

Research Article

Comparative Evaluation of Functional Outcome of Discectomy versus Discectomy with Posterior Lumbar Interbody Fusion for Treatment of Lumbar Disc Herniation

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Abstract: Background: Lumbar disc herniation is a common cause of low back pain and radiculopathy and may require surgical treatment when conservative management fails. Lumbar discectomy provides neural decompression, whereas Posterior Lumbar Interbody Fusion combines decompression with restoration of disc height and segmental stabilization. The relative short-term functional benefits of these approaches remain an area of clinical interest. **Aim:** To compare the short-term functional and clinical outcomes of lumbar discectomy versus discectomy with Posterior Lumbar Interbody Fusion in patients with symptomatic lumbar disc herniation who failed conservative management. **Materials and Methods:** A prospective comparative study was conducted among 40 patients with symptomatic lumbar disc herniation. Patients were allocated according to operative indication into a discectomy group (n = 21) and a PLIF group (n = 19). Functional outcome was assessed using the Japanese Orthopedic Association (JOA) score at 1, 3, and 6 months. Clinical outcome was assessed using the Kirkaldy-Willis criteria. Neurological recovery was evaluated using bilateral Straight Leg Raise Test and tactile sensory assessment. Postoperative complications were recorded, and radiological fusion was assessed in the PLIF group. Statistical analysis was performed using independent samples t-test, Pearson's chi-square test, and Fisher's exact test, with p<0.05 considered statistically significant. **Results:** Both groups demonstrated progressive improvement in functional outcome during follow-up. The mean JOA score increased from 6.76±1.87 preoperatively to 13.95±1.47 at 6 months in the discectomy group and from 7.32±1.42 to 13.74±1.59 in the PLIF group. The mean improvement was 7.19 points and 6.42 points, respectively, with no statistically significant difference at 6 months (p = 0.658). At 6 months, Good or Excellent Kirkaldy-Willis outcomes were achieved by 100% of patients in both groups. Excellent outcomes were observed in 57.1% of the discectomy group and 78.9% of the PLIF group, without a statistically significant difference. Bilateral SLRT values improved progressively in both groups. A significant difference was observed in right-sided SLRT improvement at 3 months, favoring PLIF (p = 0.046), but this difference was not sustained at 6 months. The overall complication rate was low, with no significant between-group differences. Complete radiological fusion was achieved in 84.2% of PLIF patients at 6 months. **Conclusion:** Both lumbar discectomy and PLIF resulted in substantial and clinically meaningful short-term functional recovery in patients with symptomatic lumbar disc herniation. No statistically significant difference was demonstrated between the procedures in JOA score, Kirkaldy-Willis clinical outcome, or complication rate during six months of follow-up. The choice of procedure should be guided by individual pathology, particularly the presence of segmental instability or listhesis, together with operative considerations.

Keywords: Lumbar Disc Herniation, Lumbar Discectomy, Posterior Lumbar Interbody Fusion, JOA Score, Kirkaldy-Willis Criteria, Functional Outcome, Prospective Comparative Study

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INTRODUCTION

Lumbar disc herniation (LDH) is a common spinal disorder and an important cause of low back pain, radicular pain, sensory disturbance, and functional limitation. It occurs when the nucleus pulposus protrudes or extrudes through a defect in the annulus fibrosus, resulting in mechanical compression and/or inflammatory irritation of the adjacent nerve root. Although many patients improve with conservative treatment, persistent radiculopathy, progressive neurological deficit, and failure of non-operative management may necessitate surgical intervention. The surgical treatment of symptomatic lumbar disc herniation has evolved considerably since the early description of operative removal of herniated disc material by Mixter and Barr [1].

Lumbar discectomy is the established decompressive procedure for patients with symptomatic disc herniation. The fundamental objective of discectomy is removal of the offending disc fragment and decompression of the affected nerve root while preserving as much of the normal spinal anatomy as possible. The development of microsurgical and minimally invasive approaches has further refined this concept, with microlumbar discectomy providing effective neural decompression while limiting tissue disruption [2]. Clinical studies have demonstrated substantial improvement in pain and functional disability following surgical treatment in appropriately selected patients. The Spine Patient Outcomes Research Trial (SPORT) provided important comparative evidence regarding operative and non-operative treatment of lumbar disc herniation and demonstrated the relevance of surgical decompression in patients with persistent symptomatic disease [3].

