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Comparative evaluation of functional outcome of discectomy and posterior lumbar interbody fusion for treatment of prolapse intervertebral disc

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Abstract

Background: Lumbar disc herniation is the most common cause of low back pain and significant disability with economic impact too. Management of disc herniation is challenging, often confusing when surgical treatment is considered, because of frequent failures after surgery in many patients to relieve symptoms. In the current study, we aimed to compare the functional outcomes of treating PIVD with discectomy alone and discectomy associated with posterior lumbar interbody fusion (PLIF).

Materials and Methods: This study is a randomised control study was conducted over 36 patients diagnosed with PIVD and operated for Discectomy (18 patients) or PLIF (18 patients) in the Orthopaedic department, Geetanjali Medical College, Udaipur, Rajasthan between January 2019 to June 2020 and randomly allotted in two groups. To evaluate Functional outcomes using Japanese orthopedic score (JOA) and kirkaldy-willis criteria in every follow-up at 2 week, 6 week, 3 month and 6 month.

Results: Calculating the functional outcome by both the criteria in all follow-ups, we concluded that in early follow-up that is of second post-op week, discectomy shows a satisfactory outcome then that of PLIF group. In 6 month last follow-up, PLIF group show a satisfactory outcome then that of Discectomy patients groups and p-value was 0.0042 which was significant. Out of 36 patients, one patient had dura rupture intraoperatively which was repaired simultaneously and one patient had surgical site infection which resolved later on, both patients were in discectomy group.

Conclusions: Although both discectomy alone and discectomy with PLIF were associated with favorable mid-term results in treating patients with PIVD, however, we recommend using discectomy with PLIF for lower radicular pain for better long term results.

Keywords: PIVD, PLIF, discectomy, Japanese orthopaedic score

Introduction

Lumbar disc herniation is one of the common cause of lower back pain ^[1, 2]. Management of disc herniation can be challenging. Non-operative treatment gives good results in the majority of the cases. Operative treatments have better results mostly in short-term pain relief and can provide relief if neural decompression is done. Early surgery does appear to affect the rate of Neurological recovery, although objective improvement in motor and sensory deficits does not appear to correlate with symptomatic relief and overall success rate ^[3]. With this evidence, it has been recognized that discectomy can give excellent early results in majority of patients with symptomatic relief with a satisfactory rate of over 95% ^[4, 5]. However, the long-term results of discectomy would become less concrete, with satisfactory rates from 40% to 80% ^[6]. Posterior Lumbar Interbody Fusion (PLIF) is the used to describe the technique of surgical fusion of two (or more) lumbar spine bones together, along the sides of the bone, which uses placement of cage, spacer or structural graft in between the vertebral bodies, which is done after discectomy and bony end plates preparation and ultimately it fuses together in period of time.

The credit for initially developing the techniques of the PLIF surgery, as it is performed today, goes to Cloward ^[7], who emphasized the importance of wide exposure of the spinal canal to minimize nerve root injuries, the use of structural graft to prevent Intervertebral collapse and the complete removal of nuclear material from the disc space and replacement with bone to

promote fusion. Cloward was, however, widely criticized for this when the procedure was attempted by other surgeons as it resulted in a poor outcome.

Widespread acceptance of PLIF did not occur until the introduction of pedicle screw instrumentation came. With PLIF the load-sharing anterior column support could be added to protect the pedicle screws without the need for a separate anterior incision. Another development that endorsed the adoption of PLIF was the invention of interbody fusion cage by Brantigan⁸ and titanium mesh cage by Harms which decreases the need of structural graft from iliac crest, which was one of the major sources of donor site morbidity. With the gradual evolution in bone grafting technique, it has now been clearly stated that fusion using a cage with bone graft taken from local site has comparable results with that of bone graft harvested from iliac crest, which has been used since the introduction of PLIF^[9]. The availability of pedicle screw instrumentation and interbody cages contributed to progressively greater adoption of the surgery, which was pioneered by Cloward^[7].

