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Original Research

Clinical Outcomes of Full Endoscopic Lumber Spine Surgery in the Management of Recurrent Disc Herniation

Muhammad Farooq[1], Naeem ul Haq[2], Shahid Nawaz[3], Mumtaz Ali[4], Muhammad Nawaz[5] Abdal Wasim Khan[1], Abdul Haseeb Sahibzada[1]

[1]Farooq Neuroendoscopic Spine Institute, Peshawar General Hospital, Peshawar
[2]Department of Neurosurgery, Khyber Teaching Hospital, Peshawar
[3]Department of Neurosurgery, Gomal Medical College, Dera Ismail Khan
[4]Department of Neurosurgery, Ali Institute of Neurosciences, Irfan General Hospital, Peshawar
[5]Department of Neurosurgery, Akhter Saeed Medical and Dental College, Lahore – Pakistan

ABSTRACT

Introduction: Full-endoscopic lumbar discectomy (FELD) has been suggested as a potentially advantageous substitute for the surgical therapy of re-herniated lumber discs. This prospective study aimed to determine the clinical outcomes of full endoscopic lumber spine surgery in re-current disc herniation.

Material and Methods: This prospective observational study was conducted over 2 years, from May 2020 to May 2022 with a year follow-up period. The study included patients who presented to the outpatient department with lumbar disc re-herniation that was confirmed to be symptomatic by conducting clinical evaluation, magnetic resonance imaging (MRI), and/or computed tomography (CT) scans. Depending on the location and size of the disc herniation, either an interlaminar or transforaminal route was used during full endoscopic lumbar spine surgery.

Results: 442 lumbar disc surgeries were carried out in total over the 2-year research period. Of these procedures, 87 cases were reherniation surgeries, which made up about 19.6% of all lumbar disc surgeries. The majority of patients (80% in transforaminal and 75% in interlaminar) had incisions less than 8mm in length. Less than 5% of cases in both method groups experienced complications during the procedures, most of which were mild dural tears and bleeding.

Conclusion: This study concluded that recurring lumbar disc herniations can be safely treated with full endoscopic lumber spine surgery with good intra and post-operative outcomes while minimizing further structural damage compared to open interventions.

Keywords: Endoscopic surgery, prospective study, recurrent disc herniation, reoperation, Pakistan.

Corresponding Author: Muhammad Farooq
Farooq Neurospine Clinic, Afridi Medical Complex, Peshawar
Email: farooqendospine33@gmail.com

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INTRODUCTION

Neuronal compression and the resulting neuropathic pain syndrome can be effectively treated with lumbar discectomy. However, after the initial surgical intervention, there is still a possibility of recurring LDH (rLDH) and reherniation, which frequently necessitates reoperation. The anticipated rates of reoperation vary significantly as well, from 3% to 18%.[1,2,3] Reoperation or redo surgery is still effective in relieving the symptoms and achieving decompression, but it is frequently linked to worsened outcomes, a higher chance of repeat surgery, and it is frequently made more complicated by the existence of epidural scarring resulting in less favorable outcomes.[4,5] Surgical intervention is required when motor deficit and clinically substantial discomfort not managed with conservative treatment options coexist necessitating a revision discectomy.[6] Understanding the risk factors for re-herniation following lumber discectomy is of paramount importance and can lead to prevention and improved management in such cases. A comprehensive review and meta-analysis by Huang et al, (2016) found smoking, protrusion-type disc herniation, and diabetes as risk factors for increased rates of recurrence following discectomy.[7] Literature has reported other risk factors, including age, gender, body mass index (BMI), smoking, annular defect type, and size, volume of excised disc, disc height, disc degeneration grade, and range of motion, have already been documented.[8]