Despite the effectiveness of simple discectomy, concerns may arise regarding disc-space collapse, segmental instability, recurrent disc herniation, and persistent mechanical back pain in selected patients. In such circumstances, lumbar fusion may be considered in addition to decompression. Posterior lumbar interbody fusion (PLIF) combines removal of the herniated disc with interbody fusion and posterior instrumentation, with the objectives of restoring disc-space height, providing anterior column support, and stabilising the involved spinal segment. The technique was developed substantially through the work of Cloward, who described vertebral body fusion for the treatment of ruptured lumbar intervertebral discs [4]. Modern PLIF techniques have subsequently incorporated interbody cages and pedicle-screw fixation to improve stability and facilitate fusion [5].

The indication for adding fusion to discectomy in lumbar disc herniation, however, remains an area of clinical debate. Satoh and colleagues evaluated the indications for PLIF in lumbar disc herniation and highlighted the importance of pre-existing structural abnormalities and instability when selecting patients for fusion [6]. Comparative studies have also examined simple discectomy and instrumented PLIF in specific patient populations, including patients with Modic endplate changes, demonstrating that the choice of procedure may be influenced by the underlying pathology rather than disc herniation alone [7]. Current guideline-based evidence similarly emphasises that fusion should not necessarily be regarded as an obligatory component of surgery for every patient with lumbar disc herniation and radiculopathy [8].

Functional recovery following lumbar spine surgery can be assessed using several validated clinical instruments. The Japanese Orthopaedic Association (JOA) score provides a structured assessment of neurological and functional status and has been evaluated for its validity in patients with lumbar disc herniation [9]. Its application in postoperative lumbar fusion patients has also been studied, supporting its usefulness for evaluating functional improvement after lumbar spine surgery [10]. The Kirkaldy-Willis criteria provide another clinically useful method of categorising postoperative results into excellent, good, fair, and poor outcomes. In addition to functional scoring, neurological recovery can be assessed through clinical parameters such as the Straight Leg Raise Test (SLRT) and tactile sensory examination.

Although both discectomy and PLIF are established surgical options, their relative short-term functional and clinical outcomes in patients with symptomatic lumbar disc herniation remain clinically relevant. Previous comparative work has directly evaluated discectomy against discectomy with PLIF, while more recent literature continues to examine factors associated with postoperative outcomes following surgery for LDH [11-12]. The decision regarding fusion is particularly important because PLIF involves additional instrumentation and fusion compared with simple decompression. Therefore, evaluating whether the addition of PLIF is associated with differences in functional recovery, clinical success, neurological improvement, and postoperative complications is of practical significance.

Against this background, the present study was undertaken to compare the short-term postoperative functional and clinical outcomes of lumbar discectomy versus discectomy with posterior lumbar interbody fusion in patients with symptomatic lumbar disc herniation who had failed conservative management. Functional recovery was assessed using the JOA score, while clinical success was evaluated using the Kirkaldy-Willis criteria at 1, 3, and 6 months following surgery. Neurological recovery and postoperative complications were also evaluated to provide a comprehensive comparison of the two surgical approaches.

MATERIAL AND METHODS

A prospective comparative study was conducted in the Department of Orthopaedics, Sir Takhtasinhji General Hospital and Government Medical College, Bhavnagar, Gujarat. The study included 40 patients with symptomatic lumbar disc herniation who underwent operative treatment during the study period. Twenty-one patients underwent lumbar discectomy, while 19 patients underwent discectomy with posterior lumbar interbody fusion (PLIF). Allocation to the surgical groups was based on the operative indication rather than randomisation; discectomy was performed in patients without demonstrable instability, whereas PLIF was performed in patients with associated listhesis.

