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ORIGINAL ARTICLE

Outcome of Discectomy with Laminotomy for the Treatment of Prolapsed Lumbar Intervertebral Disc

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ABSTRACT

Background: *Prolonged lumbar intervertebral disc (PLID) is one of the leading causes of low back pain and sciatica. Discectomy with laminotomy is a popular surgical option in patients with PLID who do not respond to conservative management. This study aimed to determine the clinical outcomes of discectomy with laminotomy in patients with PLID.* ***Methods & Materials:*** *This prospective quasi-experiment was performed at the Department of Orthopedic Surgery, Dhaka Medical College Hospital, for a period of July 2018 to June 2020. 28 consecutive patients clinically and radiologically confirmed PLID, unresponsive to conservative treatment, were included through purposeful sampling. All included patients were subjected to discectomy, along with laminotomy, under general anesthesia. The endpoints were evaluated by the Visual Analogue Scale, Modified Macnab Outcome, and Straight Leg Raise Test. Follow-ups were carried out up to 16th months.* ***Results:*** *A total of 19 males (67.9%) and 9 females (32.1%) diagnosed with PLID were subjected to this study. The maximum age of the subjects ranged from 31-40 years (39.3%). The majority were manual workers (60.7%). L4/5 levels were predominantly involved (57.1%), and posterolateral disc prolapse was the main type (60.7%). Before the operation, the subjects had moderate pain (VAS scale=3.0±0.00) and limited SLR (42.63±6.30 degrees). Postoperative changes reflect a meaningful reduction of mean VAS scales to 0.24±0.64 at the third visit; similarly, there were improvements in SLR to 89.3±2.60 degrees. Following the Modified Macnab scale, there were excellent outcomes reported by 82.1%, good by 14.3%, and fair by 3.6%. Superficial wound complications were reported by one patient (3.6%). Mean hospital stay: 3.* ***Conclusion:*** *Discectomy with laminotomy is highly successful in PLID regarding pain relief, neurological recovery, and functional restoration, and is further characterized by a low rate of complications and hospital stay.*

Keywords: *Prolapsed lumbar intervertebral disc, Discectomy with laminotomy, Sciatica*

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INTRODUCTION

Prolapsed lumbar intervertebral disc (PLID), also known as herniated nucleus pulposus, is considered to be one of the most causative agents responsible for the development of lower back pain and radicular symptoms, estimated to affect millions of patients across the globe [1]. This condition develops due to the herniation of the nucleus pulposus through an annular fissure or defect in the annulus fibrosus, causing pressure on the nearby nerve roots, which may lead to various neurological changes like sciatica, sensory loss, motor weakness, and reduced functional capacity [2]. This condition mostly influences patients in their most active phase of life; thus, those belonging to the third to fifth decades of life are predominantly affected, causing a significant burden on the socioeconomic state due to the loss of productivity due to absenteeism from work and an escalation in the utilization of health services [3]. The pathophysiological process in PLID is characterized by the interaction of compression and inflammation [4]. The lumbar levels of L4/L5 and S1/L5 represent the source of about 95% of lumbar disc herniations due to the increased level of stress exerted on these two levels due to the weight exerted throughout various activities [5]. The patient may present with mild pain or even severe pain accompanied by neurological symptoms according to the amount of compression exerted on the nerve root and the level of spinal stenosis. Conservative care, analgesics, physiotherapy, activity modification, or epidural steroid injections are still the mainstay in managing most patients with PLID, with symptom resolution in 70-80% within six to twelve weeks [6,7]. However, in situations where patients fail to respond, or in patients with neurological progression, intractable pain, or cauda equina syndrome, surgery becomes indicated. Among different surgical methods, discectomy with a laminotomy is a common method for patients with symptomatic PLID who are unresponsive to non-surgical management. This method entails a limited laminotomy for the elimination of the protruded disc material, thereby creating adequate decompression, with less micro-movement on the spine [8]. The method entails several benefits, including direct visualization of the nerve structures, with less morbidity associated with microsurgical procedures [9]. Various tools of outcome measurement have been put into practice to assess the success of the surgical intervention for PLID. The Visual Analog Scale can be used to measure the intensity of the pain, and the Modified Macnab assessment can evaluate the

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success of the procedure on a comprehensive basis on the basis of the satisfaction and ability to carry out daily activities. Also, the improvement in the Straight Leg Raising Test and the improvement in the neurological status can prove to be useful indicators of success in the procedure. Although discectomy with laminotomy has seen widespread application, there has been a constant need for further analysis of its outcomes in varied patient groups and treating setups, especially in developing nations where there may be limitations to the availability of high-tech spinal surgery care [10, 11]. Therefore, this study aimed to analyze the outcomes of discectomy with laminotomy in PLID patients to identify pain relief, neurological, functional, and complication outcomes.