Although open surgical methods are useful for treating disc herniation in the early stages, they can also cause spinal instability, promote the growth of scar tissue, and increase the chance of degeneration of the neighboring segment, which puts patients at risk of recurrence. Furthermore, the necessity for less intrusive, more focused therapies is highlighted to shorten the recovery periods and minimize the possibility of postoperative problems.[9] Full-endoscopic lumbar discectomy (FELD) has been suggested as a potentially advantageous substitute for the surgical therapy of reherniated LDH recently.[10] Transforaminal (TFED) or interlaminar (IFED) routes are chosen during FELD. FELD has experienced its exponential growth in recent years which can be attributed to remarkable surgical advantages such as preservation of dorsal muscle and spine elements as well as minimizing perioperative morbidity.[11,12,13]

Owing to the beneficial effects of full endoscopic surgery including improved visualization and decompression under magnification allow surgeons to remove herniated disc pieces with precision while protecting healthy tissue. Specifically, in reherniation cases, where scar tissue, fibrosis, and anatomical abnormalities present obstacles to conventional surgical methods, this precision is very helpful. FESS minimizes the risk of intraoperative complications and expedites recovery times by maneuvering through natural tissue planes and avoiding needless manipulation of surrounding structures. The posterolateral approach through virgin tissue that hasn't been scarred helps protect nerves and maintain spinal stability.[14]

This study aims to determine the clinical outcomes of full endoscopic lumber spine surgery in re-current disc herniation.

MATERIAL AND METHODS

Study Design/Setting and Duration

This prospective observational study was conducted at the Farooq Neuroendoscopic Spine Institute, Peshawar, over 2 years, from May 2020 to May 2022 with a one-year follow-up period. Ethical approval was obtained from the institutional review board of the hospital and data was collected from the participants after obtaining their informed consent.

Patient Selection Criteria

Inclusion Criteria

The study included patients who presented to the outpatient department with lumbar disc reherniation that was confirmed to be symptomatic by conducting clinical evaluation, magnetic resonance imaging (MRI), and/or computed tomography (CT) scans.

Exclusion Criteria

Those patients who had undergone prior lumbar spine procedures other than discectomy, significant spinal instability, cauda equina syndrome, or were contraindicated for endoscopic surgery were excluded.

Surgical Technique

Skilled neurosurgeons with expertise in endoscopic spine surgery carried out the surgical procedures. Depending on the location and size of the disc herniation, either an interlaminar or transforaminal route was used during full endoscopic lumbar spine surgery. The interlaminar approach was used for the disc fragments migrating downward or upward while in protrusion only limited to disc level, the transforaminal approach was the intervention of choice. The patient was positioned suitably while under general anesthesia, and the target disc level was determined using fluoroscopic guidance. To get access to the surgery site, a tiny incision was created and a functional cannula was placed under fluoroscopic guidance. After that, specialized probes and a high-definition camera were inserted through the cannula to treat and view the herniated disc fragments. Under direct visualization, a thorough discectomy and decompression of neural components were carried out to completely remove the herniated disc material while maintaining the integrity of the surrounding structure.

Data Collection

For each patient in the study, preoperative, intraoperative, and postoperative data were gathered. Preoperative data comprised past surgical history, clinical presentation, imaging results, and demographic data. For every procedure, intraoperative details were documented, such as the surgical approach, duration of the operation, incision size, complications that arose during the procedure, and the degree of decompression. Postoperative evaluations, which included an assessment of clinical results, pain scores, reherniation rates, functional status, complications, and patient satisfaction, were carried out at regular intervals, including the immediate postoperative period, six months, one year, and two years after surgery.

Outcome Measures

Primary outcomes of our surgery included the recurrence of symptoms, radiologically evident reherniation, reoperation rates, and total procedure success rates while improvement in clinical symptoms, decrease in pain scores (measured with a visual analog scale), and functional status (measured with the Oswestry Disability Index) were the secondary outcomes of interest.

