating a thorough understanding of patient selection and surgical technique [11]. Additionally, the long-term effectiveness and comparison with other surgical techniques remain areas of ongoing research. The current study aims to evaluate both the clinical and radiological outcomes of posterior decompression and TLIF in patients with lumbar spondylolisthesis. This evaluation is crucial in understanding the effectiveness of the procedure, identifying potential areas for improvement, and guiding future clinical practice. Lumbar spondylolisthesis is a prevalent and debilitating condition, with surgical intervention often required in severe cases. TLIF, combined with posterior decompression, offers a promising solution, but its comprehensive evaluation is essential for optimizing patient outcomes. This study seeks to contribute to this body of knowledge by providing a detailed analysis of the clinical and radiological outcomes of this surgical approach.

II OBJECTIVES

To assess the clinical & radiological outcomes of posterior decompression & transforaminal lumbar interbody fusion (TLIF) among patients with lumbar spondylolisthesis.

III METHODOLOGY & MATERIALS

This prospective observational study was carried out at NITOR, Dhaka, Bangladesh, during the period from January 2020 to December 2021. Total 30 patients with degenerative lumbar spondylolisthesis were included in this study. The patients were treated using posterior decompression & transforaminal lumbar interbody fusion (TLIF). Consent of the patients and guardians were taken before collecting data. After collection of data, all data were checked and cleaned. After cleaning, the data were entered into computer and statistical analysis of the results being obtained by using windows-based computer software devised with Statistical Packages for Social Sciences (SPSS) version 22. After compilation, data were presented in the form of tables, figures and charts, as necessary. P value of less than 0.05 was considered statistically significant.

Inclusion Criteria:

1. Age more than 40 years.
2. Degenerative lumbar spondylolisthesis
3. Spondylolisthesis grade I and II.
4. Radiologically proven instability.
5. Severe low back or leg pain or both not responding to medical treatment for consecutive 3 months
6. Progressive neurological deficit

Exclusion Criteria:

1. Severe systemic disease
2. Spondylolisthesis due to neoplastic conditions
3. Spondylolisthesis due to traumatic conditions
4. Spondylolisthesis due to Infective conditions
5. Dysplastic spondylolisthesis
6. High grade spondylolisthesis (Grade III, IV and V)

IV RESULT

Table-I presents the demographic characteristics of a study people comprising 30 individuals. The age distribution is segmented into four groups. The majority (47%) of the participants are in the 41-50 age group, followed by 23% in the 51-60 age group. Those aged ≤40 and ≥60 constitute 20% and 10% of the population, respectively. The gender split shows a higher representation of females (60%) compared to males (40%). In BMI category, the largest group falls within the 'Normal weight' category (40%). Hypertension is the most common comorbidity, affecting 30% of the participants. This is followed by coronary heart disease (23%), 'Others' (27%), and diabetes (20%). Notably, 20% of the participants do not have any of the listed comorbidities. The majority of the study population are non-smokers (60%). Both former smokers and current smokers each make up 20% of the participants. Table-II provides a detailed comparison of clinical outcomes for a study patient, measured at baseline and then again at a 1-year follow-up. The data shows significant improvements across various health indicators. The severity of low back pain, as measured

