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ORIGINAL ARTICLE

Functional outcome of lumbar discectomy by fenestration technique in lumbar disc prolapse.

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ABSTRACT… Objective: To evaluate the functional recovery, particularly in in terms of pain relief and resuming work, in patients with lumbar disc prolapse treated with the fenestration technique. **Study Design:** Prospective study. **Setting:** Doctors Hospital and Medical Center, Lahore, Pakistan. **Period:** 1st April 2024 and 30th September 2024. **Methods:** A total of 50 patients with clinical signs of lumbar intervertebral disc prolapse, unresponsive to conservative treatment, underwent fenestration discectomy. Functional outcomes were assessed using the 'Back Pain Functional Score (BPFS) This score is utilized to assess the impact of back pain on a person's ability to perform daily activities. It evaluates the functional limitations caused by back pain and tracks recovery progress, especially before and after surgical interventions, and the (PROLO): The PROLO system assesses recovery by focusing on two aspects: economic independence and functional ability. Each aspect is rated from 1 to 5, and the combined score helps determine the patient's overall recovery status over time. Rating scale, measuring both preoperative functional and economic status as well as six-month postoperative outcomes. Wadell's score system was employed to differentiate organic from non-organic signs, and surgical success was determined using McNab's criteria. **Results:** Low back pain is a widespread and disabling condition globally. Sciatica, caused by lumbar disc prolapse, affects approximately 4-6% of the population. Fenestration discectomy, a surgical technique, offers advantages such as reduced operation time, less blood loss, and fewer postoperative complications without compromising spinal stability compared to traditional laminectomy. At the six-month follow-up, 42 patients (84%) showed good outcomes, and 8 patients (16%) had fair outcomes according to BPFS and PROLO scales, with no cases classified as poor. The PROLO scale also revealed that 84% of patients resumed their prior occupations, while 76% reported complete pain relief. Statistical analysis demonstrated a significant association between functional outcomes and both patient age (p=0.089) and duration of symptoms (p=0.098), with younger patients (below 30) and those with symptoms lasting less than six months exhibiting better recovery. **Conclusion:** The fenestration technique proved effective in managing lumbar disc prolapse, showing significant improvements in terms of pain relief and return to work at six months post-surgery. Factors such as older age, prolonged symptom duration, and psychological issues were associated with poorer functional outcomes.

Key words: Lumbar Disc Prolapse, Lumbar Discectomy, Neurological Symptoms, Spinal Deformity, Spinal Surgery.

INTRODUCTION

Low back pain is a widespread and debilitating condition, representing a significant global health issue. It is one of the most common musculoskeletal disorders, Approximately 70-80% of people will experience low back pain at some point in their lives. The annual prevalence varies between 15% and 45%, depending on the population studied and the methods of surveillance employed.[1]

A leading cause of severe low back pain, particularly in the young working population, is lumbar disc prolapse. Estimates suggest that 50-70% of people experience low back pain in their lifetime, with sciatica affecting about 40% of them.[2] However, only 4-6% of these cases involve clinically significant sciatica that requires special attention. Disc degeneration, influenced by various factors, often leads to prolapse into the intervertebral foramina, primarily at the L4-L5 and L5-S1 levels, with L3-L4 and L2-L3 levels accounting for most of the remaining cases.[3]

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A precise diagnosis is vital for distinguishing disc prolapse from other potential causes of low back pain and sciatica. This involves meticulous patient selection, detailed clinical history, physical examination, and appropriate imaging techniques. For cases of severe sciatic pain, surgically removing the herniated disc offers a reliable treatment option and is generally regarded as a safe procedure, yielding favorable outcomes in the majority of patients.[4]

The fenestration technique for disc removal is widely used due to its advantages over the traditional laminectomy technique. Extensive laminectomy and discectomy have become less favored due to their extensive disruption of the spine's posterior stabilizing structures and associated complications. Fenestration discectomy is noted for being less time-consuming, involving less blood loss, fewer postoperative complications, and preserving spinal stability compared to laminectomy, owing to its minimally invasive nature.[5]

This study intends to assess the degree of functional recovery, including pain relief and the ability to return to work as well as neurological improvement in patients with lumbar disc prolapse treated using the fenestration technique. Furthermore, it aims to examine the role of preoperative symptoms and neurological signs as predictors of the outcomes associated with this surgical approach.