Although more recent advances such as the development of transforaminal and direct lateral approach to the disc have reduced the frequency with which PLIF is performed, but PLIF remains the index surgery in case of the spinal fusion.

AIM

To evaluate functional outcome of surgical treatment of prolapsed intervertebral disc (PIVD) by two different surgical methods i.e. (1) Discectomy (2) Posterior lumbar interbody fusion (PLIF) by using JOA^[9-12] score and kirkaldy-willis criteria^[13].

Material and Methods

This study is a randomised control study was conducted over 36 patients diagnosed with PIVD and operated for Discectomy or PLIF in Orthopaedic Department, Geetanjali Medical College, Udaipur, Rajasthan between January 2019 to June 2020 and randomly allotted in two groups. After clinical evaluation of patients with low back pain, which may be associated with radicular pain or neurological impairment or both. MRI was done to confirm the diagnosis.

Inclusion criteria

- Lumbar disc prolapse with sciatica not improved after conservative treatment for at least 4 to 6 weeks with MRI and clinical evidence of disc herniation.
- Age 20–70 years.
- Progressive neurological deficit and clinical symptoms in spite of conservative management.

Exclusion criteria

- Disc prolapse associated with Scoliosis and other congenital deformities of spine
- Spinal Malignancy
- Infection (spinal tuberculosis)
- Spinal canal stenosis, not due to disc herniation.
- Acute traumatic spinal injury.
- Patients who have undergone Failed back surgery syndrome with instrumentation in past.

This study includes 36 patients, 18(50%) patients underwent discectomy with Posterior lumbar interbody fusion and 18 (50%) patients underwent discectomy.

All patients had followed up at 2 week, 6 week, 3 month and 6 month. Calculate and compare the JOA score^[9-12] and Kirkaldy-Willis criteria^[13] in every follow-up and see functional outcomes difference between these two procedures.

Preoperative evaluation

After routine physical examination for confirmation of physical and neurological signs, radiographs of lumbosacral spine which includes anteroposterior, flexion and extension stress lateral views and MRI scan were done as standard protocol. After treating pre-existing co-morbidities and optimisation of patient, patients were posted for elective surgery.

Surgical Techniques

This complete position maintains the normal lordotic curvature of lumbar spine for PLIF cases.

And knee-chest prone position for Discectomy groups. Marking vertebral level under IITV.

Discectomy

Midline 3 cm incision, the spinous process is palpated and deep fascia incised on the affected side, adjacent to the spinous process. Laminaectomy is done and then Facetectomy may be done. A spinal needle is inserted to confirm disc and space with IITV. The herniated fragment and the posterior annulus are visualized once the nerve root is retracted medially. Then a cruciate or box cut is given to disc and Disc removal is done, then wash is given and closure done.

PLIF

The incision is straight one level above and below the marked vertebral levels of fixation. Paraspinal muscles are separated then pedicle screws are inserted and Over one side of pedicle screws, titanium rod is inserted and distraction to pedicle screws by distracter, then Decompression and discectomy is done, after discectomy end plate of vertebrae are prepared by angled curette and autologous bone graft was used which is harvested from the excised lamina and spinous process. The graft-filled cage is now inserted with Cage Holder Assembly and the cage final position is conformed under IITV. Now, the distraction of the rod is removed and the inner screw are tightened with compression in between screws while the opposite side rod is also placed and inner screw set are tightened, wash given and closure done in layers.

Post-operative protocol and follow-ups

All patients were mobilized on the next day of surgery in both PLIF and discectomy groups. Drain removal is done by 24-48 hours (if placed) post-operatively. Bending, twisting and weight lifting are avoided till 2-3 weeks after surgery. Suture removal was done on 2nd postoperative week, which is the first follow-up of the patient, next followed up at 6 week, 3 months and 6 months. Japanese orthopaedic score (JOA)^[9-12] and kirkaldy-willis criteria^[13] criteria were collected to calculate and compare the functional outcomes of both the procedures.