by the Visual Analogue Scale (VAS), decreased markedly from an average score of 6.2 at baseline to 1.8 after one year, a change underscored by a P-value of less than 0.001. A similar trend was observed in leg pain VAS scores, which dropped from 7.3 to 2.5. The Oswestry Disability Index (ODI), reflecting disability due to back pain, showed a significant reduction from 60% to 25%. The Roland-Morris Disability Questionnaire scores, another measure of back pain-related disability, also decreased from 15 to 5. Furthermore, there were notable improvements in the quality of life as measured by the Short Form-36 (SF-36) survey, with the Physical Score increasing from 40 to 75 and the Mental Score from 50 to 80, both changes being statistically significant ($P < 0.001$). Overall, the table illustrates substantial improvements in both pain severity and quality of life for the study participants over the one-year period. Table III presents the radiological outcomes for 30 study participants, comparing baseline measurements with those taken at a 1-year follow-up. The data indicate significant improvements across all measured parameters. Disc height increased from an average of 8 mm at baseline to 12 mm at 1 year, with a highly significant P-value of <0.001. Similarly, foraminal height showed a notable increase from 15 mm to 22 mm, also with a P-value of <0.001. In terms of the slip grade, as per the Meyerding Classification, there was an improvement from Grade 2 at baseline to Grade 1 at the 1-year mark, indicating a reduction in the severity of spondylolisthesis, with a P-value of <0.05. Lumbar lordosis angle, which is a critical measure of spinal curvature, improved from 30° to 45°, with a P-value of <0.01, suggesting a significant restoration of the spine's natural curvature. Lastly, segmental motion, which is indicative of spinal stability, showed a decrease from 10° to 2°, with a P-value of <0.01, reflecting improved spinal stability post-treatment. These results collectively suggest that the treatment was effective in improving the radiological parameters of the spine in patients with spondylolisthesis. Table IV provides a detailed overview of intraoperative data and 1-year follow-up information for a study involving 30 patients. The average operative time was approximately 147.5 minutes, with a standard deviation of 41.3 minutes, indicating some variability in surgery duration. The mean blood loss during the operations was 382.7 mL, with a standard deviation of 131.5 mL, suggesting a moderate amount of blood loss during these procedures. The average hospital stay post-surgery was 7.1 days, with a standard deviation of 3.4 days, reflecting the recovery time needed after the procedure. A key outcome of the study was the fusion rate at the 1-year follow-up. A successful fusion was achieved in 27 patients, accounting for 90% of the study group. However, 3 patients (10%) experienced nonunion or delayed union, indicating a need for further monitoring or intervention. In terms of intraoperative complications, dural tears were the most common, occurring in 4 patients (13.3%). Nerve root injuries were noted in 3 patients (10%), and vascular injuries were reported in 1 patient (3.3%). Hardware malposition occurred in 2 patients (6.7%). Despite these complications, a significant majority of the surgeries (66.7%) were completed without any intraoperative complications, highlighting the overall safety of the procedures.

Table-I: Demographic characteristics of the study people (N=30)

Variable	Number of Patients	Percentage (%)
		Age
≤40	6	20%
41-50	14	47%
51-60	7	23%
≥60	3	10%
		Gender
Male	12	40%
Female	18	60%
		BMI Category
Underweight (<18.5)	3	10%
Normal weight (18.5-24.9)	12	40%
Overweight (25-29.9)	9	30%
Obese (≥30)	6	20%
		Comorbidities
Diabetes	6	20%
Hypertension	9	30%
Coronary heart disease	7	23%
Others	8	27%
None	6	20%
		Smoking Status
Non-smoker	18	60%
Former smoker	6	20%
Current smoker	6	20%

Table-II: Clinical outcome of the study people (N=30)

Clinical Outcomes	Baseline	1-Year Follow-Up	P-value
Low back pain VAS	6.2	1.8	<0.001
Leg pain VAS	7.3	2.5	<0.001
Oswestry Disability Index (ODI)	60%	25%	<0.001
Roland-Morris Disability Questionnaire	15	5	<0.001
Short Form-36 (SF-36) Physical Score	40	75	<0.001
Short Form-36 (SF-36) Mental Score	50	80	<0.001

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

Table-III: Radiological outcome of the study people (N=30)

Radiographic Outcomes	Baseline	1-Year Follow-Up	P-value
Disc Height (mm)	8 mm	12 mm	<0.001
Foraminal Height (mm)	15 mm	22 mm	<0.001
Slip Grade (Meyerding Classification)	Grade 2	Grade 1	<0.05
Lumbar Lordosis Angle (degrees)	30°	45°	<0.01
Segmental Motion (degrees)	10°	2°	<0.01

Statistical analysis was done by unpaired Student t-test.
s= Significant
ns= Not significant

Table-IV: Intraoperative and 1-year follow-up information of the study people (N=30)

Intraoperative data	Number of Patients	Percentage (%)
		Operative time (Minute)
Mean SD	147.5±41.3	
		Blood loss (mL)
Mean SD	382.7±131.5	
		Hospital stay (Day)
Mean SD	7.1±3.4	
		Fusion Rate
Successful Fusion at 1 Year	27	90%
Nonunion or Delayed Union	3	10%
		Intraoperative Complications
Dural Tear	4	13.30%
Nerve Root Injury	3	10%
Vascular Injury	1	3.30%
Hardware Malposition	2	6.70%
No Complications	20	66.70%

