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Assessing the Outcomes of Combined Surgical Techniques in Spondylolisthesis: A One Year Retrospective Analysis

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ABSTRACT

Surgical intervention is the treatment of choice in cases of severe pain in spondylolisthesis that doesn't respond to conservative measures. Decompression and fusion surgery is the gold standard surgical procedure for treating lumbar spondylolisthesis with foraminal stenosis, and it can be carried out in a variety of ways. **Objectives:** To investigate the outcomes of combined surgical techniques, including facetectomy along with foraminotomy, to secure the normal alignment of the lumbar spine in patients with spondylolisthesis. **Methods:** This retrospective cross-sectional study included the records of fifty-two patients who underwent facetectomy along with foraminotomy for spondylolisthesis from January 2022 to March 2023. Assessment of demographic information, clinical presentations, and outcomes was conducted. Descriptive statistics were analyzed via IBM SPSS software version 26. **Results:** The Mean age of the participants was 42 ± 15 years. The majority were female, 31(59%), as compared to male. The most frequent level which demonstrated listhesis was L4-L5 23 (45%), followed by L5, S1 18 (34%) and L3, L4 11(21%). In Type 1 listhesis, Full correction was achieved in 100% of cases, while in Type 2 listhesis, 80% of cases achieved correction. Further significant association ($p \leq 0.05$) was found among post-surgical outcomes including pain, functional disability and neurological status. **Conclusions:** It was concluded that facetectomy combined with foraminotomy is associated with improved clinical outcomes in the management of spondylolisthesis, particularly in Type 1 cases. The procedure was linked to pain relief, enhanced functional ability, and improved neurological status. Further longitudinal studies are required to assess long-term efficacy and safety.

INTRODUCTION

Spondylolisthesis, derived from the Greek roots "spondyl" (for vertebrae) and "oliothesis" (for dislocation or slippage), is a clinical entity characterised by the slipping of one vertebra forward over the one below it [1, 2]. Childhood spondylolisthesis is known to occur in 4% and 6% of the time, with the majority of cases being isthmic and occurring between L5 and S1 [3]. Adult incidence rises to 5% to 10%, becoming mostly degenerative, more prevalent in the female population, and commonly affects the L4 to L5 region, then the L5 to S1 region [4]. According to the Myerding classification, the caudal vertebrae represent the amount of vertebral slippage on an X-ray.4 The Myerding classification of spondylolisthesis has five levels. Grade I slippage is less than 25%, Grade II slippage ranges between 26% to 50%, Grade III slippage (51%- 75%), Grade IV slippage (76% - 100%), and Grade V slippage is over 100% and is known as spondyloptosis [5]. A prevalent degenerative condition that affects people with low-grade spondylolisthesis at a rate of 10% to 50% is lumbar facet cysts[6]. Surgical intervention is the treatment of choice in cases of severe pain that doesn't respond to conservative measures [7]. Early treatment for Degenerative Spondylolisthesis involved decompression, reduction, fixation, and fusion, much like dysplastic spondylolisthesis. With the advent of spinal instrumentation and the identification of DS as a distinct condition, surgical

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treatment advanced mostly in the second half of the 20th century [8]. Decompression and fusion surgery is the gold standard surgical procedure for treating lumbar spondylolisthesis with foraminal stenosis, and it can be carried out in a variety of ways [9]. Surgery for partial facetectomy with or without fusion is still debatable. Fusion improves results in situations of preoperative instability or spondylolisthesis, prevents segmental instability, and lessens adjacent segment degeneration [10]. However, Literature have also reported the destabilizing effects of Facetectomy on the spine [11].

This study aims to assess the outcomes of combined surgical techniques, including facetectomy along with foraminotomy, to secure the normal alignment of the lumbar spine in patients with spondylolisthesis.