Patients aged 20–70 years with clinically and radiologically confirmed lumbar disc herniation and sciatica that had failed to improve following 4–6 weeks of conservative treatment were eligible for inclusion. Patients with progressive

neurological deficits and MRI-confirmed disc prolapse refractory to non-operative treatment were also included. Patients with scoliosis or congenital spinal deformity, spinal malignancy, spinal infection including tuberculosis, spinal canal stenosis unrelated to disc herniation, acute traumatic spinal injury, previous failed back surgery syndrome, lack of consent, or loss to follow-up were excluded.

The discectomy group underwent conventional posterior removal of the herniated disc material without instrumentation or fusion. In the PLIF group, discectomy was followed by interbody fusion using bone graft with or without a titanium interbody cage and pedicle-screw fixation. The independent variable was the type of surgical treatment, while dependent variables included functional outcome assessed by the JOA score and Kirkaldy-Willis criteria, neurological recovery assessed by bilateral SLRT and tactile sensory examination, postoperative complications, and radiological fusion status in the PLIF group.

All patients were assessed preoperatively and followed postoperatively at 1, 3 and 6 months. JOA score, Kirkaldy-Willis grading, bilateral SLRT, and tactile sensory assessment were recorded at each follow-up visit. Radiological assessment of fusion was performed in patients undergoing PLIF at 3 and 6 months. Perioperative and postoperative complications were documented prospectively.

The required sample size was calculated using an expected between-group difference of 1.5 points in JOA score, pooled standard deviation of 2.0, two-sided alpha of 0.05, and 80% statistical power, giving a minimum requirement of 18 patients per group. Allowing for approximately 10% attrition, a target of 20–22 patients per group was considered appropriate, and a final sample of 40 patients was analysed. Statistical analysis was performed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean±standard deviation, and appropriate comparative tests including the independent-samples t-test, Pearson's chi-square test, and Fisher's exact test were used. A p-value <0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee, Government Medical College, Bhavnagar, before commencement of the study. Written informed consent was obtained from all participants, and confidentiality of participant information was maintained throughout the study.

RESULTS

Table 1 shows the baseline demographic and preoperative characteristics of the patients included in the study. The mean age was 46.05±13.06 years in the discectomy group and 43.37±15.44 years in the PLIF group, with no statistically significant difference between the groups ($p = 0.556$). Females constituted 61.9% of the discectomy group and 47.4% of the PLIF group, while males constituted 38.1% and 52.6%, respectively. The preoperative JOA score was 6.76±1.87 in the discectomy group and 7.32±1.42 in the PLIF group ($p = 0.301$). The mean preoperative right-sided SLRT was 40.43±6.74° in the discectomy group and 38.00±5.63° in the PLIF group ($p = 0.226$), whereas the corresponding left-sided values were 38.24±5.45° and 38.21±7.35° ($p = 0.989$). Reduced sensation was observed in 81.0% of patients in the discectomy group and 63.2% in the PLIF group ($p = 0.277$).

Table 2 demonstrates the comparison of JOA scores and improvement from the preoperative baseline at 1, 3, and 6 months following surgery. The mean JOA score increased progressively in both groups during follow-up. At 1 month, the mean JOA score was 10.19±1.40 in the discectomy group and 10.16±1.34 in the PLIF group ($p = 0.941$). At 3 months, the corresponding scores were 12.48±1.50 and 12.26±1.48 ($p = 0.655$). At 6 months, the mean JOA score reached 13.95±1.47 in the discectomy group and 13.74±1.59 in the PLIF group ($p = 0.658$). The mean improvement from baseline at 6 months was 7.19 points in the discectomy group and 6.42 points in the PLIF group.