Results

Out of all 36 patients in this study, 18 underwent Discectomy and 18 PLIF. Age of patient's ranges from 20 years to 70 years and mean age was 43.52 years for both discectomy and PLIF groups and the sex distribution in both groups; male predominance is seen (Table 1). Most common spinal level is found to be L4-L5 (Table 2, Fig 1).

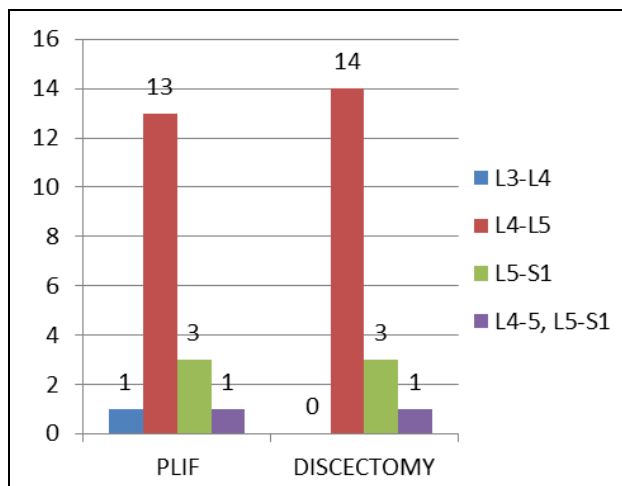


Fig 1: Number of cases in different levels.

Table 1: Sex distribution in both the cases.

	Sex	Cases	Percent
PLIF	Male	11	61%
	Female	7	39%
	Total	18	100%
Discectomy	Male	13	72%
	Female	5	28%
	Total	18	100%

Table 2: No. of cases in different levels

Procedure	L3-L4	L4-L5	L5-S1	L4-5, L5-S1	Total
PLIF	1	13	3	1	18
Discectomy	0	14	3	1	18

All the 36 cases (100%) had preoperative complaints of low back pain (LBP), which was reduced to 1 case postoperatively (2.78%). Suggested this as a significant change postoperatively (p-value <0.01). The overall result of the surgery was categorized in four categories according to Kirkaldy Willis Criteria [13]. It was based on the ability to return to work. Calculating the outcome by these criteria in all follow-ups, we concluded that in early follow-up that is of second post-op week (Fig 2), the discectomy shows a satisfactory outcome then that of PLIF group. And in 6 month last follow-up (Fig 3), PLIF group shows a satisfactory outcome then discectomy.

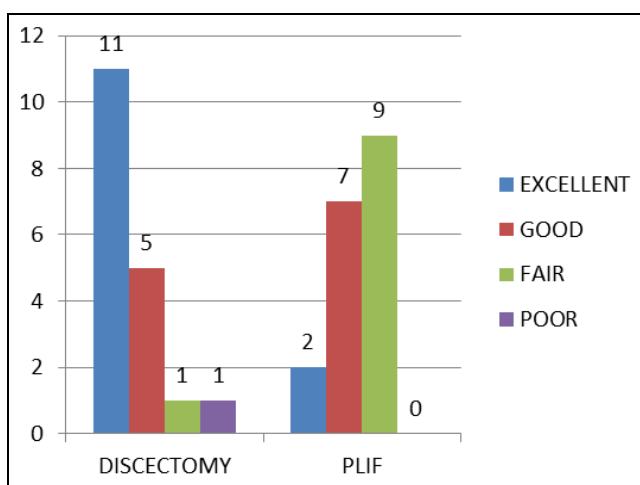


Fig 2: Functional outcome at 2 week.