METHODS

This study conducted a retrospective cross-sectional analysis. The records and data were gathered from January 2022 to March 2023 at Rizwan Medical Center, Peshawar. Ethical Approval was obtained from the Institutional Review Board of the Hospital (Ref no: 305/RMC&GH), and informed consent was obtained from all patients or their legal guardians before surgery and data collection. The study population consisted of fifty-two patients who underwent surgical intervention from January 2022 to March 2023. Inclusion criteria encompassed patients who have undergone facetectomy along with foraminotomy for spondylolisthesis diagnosed by subjective and radiological findings of plain X-ray. Patients with spondylolisthesis due to post-traumatic, post-malignant, osteoporotic, or congenital etiologies were not included in the study. Data were gathered from medical records, surgical logs, and radiological reports of patients who met the inclusion criteria. The demographic information, including age, gender, and relevant medical history, along with preoperative evaluation, including clinical evaluations, and radiological imaging (e.g., X-rays, CT scans, and MRI scans), was gathered. The patient was placed in a prone position on the operating table, and general anesthesia was administered. An incision was made over the affected lumbar area. Through the dissection of soft tissues, the surgical team gained access to the affected vertebrae and their surrounding structures. Once access was established, facetectomies were performed, according to the specific case and level of spondylolisthesis. This involved the removal of the facet joint, which articulates with adjacent vertebrae, facilitating access to the spinal canal. Following this, a foraminotomy was performed to enlarge the neural foramen, the passageway through which spinal nerves exit the spine. The incision was then closed, often utilizing absorbable sutures or staples. Postoperatively, patients were closely monitored in the recovery area before being transferred to a standard hospital room. Physical therapy and rehabilitation commenced to aid the recovery process, and follow-up visits were scheduled. Postoperative clinical outcomes were assessed using standardized measures such as the Visual Analogue Scale (VAS) for pain intensity, the Oswestry disability index for functional disability scores, and neurological status. These assessments were performed at specified follow-up intervals post-surgery of 8 months. Any perioperative and postoperative complications were documented, including infection, neurological deficits, hardware failure, and wound-related issues. Statistical analysis was done on SPSS version 26.0. Descriptive statistics were reported to summarize the demographic and clinical outcomes data. Frequency and percentages were used to analyze categorical variables, while continuous variables were assessed through mean and standard deviation. A paired sample t-test was used to evaluate the difference between pre- and post-values. A p-value of ≤0.05 was considered statistically significant.

RESULTS

The study shows the demographics of patients. A total of 52 individuals were enrolled in the study, ranging in age from 30-54 years, with a mean age of 42 ±15 years. The sample consisted of 21 (41%) male and 31 (59%) female in the study population. 4 (7%) of patients presented after surgical management for laminectomy and discectomy. 3 (6%) of patients presented with post-discitis. Degenerative listhesis was the most common clinical presentation, accounting for 17 (33%) of cases. 8 (15%) of patients exhibited a pars defect as part of their clinical presentation (Table 1).

Table 1: Patient characteristics of enrolled participants

Patient Characteristics	Categories	Frequency (%)
Gender	Male	21 (41%)
	Female	31 (59%)
Age (Years)	Age Range (30-54)	Mean age 42 ± 15 Years
Post-surgical Patients Undergoing Laminectomy and Discectomy	Laminectomy Post-Discitis	4 (7%)
	Discectomy Post-Discitis	3 (6%)
Clinical Presentation	Degenerative listhesis	17 (33%)
	Pars defect	8 (15%)

The most frequent level which demonstrated listhesis was L4-L5 23 (45%), followed by L5, S1 18 (34%) and L3, L4 11 (21%) (Table 2).

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Table 2: Level of Listhesis

Level of Listhesis	Frequency (%)
L4-L5	23 (44.2%)
L5-S1	18 (34.6%)
L3-L4	11 (21.2)

The Sapiro-Wilk test was applied to test for normal distribution. The current study found that the dataset was normally distributed, as its significance value was (p>0.05) (Table 3).

Table 3: Shapiro-Wilk Test

Sapiro-Wilk Test	Statistic	Sig
Pain	0.962	0.16
Functional Disability	0.971	0.11
Neurological Status	0.917	0.09

The outcomes of the surgical procedure varied based on the type of spondylolisthesis: In Type 1 listhesis, Full correction was achieved in 100% of cases, while in Type 2 listhesis, 80% of cases achieved correction. Residual listhesis was observed in 10% of the cases of Type II, and 30% of cases were of Type 3 listhesis. Post-operative outcomes are summarized in this study. A significant reduction (p=0.02) in pain scores was observed with a mean score from (mean ± SD (7.8 ± 1.1)) to (3.2 ± 0.9)) in the study population following surgery with 39 (75%) of patients reporting a decrease in pain scores after the procedure, while 8 (15%) of patients experienced no significant change in pain scores and 5 (10%) of patients reported an increase in pain scores post-surgery. After assessing the functional ability of patients, the results showed that 31 (60%) of patients showed a statistically significant functional improvement (p=0.05) with a mean score ranged from 62.5 ± 7.3 to 36.4 ± 6.5 in functional disability scores, while 13 (25%) of patients demonstrated no change in functional disability scores. However, 8 (15%) of patients experienced moderate improvement in functional disability scores. The study also evaluated changes in neurological status following the surgical intervention. 44 (85%) of patients showed statistically improved neurological functioning (p=0.05) with a mean score ranged from 4.3 ± 1.5 to 8.2 ± 1.0 in neurological status post-surgery while 6 (12%) of patients exhibited a moderate improvement in neurological status and 2 (3%) of patients experienced no significant change in neurological status (Table 4).