METHODS

This study was conducted prospectively at Doctors Hospital and Medical Center, Lahore, Pakistan, from April 1, 2024, to September 30, 2024. The study aimed to evaluate the functional outcomes of lumbar discectomy using the fenestration technique in patients with lumbar disc prolapse. Ethical approval for the study was granted by the hospital's Ethical Review Board (RMC/1120/2024).

Patient Selection

A total of 50 patients diagnosed with lumbar disc prolapse were included in the study. Inclusion criteria required patients to have clinical and radiological evidence of lumbar disc prolapse, with persistent symptoms despite at least six weeks of conservative management. Symptoms included sciatica, low back pain, and neurological deficits in the lower limbs. All patients had progressive neurological symptoms or deficits in motor and sensory function that were unresponsive to nonsurgical interventions. Exclusion criteria included patients with recurrent disc herniation, lumbar canal stenosis, lumbar disc prolapse associated with discitis, and those with previous spinal surgeries or additional spinal pathologies. Additionally, patients with central or far lateral disc prolapse causing nerve root compression were excluded from the study.

Preoperative Assessment

Upon admission, each patient underwent a detailed history and physical examination. MRI scans were performed to confirm the diagnosis and assess the extent of disc prolapse. Symptoms, such as low back pain, sciatica, and sensory and motor deficits, were documented. Preoperative functional status was assessed using the Back Pain Functional Score (BPFS), which measures the severity of functional impairment due to back pain. The PROLO Rating Scale, which evaluates both the economic and functional status of patients, was used for preoperative assessment and for comparing postoperative outcomes. Waddell's score system was also used to differentiate between organic and nonorganic signs, which helped identify factors influencing functional recovery. This scoring system helps in distinguishing between physical and psychological causes of back pain. It is often used to identify any psychological factors that might affect a patient's recovery process.

Surgical Technique

All surgeries were performed under general anesthesia. The fenestration technique for lumbar discectomy was used. Patients were positioned either in the knee chest position or prone on bolsters, depending on the surgeon's preference. The standard fenestration procedure involved making a small incision to access the herniated disc, without extensive removal of surrounding tissue. This technique was chosen for its minimally

invasive nature, which reduces blood loss and preserves spinal stability compared to traditional laminectomy.

Postoperative Care and Follow-up

Postoperatively, patients were mobilized on the first day after surgery and encouraged to begin walking progressively. Physical restrictions, such as avoiding lifting, bending, or stooping, were advised for the first six weeks. Patients involved in strenuous physical labor or long-distance driving were advised to limit such activities during the recovery period. A structured back exercise regimen was introduced three weeks after surgery to aid in recovery and improve spinal function.

Follow-up visits were scheduled at 3 weeks, 6 weeks, 3 months, and 6 months post-surgery. During these visits, functional recovery was evaluated using the BPFS and the PROLO Rating Scale. Patients were also assessed for any neurological improvement, pain relief, and their ability to resume normal daily activities or work.

Data Collection and Analysis

The primary outcomes of interest included pain relief, functional recovery, and the ability to return to work. Data from the BPFS and PROLO scales were collected at each follow-up visit and analyzed to determine the effectiveness of the fenestration technique. Statistical analysis was performed using paired Student's ttests to evaluate changes in preoperative and postoperative functional scores. A significance level of $p < 0.05$ was considered for all statistical tests.

Outcome Measures

BPFS was used to assess the degree of functional impairment caused by low back pain before and after surgery.

PROLO Rating Scale was used to assess both economic and functional outcomes, categorizing patients into five levels (E1 to E5 for economic status and F1 to F5 for functional status).

Waddell's Score System helped differentiate between organic and nonorganic symptoms, providing insight into the psychological factors that might influence recovery.

Limitations of the Methodology

This study had a relatively short follow-up period (six months), which limits our ability to assess long-term outcomes of the fenestration technique. Furthermore, the impact of psychological factors on functional recovery was not thoroughly explored, and the study did not compare fenestration discectomy with other surgical techniques, such as microdiscectomy, which are also commonly used for lumbar disc prolapse.

RESULTS

The study involved 50 participants, consisting of 28 males (56%) and 22 females (44%), with an average age of 37.96 years, ranging from 24 to 60 years. Clinical history analysis showed that 36 patients (72%) reported a gradual onset of low back pain, 12 (24%) had experienced heavy lifting prior to symptoms, and 2 (4%) attributed their pain to a fall. Of the participants, 22 (44%) were involved in physically demanding work, while the others engaged in lighter tasks. In terms of symptom progression, 34 patients (68%) initially experienced low back pain, followed by sciatica, while 16 patients (32%) had both conditions emerge simultaneously. No patient had sciatica alone. The average duration of low back pain was 6.5 months, with a range from 20 days to 18 months. Radicular pain persisted for an average of 2.5 months. Most patients (46%, 23 patients) experienced left-sided sciatica, while the remainder had right-sided sciatica.