METHODS & MATERIALS

This prospective interventional quasi-experimental study was done in the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, from July 2018 to June 2020 among patients with clinically and radiologically proven prolapsed lumbar intervertebral disc. Ethical clearance was taken from the institutional review committee, and written informed consent was sought from all participants after explaining to them about the procedure, expected benefit, possible risk, and follow-up. Patients of either sex were included if they developed progressively worsening symptoms in which leg pain dominated backache, clinically consistent nerve root compression as evidenced by restricted straight leg raising, and proven PLID on magnetic resonance imaging, and if conservative management had failed for at least three to six weeks. Patients suffering from PLID because of direct trauma, Cauda equina syndrome, presence of spine tumors, active infection of the spine, and history of lumbar spine surgery, presence of severe associated comorbidities making general anesthesia contraindicated, and those refusing surgical intervention were excluded. By the purposive sampling method, 28 patients were selected for this study. These patients were studied after complete preoperative evaluation, including history taking, complete neurological examination, including assessment of motor power, sensory defects, tendon reflexes, and straight leg raising tests, and radiographic evaluation by plain radiographs and lumbosacral spine MRI. All patients are subjected to standard discectomy by laminotomy by posterior midline approach after administration of general anesthesia, during which fluoroscopic localization of the operative level is done by minimal laminotomy, gentle retraction of the dural sac and nerve root, and removal of the herniated disc under strict asepsis and using antibiotics as anti-endophthalmitis prophylaxis. In all patients, postoperative care included early mobilization, adequate pain control, physiotherapy, and gradual resumption of usual activity without heavy lifting, prolonged sitting, and forward bending position for six weeks. These patients are followed initially at one month, three months, and finally at sixteen months. The data of this study were entered and analyzed using SPSS version 26.

RESULTS

Table I represents the demographics of patients in the study. Most patients (39.3%) belonged to the 31-40 age group, and only 28.6% were ≤ 30 years old. Also, it was seen that more men (67.9%) were prone to PLID compared with only 32.1% women, which is more expected because men are also more involved in occupations and physical activity. Occupation indicated that 60.7% were manual laborers, 21.4% housewives, and only 17.9% were sit-down workers. [Table I]

Table – I: Demographic characteristics of the study population (*n* = 28)

Variable	Category	(n)	(%)
Age (Years)	≤30	8	28.6
	31-40	11	39.3
	41-50	6	21.4
	≥51	3	10.7
Sex	Male	19	67.9
	Female	9	32.1
Occupation	Manual worker	17	60.7
	Sedentary worker	5	17.9
	Housewife	6	21.4

Table II shows that L5 nerve root impairment was predominant (57.1%) among the sensory impairments, followed by impairment of S1 (35.7%), whereas 7.1% had impairment in both L5 and S1. Comparing motor impairment, extensor hallucis longus impairment was observed in 57.1% patients only, whereas impairment in flexor hallucis longus was recorded in 42.9% patients. [Table II]

Table – II: Preoperative neurological status of the study population (*n*=28)

Variable	Category	(n)	(%)
Preoperative sensory deficit	L5	16	57.1
	S1	10	35.7
	Both L5 and S1	2	7.1
Preoperative motor weakness	EHL	16	57.1
	FHL	12	42.9

Table III revealed loss of lumbar lordosis in 64.3% patients, indicating muscle spasm and protective posture, while in 17.9%, there was the presence of transition vertebra (lumbarization/sacralization), predisposing to possible disc degeneration at adjacent levels. MRI analysis disclosed a prolapsed disc in the posterior lateral region in 60.7%, followed by those with a central prolapsed disc in 10.7%. The most common region involved was L4/L5 in 57.1%, followed by L5/S1 in 35.7%; while 7.1% patients demonstrated involvement at both levels. Left-sided prolapsed disc dominance was also observed in 57.1%, as compared to right-sided prolapsed disc in 42.9%. [Table III]