Table 3 presents the distribution of clinical outcomes according to the Kirkaldy-Willis criteria at 1, 3, and 6 months. At 1 month, the majority of patients in both groups had a Fair outcome, comprising 52.4% of the discectomy group and 63.2% of the PLIF group. Good outcomes were observed in 38.1% and 26.3% of patients, respectively, while Poor outcomes were observed in 9.5% and 10.5%. No patient achieved an Excellent outcome at 1 month. At 3 months, Good outcomes were observed in 57.1% of the discectomy group and 84.2% of the PLIF group, while Excellent outcomes were observed in 23.8% and 10.5%, respectively. By 6 months, no patients remained in the Poor or Fair categories. Good outcomes were observed in 42.9% of the discectomy group and 21.1% of the PLIF group, while Excellent outcomes were observed in 57.1% and 78.9%, respectively.

Table 4 describes the adverse events recorded during the postoperative follow-up period. At 1-month, wound infection occurred in 4.8% of patients in the discectomy group and 5.3% in the PLIF group. A decrease in motor power was observed in 4.8% of patients in the discectomy group and none in the PLIF group. Improper spinal reduction was recorded in 14.3% of patients in the PLIF group and was not observed in the discectomy group. At 3 months, increase in symptoms was recorded in 4.8% of patients in the discectomy group and none in the PLIF group. At 6 months, improper spinal reduction was recorded in 4.8% of PLIF patients. The reported comparisons did not demonstrate statistically significant differences between the groups.

Table 1: Baseline Demographic and Preoperative Characteristics of Patients

Variable	Discectomy (n = 21)	PLIF (n = 19)	p-value
Age (years), Mean±SD	46.05±13.06	43.37±15.44	0.556
Female, n (%)	13 (61.9)	9 (47.4)	0.525
Male, n (%)	8 (38.1)	10 (52.6)	—
Preoperative JOA Score, Mean±SD	6.76±1.87	7.32±1.42	0.301
Preoperative SLRT Right (°), Mean±SD	40.43±6.74	38.00±5.63	0.226
Preoperative SLRT Left (°), Mean±SD	38.24±5.45	38.21±7.35	0.989
Reduced Sensation, n (%)	17 (81.0)	12 (63.2)	0.277

Table 2: Comparison of Mean JOA Scores and Improvement from Preoperative Baseline

Timepoint	Discectomy Mean±SD	PLIF Mean±SD	Mean Improvement Discectomy	Mean Improvement PLIF	p-value
Preoperative	6.76±1.87	7.32±1.42	—	—	0.301
1 Month	10.19±1.40	10.16±1.34	+3.43	+2.84	0.941
3 Months	12.48±1.50	12.26±1.48	+5.71	+4.95	0.655
6 Months	13.95±1.47	13.74±1.59	+7.19	+6.42	0.658

Table 3: Kirkaldy-Willis Clinical Outcome Distribution at 1, 3 and 6 Months

Follow-up	Outcome	Discectomy n (%)	PLIF n (%)
1 Month	Poor	2 (9.5)	2 (10.5)
	Fair	11 (52.4)	12 (63.2)
	Good	8 (38.1)	5 (26.3)
	Excellent	0 (0)	0 (0)
3 Months	Poor	0 (0)	0 (0)
	Fair	4 (19.0)	1 (5.3)
	Good	12 (57.1)	16 (84.2)
	Excellent	5 (23.8)	2 (10.5)
6 Months	Poor	0 (0)	0 (0)
	Fair	0 (0)	0 (0)
	Good	9 (42.9)	4 (21.1)
	Excellent	12 (57.1)	15 (78.9)

Table 4: Comparison of Adverse Events Between Discectomy and PLIF Groups

Follow-up	Adverse Event	Discectomy n (%)	PLIF n (%)	p-value
1 Month	Wound Infection	1 (4.8)	1 (5.3)	1.000
	Decrease in Motor Power	1 (4.8)	0 (0)	1.000
	Improper Spinal Reduction	0 (0)	3 (14.3)	0.233
	Increase in Symptoms	0 (0)	0 (0)	—
3 Months	Wound Infection	0 (0)	0 (0)	—
	Increase in Symptoms	1 (4.8)	0 (0)	1.000
6 Months	Improper Spinal Reduction	0 (0)	1 (4.8)	1.000
	Wound Infection / Other	0 (0)	0 (0)	—