The Back Pain Functional Score (BPFS) measures how back pain affects daily activities, serving as a reliable tool to monitor improvements in function and relief from pain after treatment. The PROLO scale, on the other hand, assesses recovery by evaluating both economic independence and functional ability, both of which are significantly influenced by effective pain management. Waddell's score, designed to identify psychological factors linked to back pain, also indirectly highlights the importance of pain relief, as lower scores suggest fewer non-organic pain indicators. Lastly, McNab's criteria assess the outcomes of spinal surgeries based on patient feedback, where higher ratings reflect significant pain reduction and improved functionality.

Collectively, these measures emphasize the importance of pain relief in evaluating the success of interventions for back pain.

Common symptoms included low back pain and radicular pain. Additionally, 68% of patients experienced paresthesia in the affected dermatomes, 52% had weakness in the myotomal muscles, and 36% had reduced sensation in the affected dermatomes. On examination, the Straight Leg Raising Test (SLRT) was positive for all patients, with results ranging from 30° to 60°. The Cross SLRT, used for assessing root tension, was positive in 32% of cases. Loss of lumbar lordosis was noted in 88% of patients, and 16% exhibited functional scoliosis due to nerve root irritation. Lasegue's test, an extension of the SLRT, was also positive in all patients. Normal tendon reflexes were found in 84% of patients with L4-L5 disc prolapse. Ankle reflexes were hypoactive in 14% of cases involving L5-S1, while knee reflexes were hypoactive in 2% of patients. Preoperative motor deficits were noted in 52% of cases, using the Medical Research Council (MRC) scale. Progressive neurological decline was one of the key factors prompting surgical intervention. MRI scans revealed unilateral posterolateral herniations in all patients, with 84% having L4-L5 prolapses, 14% with L5-S1, and 2% with L3-L4 disc prolapses.

During surgery, the discs were classified as protrusions, extrusions, or sequestrations. The average surgical duration was 75 minutes, with estimated blood loss averaging 150 mL, ranging from 100 to 250 mL. the Figure-1 shows the before and after surgery situation of patient.

Figure-1. Before surgery, functional scoliosis caused by lumbar disc prolapse was observed in some cases, known as preoperative sciatic list. Following surgery, relief from this sciatic list was noted in these patients.

Preoperative Sign	Frequency (n=50)	Percentage
Positive SLR Test	50	
Crossed SLR Test	15	30%
Paraspinal Muscle Spasm with Loss of Lumbar Lordosis	43	86%
Sciatic List	9	18%
Restricted Spinal Movements	35	70%
Sensory Deficits	19	38%
Motor Deficits	25	50%
Deep Tendon Reflex Abnormalities - Ankle Jerk	9	18%
Hypoactive Knee Jerk	2	4%

Table-I. Sign and their frequency

Study Findings

In this investigation, a notable portion of the participants, 42 out of 50 (84%), decided to take a break from work or temporarily suspend their employment. The remaining 8 participants (16%), mainly women, continued working due to their household responsibilities. The length of time off work varied significantly, ranging from 20 days to 9 months, with an average of approximately 3.7 months.

Functional outcomes, assessed using the Back Pain Functional scale by Strafford et al., which measures functional status through structured questions, showed positive results in 42 patients (84%), while 8 participants (16%) showed fair outcomes. No participants were categorized with poor outcomes at the six-month follow-up.

PROLO Scale (Economic)	End of Follow-up PROLO Scale (Economic)	Percentage	End of Follow-up PROLO Scale (Functional)	Percentage2
E1 (n = 20)	E3 (n = 8)	40%	F3 (n = 6)	30%
E2 (n = 28)	E4 (n = 6)	21%	F4 (n = 6)	30%
E3 (n = 2)		%	F5 (n = 38)	40%
Sensory Deficits	19	8%		
Motor Deficits	25	0%		
Deep Tendon Reflex Abnormalities Ankle Jerk	9	88%		
Hypoactive Knee Jerk	2	0%		

Table-II. Preoperative and end of follow-up PROLO rules

To assess the economic and functional impact, the PROLO scale was used, with each patient receiving a score based on both their economic (E) and functional (F) status. The PROLO scale evaluates economic status from E1 (worst) to E5 (best) and functional status from F1 (worst) to F5 (best). For example, a patient with an E4 score for economic status and an F5 score for functional status would have a total score of 9 (E4 + F5 = 9). According to this scale, 42 participants (84%) had good outcomes, while 8 patients (16%) had fair outcomes, with no poor results observed.