Statistical Analysis

Statistical analyses were carried out with the SPSS version 26 software. The study population's clinical and demographic features were compiled using descriptive statistics. Categorical variables were shown as frequencies and percentages, whereas continuous variables were given as mean ± standard deviation. Association between the prevalence of re-herniation and different variables such as size of disc fragments, annular defect size, disc height, type of annular defect, and BMI were calculated through a chi-square test with a significance value set at $p < 0.05$.

RESULTS

Patients and Demographic Characteristics

At Farooq Neuroendoscopic Spine Institute, 442 lumbar disc surgeries were carried out in total over the 2-year research period. Of these procedures, 87 cases were reherniation surgeries, which made up about 19.6% of all lumbar disc surgeries performed during the study period. Among the reherniation surgeries performed the majority of the participants were male 54 (62%) patients than females (33, 38%). Patients undergoing reherniation procedures ranged in age from 28 to 65, with a mean age of 47.5 years. Reherniated discs were distributed differently among lumbar levels, with L4-L5 and L5-S1 levels accounting for the bulk of cases (Table 1). More demographic factors, including smoking status, comorbidities, and body mass index (BMI) were evaluated. Table 1 presents a summary of the patient and demographic characteristics among reherniation cases.

Table 1: Patient and Demographic Characteristics of Reherniation Cases.

Variable	Frequency/Percentage
Gender	
• - Male	54(62%)
• - Female	33(38%)
Age (years)	
• - Mean (±SD)	47.5 ± 9.2
• - Range	28-65
Reherniated Disc Level	
• - L3-L4	5 (6%)
• - L4-L5	50 (57.22%)
• - L5-S1	32 (36.78%)
Body Mass Index (BMI)	
• - Normal (18.5-24.9)	23 (34.48%)
• - Overweight (25-29.9)	30 (39.08%)
• - Obese (≥30)	34 (17.24%)
Comorbidities	
• - Hypertension	15 (11.49%)
• - Diabetes	12 (51.72%)
• - Hyperlipidemia	8 (9.2%)
Smoking Status	
• - Non-smoker	50 (57.5%)
• - Former smoker	22 (25.3%)
• - Current smoker	15 (17.2%)

Surgical Approach for Re-herniation Surgery

The transforaminal approach was the primary surgical technique used in 53 cases (60.9%) of the 87 reherniation cases included in the study, indicating its predominance in treating recurrent lumbar disc herniations. Subsequent analysis within the transforaminal approach group indicated that the L4-L5 (n = 38, 71%) and L5-S1 (n = 12, 24%) disc levels were the primary targets of most procedures. On the other hand, 34 cases (39.1%) used the interlaminar technique. Furthermore, there were differences in the distribution of reherniated discs between the two surgical approach groups: the transforaminal approach group showed a greater percentage of L4-L5 level surgeries than the interlaminar approach group.

Table 2: Surgical Approaches and Patient Characteristics.

Surgical Approach	Cases performed Frequency (Percentage)	Re-herniated Disc Level Frequency (Percentage)
Transforaminal	53 (60.9%)	L3-L4: 3 (5%) L4-L5: 38 (71%) L5-S1: 12 (24%)
Interlaminar	34 (39.1%)	L3-L4: 2 (5.9%) L4-L5: 13 (37.1%) L5-S1: 19 (57%)

Intraoperative and Postoperative Outcomes of Transforaminal and Interlaminar Approaches in Reherniation Cases

Intraoperative outcomes: The length of the procedure, the size of the incision, complications that developed throughout the surgery, and the level of decompression were among the intraoperative outcomes. Between the two methods, the average operation time was similar, averaging 62 minutes for the transforaminal group and 70 minutes for the interlaminar group. The majority of patients 42(80%) in transforaminal and 26(75%) in interlaminar had incisions less than 7 mm in length. The size of incisions was similar in both groups. Minor complications were observed in both groups of patients. 1(1%) patient in the transforaminal group experienced complications during the procedures. No dural tear was reported in the transforaminal approach while 2 patients (6%) experienced dural tear in the interlaminar group.