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Table – III: Radiological findings and anatomical distribution of disc prolapse (*n* = 28)

Parameter		(n)	%
Plain X-ray findings	Transitional vertebra (lumbarization/sacralization)	5	17.9
	Loss of lumbar lordosis	18	64.3
	Diminished disc space	2	7.1
	Osteophytes	3	10.7
MRI findings	Posterolateral disc prolapses	17	60.7
	Central disc prolapses	3	10.7
Level of disc prolapse	L4/L5	16	57.1
	L5/S1	10	35.7
	L4/5 & L5/S1	2	7.1
Side of disc prolapse	Left	16	57.1
	Right	12	42.9

Table IV shows that the mean follow-up period was 9.46±3.94 months, with a follow-up period of 6 months for 42.9% patients, 7 to 9 months for 21.4% patients, and over 10 months for 35.7% patients, thereby providing sufficient follow-up for the assessment of surgery outcomes and complications. The mean hospital stay before surgery was 11.29±5.94 days, which may be a period for preoperative optimization, investigations, and scheduling of surgery in a busy tertiary care hospital. The hospital stay was much shorter at a mean of 3.82±2.39 days, thereby establishing its potential for early hospital discharge for patients undergoing discectomy with laminotomy, with consequent reduction in hospital charges and the risk of infection in a hospital setup.

Table – IV: Duration of follow-up and hospital stay among the study population (*n* = 28)

Parameter	Category	(n) / Mean ± SD	Percent
Follow-up duration (months)	Up to 6 months	12	42.9
	7-9 months	6	21.4
	≥10 months	10	35.7
	Mean± SD	9.46 ± 3.94	-
Hospital stays (days)	-	**Mean ± SD**	
	Preoperative	11.29 ± 5.94	
	Postoperative	3.82 ± 2.39	

Table V shows the progressive recovery from pain and neurological deficits postoperatively. Preoperatively, all the patients (100%) had moderate pain (VAS score 3). At the first postoperative visit (1 month), 89.3% were having mild pain with a mean VAS score of 1.79±0.62. At the second visit (3 months), 57.1% were pain-free with further reduction in mean VAS score to 1.07±0.84. At the final third visit, 92.9% patients had complete resolution of pain with a mean VAS score of 0.24±0.64, indicating net improvement in pain by 92%. Both straight leg raising movements demonstrated congruent improvement, with progressive increase from the severely restricted preoperative mean value of 42.63±6.30 degrees to 75.0±5.77 degrees at the first postoperative visit, further increasing to 83.6±4.88 degrees at the second visit, and finally reaching 89.3±2.60 degrees at the final follow-up visit, nearing normalization with complete resolution of nerve root irritation symptoms.

Table – V: Distribution of pain score and straight leg raising (SLR) during follow-up (*n* = 28)
(A) Pain score distribution (VAS)

Pain score	Preoperative	1st visit	2nd visit	3rd visit
	n (%)	n (%)	n (%)	n (%)
Absent (0)	0 (0)	0 (0)	16 (57.1)	26 (92.9)
Occasional (1)	0 (0)	2 (7.1)	5 (17.9)	0 (0)
Mild (2)	0 (0)	25 (89.3)	7 (25)	2 (7.1)
Moderate (3)	28 (100)	1 (3.6)	0 (0)	0 (0)
(B) Mean VAS score				
Stage			**Mean ± SD**	
Preoperative			3.00 ± 0.00	
Postoperative 1st visit			1.79 ± 0.62	
Postoperative 2nd visit			1.07 ± 0.84	
Postoperative 3rd visit			0.24 ± 0.64	
(C) Straight Leg Raising				
Visit			**Mean ± SD**	
Preoperative			42.63 ± 6.30	
Postoperative 1st visit			75.0 ± 5.77	
Postoperative 2nd visit			83.6 ± 4.88	
Postoperative 3rd visit			89.3 ± 2.60	

Table VI demonstrates excellent outcomes in 82.1% of patients resuming previous activities without restrictions or pain, good outcomes in 14.3% of patients with occasional back or leg pain not interfering with work or daily activities, and a fair outcome in 3.6% (one patient) with improved but persistent symptoms that limit some activities. 96.4% of patients remained uncomplicated post-operatively.