V DISCUSSION

The current study was conducted assess the clinical & radiological outcomes of posterior decompression & transforaminal lumbar interbody fusion (TLIF) among 30 patients with lumbar spondylolisthesis. The demographic characteristics of the study population align with trends observed in lumbar spondylolisthesis research. The predominance of the 41-50 age group (47%) in our study is consistent with the age-related degenerative changes seen in lumbar spondylolisthesis, as noted in similar studies [13]. The higher representation of females (60%) in our study mirrors the demographic trends observed in lumbar spine pathologies, where women are often more affected, as indicated in the study of Chan AK *et al.,* [14] In BMI category, the largest group falls within the 'Normal weight' category (40%). Hypertension is the most common comorbidity, affecting 30% of the participants. The majority of the study population are non-smokers (60%). The mean Visual Analogue Scale (VAS) score for low back pain improved from 6.2 at baseline to 1.8 at the 1-year follow-up, indicating a substantial reduction in pain intensity. This improvement is greater than the findings reported in a 2023 study on endoscopic TLIF, which also noted significant pain relief post-surgery [15]. The Oswestry Disability Index (ODI) showed a decrease from 60% to 25%, reflecting a marked improvement in disability due to back pain. This reduction is in line with the results from similar surgical interventions, where significant decreases in ODI scores were commonly observed in the study of Sim DS *et al.,* [16] Another study of Cheng X *et al.,* [17] observed significant improvements in the leg pain VAS and ZCQ score for both cohorts at 3 months and 2 years after surgery. Radiological outcomes of the current study also showed significant improvements. The increase in disc height

from 8 mm to 12 mm and foraminal height from 15 mm to 22 mm, both with P-values of <0.001, are indicative of the efficacy of the surgical procedure in restoring spinal anatomy. These improvements are comparable to those reported in a 2022 study, where postoperative radiological parameters significantly improved following lumbar spondylolisthesis surgery [18]. In the present study, the average operative time of 147.5 minutes and blood loss of 382.7 mL are within the ranges reported in the literature, suggesting a standard level of complexity and risk associated with these procedures [19]. The fusion rate at 1-year follow-up was 90%, which is a favorable outcome compared to similar studies. However, the incidence of intraoperative complications, such as dural tears (13.3%) and nerve root injuries (10%), although within the expected range, highlights the need for careful surgical planning and technique. The substantial improvements in pain, disability, and quality of life, along with the favorable radiological outcomes, reinforce the value of these surgical procedures in the management of lumbar spondylolisthesis.

VI Limitations of the Study

This is a single centered study with only 1 year follow up. As a result, long term complications like pseudarthrosis requiring revision, adjacent segment degeneration and implant failure could not be evaluated. Foraminal widening and fusion assessment needs CT evaluation, but was ignored due to patients' financial constraints. T2-weighted kinetic MRI and three-dimensional CT reconstruction had been recommended for a precise diagnosis of lumbar spinal instability, but these could not be performed due to unavailability of expertise. Due to COVID 19 pandemic situation, follow-up could not be done properly. Patients from long distance residence often lost follow up timely. The sample size was small.

VII CONCLUSION AND RECOMMENDATIONS

From the findings of this current study, posterior decompression and TLIF appear to be effective in treating lumbar spondylolisthesis, as evidenced by improved clinical and radiological outcomes. This technique offers significant pain relief and functional improvement. However, careful patient selection and surgical expertise are crucial for optimal results. Further studies with larger sample size and long time follow up are required to have better understanding.

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Citation: Md. Sahidur Rahman Khan, Muhammad Eusuf Harun, Md. Ferdous Rayhan, Kamrun Naher, S M Zubaer Hasan, Md. Syedur Rahaman, Md. Tanvir Ahasan Juglol Khan (2023). Clinical & Radiological Outcomes of Posterior Decompression & Transforaminal Lumbar Interbody Fusion (TLIF) among Patients with Lumbar Spondylolisthesis – A Prospective Study. *EAS J Orthop Physiother*, *5*(6): 75-80.