Table 5: Comparison of SLRT Values and Improvement from Preoperative Baseline

Timepoint & Side	Discectomy Mean±SD	PLIF Mean±SD	Discectomy Gain	PLIF Gain	p-value
Preoperative – Right	40.43±6.74°	38.00±5.63°	—	—	0.226
1 Month – Right	67.71±4.67°	65.00±4.57°	+27.29°	+27.00°	0.912
3 Months – Right	83.71±2.90°	85.58±3.52°	+43.29°	+47.58°	0.046
6 Months – Right	87.95±5.33°	86.79±5.97°	+47.52°	+48.79°	0.628
Preoperative – Left	38.24±5.45°	38.21±7.35°	—	—	0.989
1 Month – Left	67.86±3.84°	68.68±4.45°	+29.62°	+30.47°	0.713
3 Months – Left	85.86±3.12°	85.63±3.17°	+47.62°	+47.42°	0.937
6 Months – Left	89.05±3.26°	90.00±0.00°	+50.81°	+51.79°	0.662

Table 5 shows the postoperative changes in bilateral Straight Leg Raise Test values compared with the preoperative baseline. On the right side, the mean SLRT increased from 40.43±6.74° preoperatively to 67.71±4.67° at 1 month, 83.71±2.90° at 3 months, and 87.95±5.33° at 6 months in the discectomy group. In the PLIF group, the corresponding values increased from 38.00±5.63° to 65.00±4.57°, 85.58±3.52°, and 86.79±5.97°. On the left side, SLRT increased from 38.24±5.45° preoperatively to 67.86±3.84°, 85.86±3.12°, and 89.05±3.26° at successive follow-ups in the discectomy group. The corresponding PLIF values were 38.21±7.35°, 68.68±4.45°, 85.63±3.17°, and 90.00±0.00°. The comparison of improvement showed a statistically significant difference for right-sided improvement at 3 months ($p = 0.046$), while the remaining comparisons were not statistically significant.

DISCUSSION

This prospective comparative study evaluated the short-term functional and clinical outcomes of lumbar discectomy and discectomy with Posterior Lumbar Interbody Fusion (PLIF) in 40 patients with symptomatic lumbar disc herniation.

The two groups were comparable at baseline with respect to age, sex, preoperative JOA score, bilateral SLRT values, and sensory status. This baseline similarity provided a reasonable basis for comparison, although the non-randomized allocation according to operative indication remains an important limitation of the study.

The principal finding of the study was that both surgical procedures produced substantial functional improvement over the six-month follow-up period. The mean JOA score increased from 6.76 ± 1.87 to 13.95 ± 1.47 in the discectomy group and from 7.32 ± 1.42 to 13.74 ± 1.59 in the PLIF group. The mean improvement from baseline was 7.19 points with discectomy and 6.42 points with PLIF, with no statistically significant difference between the groups at six months. Thus, both procedures were associated with clinically meaningful functional recovery. The findings are consistent with the principle outlined in the guideline update by Wang *et al.*, which indicates that fusion does not necessarily provide additional functional benefit over decompression in patients with lumbar disc herniation and radiculopathy when significant instability is absent [8].

The Kirkaldy-Willis clinical outcome demonstrated a similar pattern. At one month, Fair outcomes predominated in both groups, reflecting the expected early postoperative recovery phase. By three months, most patients had achieved either Good or Excellent outcomes. At six months, all patients in both groups achieved either Good or Excellent outcomes. Although the proportion of Excellent outcomes was numerically greater in the PLIF group than in the discectomy group, the difference was not statistically significant. These findings suggest that the addition of fusion did not result in a demonstrable short-term clinical advantage in the present cohort.

The role of fusion in lumbar disc herniation remains dependent on the underlying pathology. Wang *et al.* emphasized that fusion should not routinely be added to decompression for uncomplicated radiculopathy in the absence of instability [8]. DiPaola and Molinari described PLIF as a technique capable of achieving neural decompression together with restoration of disc height and segmental stability, making it particularly relevant when instability or structural compromise is present [5]. In the present study, PLIF was specifically used in patients with associated listhesis, whereas discectomy was performed in patients without demonstrable instability. Therefore, the results should be interpreted as outcomes of two procedures applied to different clinical indications rather than as a direct randomized comparison of identical patient populations.