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Table – VI: Final functional outcome and postoperative complications (*n* = 28)

Outcome	Category	(n)	(%)
Modified Macnab Criteria and VAS score	Excellent	23	82.1
	Good	4	14.3
	Fair	1	3.6
	Poor	0	0.0
Postoperative complications	Superficial complications	1	3.6
	No complications	27	96.4

DISCUSSION

This study assessed the results of discectomy with laminotomy for patients with prolapsed lumbar intervertebral discs and found excellent pain relief efficacy as well as low complication rates. The high success rate among this population of patients with PLID indicates that this surgical method is still highly applicable and valid, especially in resource-limited settings. The demographic factors showed a strong dominance of males along with a peak age group of 31-40 years, which is in agreement with Luoma et al., who have recognized PLID to be more common in the working age group of males who are involved in strenuous occupations [12]. The preponderance of manual labor works well with the existing evidence by Palmer et al., who pointed towards the role of occupational factors like repetitive lifting, bending, and hyperhensive seating in the development of disc degeneration and herniation [13]. The younger age group presentation can be attributed to varied occupational and accessibility factors associated with developing nations. Radiological analysis showed L4/L5 to be the most frequently affected level, followed by L5/S1, a fact that has long been observed in literature by virtue of higher stress at these points when undertaking various activities [14]. The common form of disc prolapse in these cases is posterolateral disc herniation, leading mainly to unilateral radiculopathy. This finding showed a very good correlation with the clinical aspects, wherein primarily L5 and S1 nerve roots were found to be more frequently affected, thereby proving anatomical-clinical correlation in PLID. The results of the surgery were highly encouraging, with excellent or good results achieved in more than 95% of cases using the Modified Macnab criteria [15]. To a large extent, these results correlate with those of systematic reviews and studies, where an 85-95% level of success has been shown [15,16]. Pain relief also achieved a level of significance, considering the enormous reduction shown in VAS scores from the confirmatory diagnosis with final follow-up, similar to studies showing a quick and durable relief of symptoms achieved after a lumbar discectomy surgery [16]. Objective neurological improvement also carried considerable significance, considering the improved straight leg-raising angles that indicated adequate decompression of the injured roots. The complication rate was surprisingly low, with only one superficial wound infection being reported. This compares very favorably with the complication rate, ranging from 3% to 15%, as documented by Mattar et al., according to the patient selection, the method of surgery, and the follow-up time [17]. The more frequently reported complications, including dural tear, nerve root damage, and herniation of the intervertebral disc, were not found in the collected series [18,19]. The mean post-operative hospital stay was slightly longer than a report by Noshchenko et al., where earlier discharge rates after lumbar discectomy are high [20]. This can be due to institutional factors and the nature of healthcare systems. However, the aspects of early mobilization and shorter hospital stay emphasize the practicability and viability of the technique. Though MILD and endoscopic procedures have become increasingly popular, studies have found them to be equally effective compared to open discectomy with laminotomy in the long term [21,22]. However, in resource-poor conditions, traditional discectomy is an effective and inexpensive technique. Positive predictive factors of early success, including younger patients, dominant radicular pain, single-level pathology, and absence of previous surgery, were predominantly represented in the current patient population and likely contribute to the high success rates found. Nevertheless, the high satisfaction rates found are supported by studies correlating success rates to relief of symptoms and restoration of functionality.

Limitations of the Study:

This was a single-center study and involved a small sample size with purposive sampling. This may affect its generalization. The study was short-term; thus, its long-term outcome and other surgical alternatives or conservative approaches could not be established.

CONCLUSION

This study demonstrates that discectomy with laminotomy is very effective and safe for the prolapsed lumbar intervertebral discs that have not improved with conservative treatment. This procedure brought considerable pain relief and improvement in the quality of life with very few complications. Most patients had excellent outcomes with considerable relief in quality of life and everyday activities. Early surgical intervention in selected cases will have predictable and reliable outcomes with quick recoveries.

RECOMMENDATION

Future randomized studies with larger numbers of patients and longer-term follow-ups would be valuable in comparing outcomes between standard discectomies, minimally invasive procedures, and endoscopic procedures.

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