Significantly, 46(87%) of cases in the transforaminal approach group showed total decompression of neural structures, compared to 25(73%) in the interlaminar group, indicating a higher degree of decompression attained during surgery.

Postoperative Outcomes

Following surgery, both surgical interventions showed a considerable reduction in pain scores: 48(91%) of patients in the transforaminal group reported improvement of at least three points on the visual analog scale than 28(82%) in the interlaminar group. In the transforaminal approach group, recurrent disc herniation was observed in only 2(4%) of cases compared to 3(9%) in the interlaminar group. Both groups experienced improvements in their functional status; however, patients who underwent the transforaminal technique demonstrated more gains in their mobility and decreased impairment. Throughout the postoperative phase, both groups' complication rates stayed low (less than 7%), and no significant complications were recorded.

Association of Re-herniation with Different Variables

The results of the chi-square test demonstrated a statistically significant association between re-herniation and different variables such as the size of disc fragments (p value: 0.02), annular defect size (p value: 0.04), annular defect type (p value: 0.001), disc height (p value: 0.004) and body mass index (BMI) (p value: 0.01). The results showed that the prevalence of re-herniation for large disc fragments was greater (24.7%) compared to small fragments (10%). The re-herniation rate for large annular defects was reported to be 27.9%, while the rate for small defects was 7.8%. Re-herniation rates for annular defect types III/IV/V were reported to be 31%, while those for types I/II were 6%. Table 4 illustrates the frequency and percentages of re-herniation cases reported among different groups of patients.

Table 3: Intraoperative and Postoperative Outcomes.

	Outcome	Transforaminal Approach (n=53)	Interlaminar Approach (n=34)
Intra-operative Outcomes	Mean Duration of Surgery	62 minutes	70 minutes
	Incision Size (<7mm)	42 (80%)	26 (75%)
	Complications During Procedure	2(3%)	1(4%)
	Degree of Decompression	Complete: 46(87%)	Complete: 25(73%)
	Reduction in Pain Scores (3 points)	Decrease: 48(91%)	Decrease: 28(82%)
Post-operative Outcomes	Re-herniation Rates	2(4%)	3(9%)
	Functional Status Improvement	Improved: 48(90%)	Improved: 27(80%)
	Complication Rates	1(1%)	2(6%)

DISCUSSION

Full endoscopic lumber spine surgery is a safe and effective surgical method for treating recurrent lumbar disc herniation, whether or not traditional open procedures were used for the first procedure. To permit safe exploration and discectomy, this method offers an efficient working channel to expose and slightly extend the borders of the previous laminectomy defect to disclose the virginal tissue plane. The full endoscopic procedure for recurrent lumbar discectomy was carried out in our cohort of patients which demonstrated promising outcomes.

Table 4: Association of Different Variables with Re-herniation Rates.

Variables	Groups	Re-Herniation Cases	Chi-Square P Value
Size of Disc Fragments	Small (n=150) Large (n=292)	Small: 15 (10%) Large: 72 (24.7%)	0.02*
Annular Defect Size	Small (n=180) Large (n=262)	Small: 14 (7.8%) Large: 73 (27.9%)	0.04*
Annular Defect Type	Type I/II (n=200) Type III/IV/V (n=242)	Type I/II: 12 (6%) Type III/IV/V: 75 (31%)	0.001*
Disc Height	Normal (n=210) Reduced (n=232)	Normal: 18 (8.6%) Reduced: 69 (29.7%)	0.004*
Body Mass Index (BMI)	Normal (n=220) Overweight/Obese (n=222)	Normal: 17 (7.7%) Overweight/Obese: 70 (31.5%)	0.01*

*Significant values

Key: Small (Refers to size of variables such as small disc fragments and small annular defect) Large (Refers to the size of variables such as large disc fragments and large annular defect)