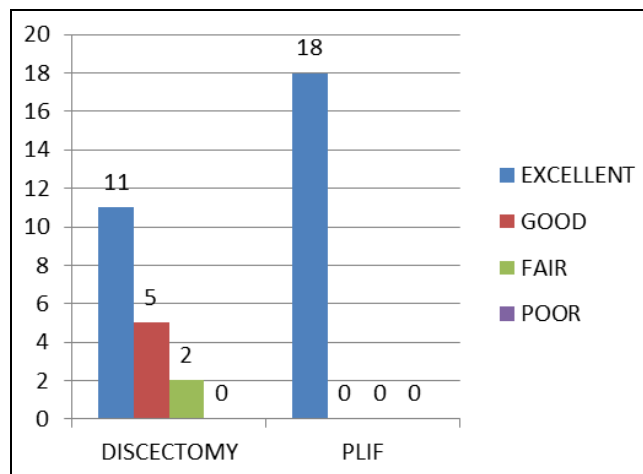


Fig 3: Functional outcome at 6 month.

In our study, pre-op JOA score [9-12] of all 36 patients, mean was 17.80 and at 2-week post operatively follow up JOA score, mean was 25.42, here P-value is <0.0001 which is less than 0.05, the conclusion is that the two means are significantly different. At 2 week follow up (Table 3), here p-value = 0.0002 which is less than 0.05 (P<0.05). At 6 week follow up (Table 4), p-value = 0.0055 which is less than 0.05 (P<0.05). At 3 month follow up (Table 5), p-value = 0.1924 which is more than 0.05 (P<0.05). At 6 month follow up (Table 6), p-value = 0.0042 which is less than 0.05 (P<0.05). So, this result in all follow-ups shows that in early follow up that is in 2 week and 6 week Discectomy has significantly better functional outcome then PLIF group and in last follow up PLIF shows better functional outcome then Discectomy patient group.

Table 3: JOA score at 2 week

Group	Mean	SD	P-Value
Discectomy	26.94	2.62	0.0002
PLIF	24	1.41	

Table 4: JOA score at 6 week.

Group	Mean	SD	P-Value
Discectomy	28.16	2.09	0.0055
PLIF	26.22	1.83	

Table 5: JOA score at 3 month.

Group	Mean	SD	P-Value
Discectomy	27.72	1.77	0.1924
PLIF	28.38	1.14	

Table 6: JOA score at 6 month

Group	Mean	SD	P-Value
Discectomy	27.52	1.85	0.0042
PLIF	28.88	0.32	

In our study average operative time is 125 min in PLIF group and 45.55 min in Discectomy group. Here p-value between operative is <0.0001 which is <0.05, so it is statically significant. All the patients had usual span of hospitalized duration. They were admitted till intravenous medication was completed. None of the patient was kept admitted for more than 5 days.

Complications

Complications that occurred in our study are: (1) Infections – Surgical site infection (SSI) superficially in 1 case (Discectomy group), Pus culture and sensitivity was done and appropriate antibiotics were given and the infection settled

down, in follow up infection is reappear so debridement is done and after it the infection is suppress. (2) Dural tear – In 1 case (Discectomy), dura repair is done intraoperatively, but the post-operative headache is for a long time up to follow-up of 6 weeks.