Table 4: Outcome Measure Score

Outcome Measure	Categories	n (%)	Pre-operative (mean ± SD)	Post-operative (mean ± SD)	p-Value
Pain Scores	Significantly Improved	39 (75%)	7.8 ± 1.1	36.4 ± 6.5	0.02
	No Change	8 (15%)			
	Worsened	5 (10%)			
Functional Disability	Significantly Improved	31 (60%)	62.5 ± 7.3	3.2 ± 0.9	0.01
	No Change	13 (25%)			
	Moderate Improvement	8 (15%)			
Neurological Status	Significantly Improved	44 (85%)	4.3 ± 1.5	8.2 ± 1.0	0.05
	No Change	2 (3%)			
	Moderate Improvement	6 (%)			

Foot drop was observed in 1 patient (2%) while Wrong screw placement was noted in 3 cases (5%) and Tears were observed in 1 case (2%). Wound infection was documented in 1 case (2%) (Table 5).

Table 5: Complications of the Procedure

Complications	Frequency (%)
Footdrop	1 (2%)
Wrong Screw Placement	3 (5%)
Tears	1 (2%)
Wound Infection	1 (2%)

DISCUSSION

The findings of this study provide valuable insights into the clinical outcomes of combined surgical intervention for spondylolisthesis in a cohort of 52 patients at Afridi Medical Complex, Peshawar. Congenital dysplasia, excessive stretch, traumatic injury and other etiologies of improper musculoskeletal attachment between adjacent vertebral bodies are the causes of lumbar spondylolisthesis [12]. Based on the cause, Wiltse divided spondylolisthesis into six categories: pathogenic, congenital, degenerative, isthmic, and iatrogenic [13]. The symptoms of lumbar spondylolisthesis aggravate gradually, such as low back muscles ache with lower limb numbness, and discomfort, since the extent of degeneration and injuries are not the same [14, 15]. As a result, many surgeons favour surgical treatment for lumbar spondylolisthesis [16]. Laminectomy is the surgical procedure of choice for treating lumbar spinal stenosis secondary to spondylolisthesis, and it's frequently paired with medial facetectomy and foraminotomy [17]. Current study identified a higher representation of female, 31 (59%), within our study cohort. This contrasts with the previous study's results, which involved 4,548 participants in the study, and 2,490 (54.75%) of them were males and 2,058 (45.25%) were female. Our study, reflecting the ongoing pattern of spondylolisthesis, demonstrates a greater prevalence among female [18]. Research studies and epidemiological data have shown that female are often at a higher risk of developing spondylolisthesis compared to males. This gender difference may be attributed to factors such as differences in spinal anatomy, hormonal influences, and biomechanical

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factors. The mean age of participants having spondylolisthesis was observed to be 42 years in our study. A study reported that age greater than 50 is more associated with the incidence of spondylolisthesis, as their results depicted the range of 55-59 to be the most common age, having high cases observed in the study group [18]. The prevalence rate may vary, but spondylolisthesis becomes more prevalent as individuals reach their 50s and beyond. The most common type of listhesis reported in our study was degenerative in 17 (33%) of patients. These findings are following the well-established understanding that degenerative changes and pars defects are primary contributors to spondylolisthesis. The results of our study are consistent with a study which illustrated the frequency of degenerative spondylolisthesis to be 30% [19]. Additionally, post-discitis cases 3 (6%) and post-surgical cases 4 (7%) underscore the diverse etiologies of spondylolisthesis. Our study identified L4-L5 23 (45%) as the most frequently affected level of listhesis, followed by L5-S1 18 (34%) and L3-L4 11 (21%). These results are consistent with existing literature, which often reports a higher prevalence of listhesis in the lower lumbar spine, particularly at the L4-L5 and L5-S1 levels [20, 21]. Present study highlighted the postoperative clinical outcomes, including pain reduction and improved functional ability. A significant reduction in pain scores was noted in 75% of patients, which is consistent with the primary goal of surgical intervention to alleviate pain. Moreover, the majority of patients exhibited improved functional ability, with 60% showing significant improvement in functional disability scores. These outcomes underscore the potential benefits of surgical intervention in enhancing patients' quality of life [22]. In terms of neurological status, a substantial improvement was observed in 85% of patients, further supporting the positive impact of surgery on neurological outcomes. Complications following surgery were relatively low in current study. Foot drop occurred in 1 (2%) of cases, while wrong screw placement and dural tears were observed in 3 (5%) and 1 (2%) of cases, respectively. Wound infection was documented in 1(2%) of cases. In a previous study, one case of dural tear was observed as consistent with present study [9]. While complications are inherent risks in surgical procedures [23], current study's low complication rates are encouraging and reflect the dedication to patient safety during surgical interventions.

CONCLUSIONS

It was concluded that facetectomy combined with foraminotomy is associated with improved clinical outcomes in the management of spondylolisthesis, particularly in Type 1 cases. The procedure was linked to pain relief, enhanced functional ability, and improved neurological status. Further prospective studies are needed to assess long-term efficacy and safety.

Authors Contribution

Conceptualization: KU
Methodology: KU, RUK
Formal analysis: RUK
Writing review and editing: KU

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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