Compared to traditional open lumber surgery, PELD is a type of minimally invasive surgery that offers several benefits, including the ability to be done under local anesthesia, and the preservation of normal Para spinal tissues throughout the process.[15] Thus, it would be advantageous to avoid reopening the previous scar tissue and avoid general anesthesia in cases of recurrent disc herniation through endoscopic spine surgery.[16]

Our results demonstrated that for the management of re-herniated lumbar discs, both transforaminal and interlaminar endoscopic techniques illustrated good intraoperative outcomes. Both procedures were efficient, as evidenced by the similar average duration of surgery (67.5 minutes for the transforaminal group and 62 minutes for the interlaminar group) for both. These findings are consistent with a similar study conducted by GOKER et.al which compared the clinical outcomes of endoscopic surgery in herniation cases, the results of which stated a significant difference ($p<0.05$) between the mean operating times of the FEID group, which was 29.2 ± 9.0 minutes, and the MD group, which was 36.8 ± 11.4 minutes.[17] Our findings showed that both groups had incisions less than 7mm highlighting the minimally invasive nature of these approaches as highlighted in literature (4mm).[18]

Approach-related complications are the main concern in performing open lumber microdiscectomy for recurrent disc herniation. Scar tissue typically increases the likelihood of dural rupture and/or nerve root injury and makes repeating OLM more challenging.[19] Up to 20% of patients had dural tears during repeated OLM, according to reports.[20] It has been proposed that lumbar disc surgery dural tears are linked to longer-term clinical aftereffects and less favorable clinical results. Less than 5% of cases had mild complications like bleeding and dural tears, indicating a low risk of complications and further supporting the safety of endoscopic surgery. However, Hoogland et al, (2013) reported no conclusive dural leakage following surgery in 262 consecutive patients, whereas Ahn et al, reported no occurrence of dural tear in 43 consecutive patients.[21,22] While the results of a study conducted by Dong Yeob Lee and colleagues reported that two patients (6.9%) in the repeated open lumber

microdiscectomy group experienced a dural tear and one patient experienced dysesthesia combined with voiding dysfunction however no such cases were reported in PELD group.[23] These differences may be attributed to differences in surgical methods, surgeon expertise learning curve, and use of advanced endoscopic tools.

The findings of our study showed promising postoperative outcomes as 48(91%) of patients in the transforaminal group and 28(82%) in the interlaminar group experienced a decrease in their pain level by at least 3 points. Compared to the interlaminar group 3(9%), the transforaminal group 2(4%) had a lower rate of recurrent herniation. Less than 3% of complications occurred in either group, demonstrating the effectiveness and safety of these endoscopic techniques. These findings are consistent with the work done by Hoogland et al,[21] who reported 11 cases (4.62%) of a second recurrence following PELD for recurrent disc herniation.

As the study was conducted in a single hospital with a smaller sample size, therefore reducing the generalizability of the data on the targeted population is a potential limitation of the study. Future studies incorporating increased sample size, with longer follow-up periods along with data collected from different centers should be conducted.

CONCLUSION

Full Endoscopic lumber spine surgery is an effective, safe, and reliable surgical intervention to treat recurrent disc herniations. The results of our study showed that both the transforaminal and interlaminar approaches of full endoscopic lumber surgery have been associated with improved intra and post-operative outcomes along with the potential advantage of being less invasive and resulting in the prevention of further damage as associated with conventional open procedures.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
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AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1	Muhammad Farooq & Abdul Haseeb Sahibzada	Study Design, Methodology, and Paper Writing.
2	Muhammad Farooq & Shahid Nawaz	Data Calculation and Data Analysis.
3	Muhammad Farooq & Mumtaz Ali	Interpretation of Results.
4	Muhammad Farooq, Abdal Wasim Khan & Abdul Haseeb Sahibzada	Statistical Analysis.
5	Naeem ul Haq & Muhammad Nawaz	Literature Review.
6	Muhammad Farooq & Abdul Haseeb Sahibzada	Literature Review and Quality Insurer.