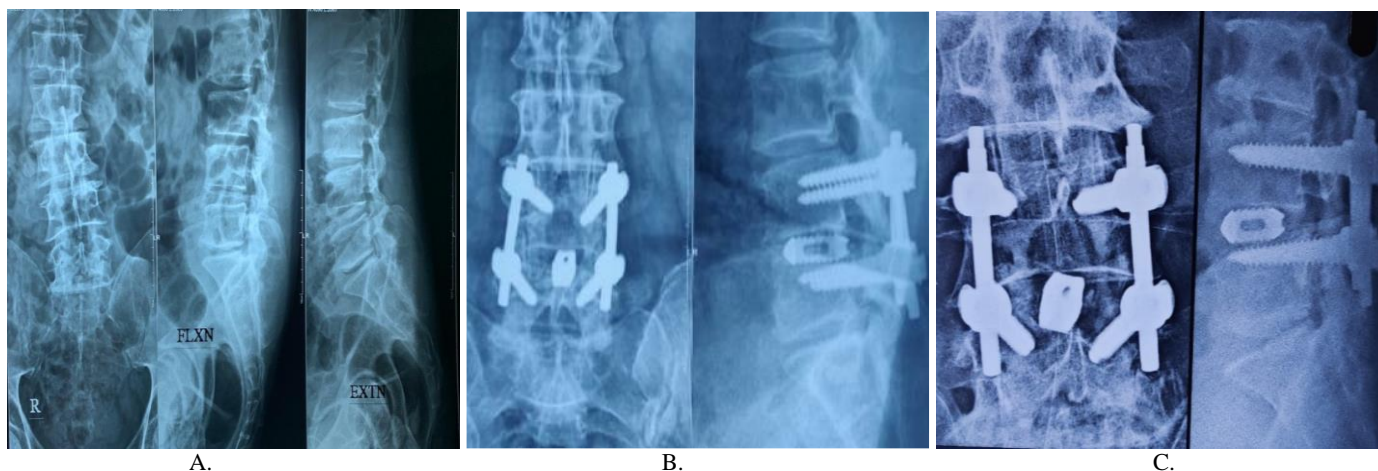


Fig 4: Case of PIVD L4-L5 PLIF (A) Pre-op x-ray, (B) Immediate post-op x-ray, (C) 6-month follow-up x-ray.



Fig 5: Case 1 showing Back Range of motion at 6 month Post-operative follows up

Discussion

LBP frequently leads to disability in active people to such an extent that it doesn't allow them to carry out normal routine activities of daily living and often leads to absenteeism from work. Out of these patients, PIVD is a very common cause [1, 2]. Posterior Lumbar interbody fusion (PLIF) surgery is one of the best options for management of degenerative disc disease. In the present study, we compared preoperative clinical condition with final follow-up condition of the patient and compared between the follow-ups to find out which surgical procedure has a better functional outcome, final functional status with, the ability to return to work. Scott L. Parker *et al.* [14] in his analysis of a systematic literature review and prospective longitudinal outcomes study had included studies which accounts to 21180 patients. The analysis showed the proportion of 2-year, same-level disc prolapse requiring revision Discectomy was nearly 6%. Two-year recurrent low back pain after discectomy may occur in 15% to 25% of

patients. But the level of pain and disability remains less than that experienced at the time of prior disc herniation and index surgery. Cloward [7] was the pioneer of PLIF surgery in disc prolapse. The justifiable causes proposed for performing fusion includes a ruptured disc will result in instability of the joint which will eventually produce symptoms, loss of nucleus pulposus cannot be compensated or replaced, simple discectomy have cured only half the patients.

The mean age in this study was 43.52 years and the range is from 20-70 years. In other studies like in Krishnan AS *et al.* [15] mean age was 40 years, Zhuron S *et al.* [16] mean age was 32.46, Lee *et al.* [17] mean age in his study was 37.90 and in study of EL Shazly *et al.* [18] mean age was 40.50.

In this study, calculating p values in all follow-ups between these two procedures we concluded that Discectomy has significantly (p-value <0.05) better functional outcome in early follow-ups that is in 2 week and 6 week then that of PLIF, but in last follow-up of 6 month in this study PLIF shows significantly better functional outcome then that of Discectomy so although discectomy shows better functional outcome then PLIF in early follow-up, less surgery time, less blood loss and feasible for patients but PLIF shows better long term results according to this study. In study of Zhuron S *et al.* [16] Both methods of surgery independently improved outcomes compared with baseline status based on VAS, ODI, and JOA scores ($P < 0.05$), and no significant differences were found between the two groups at most of the measuring points in time, although patients with decompression alone had a higher JOA score ($P = 0.016$) and higher JOA recovery rate ($P = 0.010$) at the 3-month follow-up. The short-term results of our study showed that both methods of surgery obtained effective clinical outcomes, but decompression alone had some advantages (shorter surgery time, less blood loss, shorter hospital stay, and lower cost) compared with decompression with instrumented fusion. But in last follow-up of 1 year decompression with instrumentation that is PLIF shows better JOA mean score then that of discectomy alone.