McNab's criteria also supported these findings, showing favorable results in 42 cases (84%) and fair results in 8 cases (16%). A classification method for evaluating the success of spinal surgeries. It relies on the patient's own feedback regarding pain relief and functionality, categorizing outcomes into excellent, good, fair, or poor.

DISCUSSION

Low back pain arising from lumbar intervertebral disc prolapse constitutes a significant burden in clinical practice. Although lumbar disc disease is not life-threatening, it significantly contributes to morbidity and economic losses through reduced work productivity. Prolapsed intervertebral discs impact approximately 5-10% of patients with back pain and commonly manifest as sciatica.[9] Even a minor disc protrusion within a narrow spinal canal can compress the cauda equina and its nerve roots, necessitating surgical intervention.[10]

The primary treatment approach for lumbar disc prolapse remains discectomy, aiming to remove the offending disc material. Various surgical techniques exist, with studies indicating that traditional extensive laminectomy procedures may result in higher morbidity compared to less invasive methods such as interlaminar fenestration.[11] The ultimate goal of any therapeutic intervention is to achieve a favorable functional outcome, as this directly impacts patient satisfaction and quality of life. Lumbar disc disease, characterized by benign progression and pain as a predominant symptom, underscores the importance of achieving optimal functional recovery post-treatment.[12] Studies report varying success rates ranging from 49% to 90%, highlighting the multifactorial nature of outcomes influenced by patient-specific factors and surgical techniques.[13] Selecting appropriate surgical candidates involves careful consideration of indications for symptomatic relief, minimizing risks, and optimizing cost-effectiveness. For instance, studies by Manohara B et al., Nahar et al., and Garg et al. have reported differing success rates, underscoring the impact of patient selection criteria on outcomes. Research consistently demonstrates successful return-to-work rates ranging from 66.67% to 90%, consistent with findings showing 84% of patients in our study returning to their pre-treatment occupations without limitations at six months.[14] Pain relief outcomes following fenestration discectomy have been similarly varied, with our study observing complete pain relief in 76% of cases. Age has been consistently identified as a negative predictor of surgical outcomes, aligning with findings that older patients may experience less favorable recoveries.[15] Preoperative occupational workload significantly influences surgical outcomes, with heavy manual labor correlating with greater functional disability post-surgery due to increased lumbar spine stress and potential for joint injury and degeneration.[16] Predictors

of successful outcomes include younger age, shorter duration of symptoms, and absence of previous lumbar surgery. Conversely, prolonged preoperative leg pain exceeding 8 months often correlates with more severe nerve root lesions and poorer prognoses.[17] Comparative studies favor fenestration over laminectomy due to shorter surgical durations, reduced blood loss, faster recovery times, and lower complication rates such as adhesions and arachnoiditis. Fenestration also addresses lateral recess stenosis more effectively than microdiscectomy by providing additional surgical exposure. In summary, our study confirms that fenestration discectomy, which involves minimal excision of the disc, is a safe, effective, and a reliable treatment option for carefully selected patients with herniated lumbar discs.[18]

LIMITATIONS

However, this study has certain limitations. The short-term follow-up period prevents us from making conclusions about the long-term outcomes of the patients. Additionally, our study did not include a comparison with the latest microdiscectomy techniques, which are increasingly preferred for their minimally invasive nature in treating the same condition. Additionally, the impact of psychological factors on post-surgical functional outcomes was not thoroughly explored in this study.

CONCLUSION

In conclusion, our findings support fenestration lumbar discectomy as a straightforward and reliable approach for treating carefully selected patients with lumbar disc prolapse. This technique offers several advantages including minimal morbidity, low blood loss, cost-effectiveness, and preservation of spinal stability. Our study demonstrated satisfactory functional outcomes, with successful return to work and full pain relief observed at the six-month follow-up.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Mubashar Ahmed Bajwa:** Article writing.
2	**Dimas Rahman Setiawan:** Data collection.
3	**Jung Wook Lim:** Data collection.
4	**Chang Hwa Ham:** Biostatical Analysis.
5	**Muhammad Tariq Sohail:** Study design.
6	**Seung Woo Suh:** Biostatical analysis.