With regard to safety, the overall complication burden was low in both groups and no statistically significant difference was demonstrated. Wound infection occurred in 4.8% of discectomy patients and 5.3% of PLIF patients. A transient decrease in motor power occurred in one patient following discectomy and resolved by three months. Improper spinal reduction was noted in three PLIF patients at one month, although the difference did not reach statistical significance. The small sample size limits the ability of the study to detect differences in relatively uncommon complications. Shriver *et al.*, in their systematic review and meta-analysis of lumbar microdiscectomy complications, demonstrated that neurological and other perioperative complications are generally uncommon, supporting the relatively low complication burden observed in the present study [13].

Neurological recovery assessed through SLRT showed progressive improvement in both groups. At six months, near-complete bilateral recovery was observed in both groups. A statistically significant greater improvement in right-sided SLRT was observed in the PLIF group at three months; however, this difference was not maintained at six months. Because this was an isolated significant finding among multiple comparisons, it should be interpreted cautiously rather than considered evidence of a sustained neurological advantage of PLIF. The source study itself notes the possibility of type I error in this comparison.

An important consideration in evaluating PLIF is that the benefits of fusion may extend beyond short-term neurological recovery. Fusion is intended to provide structural stability and may be particularly relevant in patients with listhesis or demonstrable instability. In the present study, complete radiological fusion was achieved in 84.2% of PLIF patients by six months. However, the study was limited to a six-month follow-up period and therefore could not determine whether radiological fusion would translate into differences in long-term functional outcomes, recurrence, or adjacent segment disease. Park *et al.* highlighted adjacent segment disease as an important consideration following lumbar or lumbosacral fusion, emphasizing the need for longer-term follow-up when assessing fusion procedures [14].

The findings of the present study should therefore be interpreted within its methodological limitations. The sample size was relatively small, with 21 patients in the discectomy group and 19 in the PLIF group. Allocation was based on operative indication rather than randomization, and the follow-up period was limited to six months. The study was consequently better suited to evaluating short-term functional recovery than long-term recurrence, reoperation, adjacent segment disease, or sustained superiority of either procedure. In addition, the numerical difference in Excellent Kirkaldy-Willis outcomes at six months and the transient difference in right-sided SLRT improvement require confirmation in larger studies.

Overall, the results indicate substantial recovery following both procedures, with no statistically significant difference in the principal functional and clinical outcomes during six months of follow-up. These findings are also compatible with the broader literature showing that recovery after primary lumbar discectomy is generally progressive

over the postoperative period. Rushton *et al.* reported a favorable clinical course of pain and disability following primary lumbar discectomy, supporting the observation that decompression alone can provide substantial symptomatic and functional recovery in appropriately selected patients [15].

CONCLUSION

Both lumbar discectomy and Posterior Lumbar Interbody Fusion produced substantial and clinically meaningful functional improvement in patients with symptomatic lumbar disc herniation over six months of follow-up. The improvement in JOA scores exceeded the clinically meaningful threshold in both groups.

No statistically significant difference was observed between the two procedures with respect to JOA score, Kirkaldy-Willis clinical outcome, or postoperative complications at the assessed follow-up points. Although the PLIF group showed a numerically higher proportion of Excellent clinical outcomes at six months and a transient advantage in right-sided SLRT improvement at three months, these findings did not demonstrate a sustained statistically significant benefit.

PLIF achieved complete radiological fusion in 84.2% of patients by six months, supporting its structural role in patients with associated listhesis or segmental instability. However, the present study does not establish a short-term functional superiority of PLIF over discectomy. Surgical selection should therefore be based on the individual patient's pathology, particularly the presence or absence of instability, listhesis, and other structural indications for fusion.

Larger prospective, preferably randomized, multicentre studies with longer follow-up are required to determine whether the structural benefits of PLIF translate into differences in long-term functional outcome, recurrence, reoperation, or adjacent segment disease.

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