Dai *et al.* [19] during the final visit, we observed that the average JOA increased from 12 to 24 and improvement degree varied between 29% to 100% (mean: 72%). And in this study JOA increased from 14 to 29 and improvement degree varied from 25% to 100%.

In a study of Cao *p et al.* [20] use JOA score to evaluate functional outcome between Discectomy alone and PLIF and he concluded that PLIF significantly superior outcome compare to simple discectomy in follow-up of 18 month.

Several authors [21-23] have reported comparative studies evaluating clinical results of disc excision for lumbar disc herniation with and without fusion. Nachlas [24] first reported the comparative analysis of 374 cases concerning the treatment of lumbar disc herniation by excision with and without fusion in 1952. He concluded that excision with fusion offered few advantages in the treatment of lumbar disc herniation from clinical results but the differences were not significant on residual low back pain and leg pain in both fusion and nonfusion group. There are several reports similar to Nachlas's results. The negative aspects of spinal fusion are indicated as pseudoarthrosis at the high rate of 13.7% by Barr *et al.* [70] and as donor site pain in 37% by Frymoyer *et al.* [25].

As in this study we use autologous bone graft was used which is harvested from the excised lamina and spinous process is filled in empty disc space, donor site pain is not there in this study and no patients had pseudoarthrosis in PLIF group in all follow-up to 6 month.

Discectomy is a choice of surgery for PIVD due to its outcomes and less intraoperative complications, less blood loss, less operative timing and pain relief than PLIF. In early follow-up Discectomy had better functional outcomes considering excellent and good outcome as satisfactory outcome on ability to return to work in 88.88% of cases then in PLIF group that is 50% of cases, And midterm follow up shows favorable results in both discectomy and PLIF group. But in last follow-up of 6 month, PLIF group had better functional outcomes considering excellent and good outcome as satisfactory outcome in 100% cases then in Discectomy group that is 88.88%.

In study of Aghayee HN [26], In discectomy alone, 82.3% of patients (14 subjects) and in discectomy+ PLIF, 87.5% (21 subjects) stated that they have the ability to return to prior activities, however, there wasn't statistical significant difference between these two groups ($p=0.679$). Conclusion of this study was both discectomy alone and discectomy with PLIF were associated with favorable mid-term results in treating patients with RLDH, however, the authors recommend using discectomy with PLIF for lower radicular pain by using the back and radicular pain intensity using visual analogue scale (VAS), functional outcome using Oswestry low back pain disability scale (ODI), return to previous work and complication.

Complications that occurred in our study are Surgical site infection (SSI) superficially in 1 case (Discectomy group), Pus culture and sensitivity was done and appropriate antibiotics were given and the infection settled down, in follow up infection is reappear so debridement is done and after it the infection is suppress and In 1 case (Discectomy), dura rupture intraoperatively and repaired, but post-operative headache is for long time up to follow up of 6 weeks.

In study of Chen *et al* [27], two patients had Dura rupture and none showed CSF leak. One patient showed superficial surgical wound infection. Krishnan AS *et al* [15] four patients had superficial infections in the discectomy group and two for PLIF group. Standard protocol for early post-op infection was followed and the infection subsided. Dural tear occurred in 4 patients, 3 for discectomy and 1 for the PLIF group. We did not have any new neurological deficit after surgery in any patient. In study of Aghayee HN *et al.* [26] Side effects were observed in 5 patients (13.9%) with good results (2 cases of

dura rupture, 2 cases of nervous root damage and 1 case of deep infection) and 3 patients whose treatment had failed (3 cases of dura rupture).

Conclusion

In conclusion, although the PLIF procedure are substantially increased nowadays, the short-term results in our study show that discectomy alone has some advantages (shorter surgery time, less blood loss, and lower cost) compared with PLIF, and patients had better functional outcome than that of PLIF group after surgery in 2 and 6 week follow-ups. We can safely conclude from the study that discectomy alone is the advised surgical method of treatment for patients with PIVD but if the feasibility of the patients allows, PLIF provides better long term functional outcome and stability with lesser chances of recurrences.

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