

Conventional Open Discectomy Versus Interlaminar Discectomy in Management of Lumbar Disc Prolapse: A Comparative Study

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Abstract

Background: Lumbar discectomy is one of the most commonly performed surgical procedures of the lumbar spine. Interlaminar discectomy is becoming the mainstay approach for excision of a herniated lumbar disc as it provides a minimally invasive approach that preserves the normal spine anatomy.

Aim of Study: This study aimed to compare the outcome of interlaminar lumbar discectomy to the conventional open approach for cases with lumbar disc prolapse.

Patients and Methods: This is a single-blinded randomized controlled study of 20 patients, divided into two groups. Group A were operated upon by conventional open lumbar discectomy and Group B were subjected to the interlaminar approach

Results: Our results showed a marked reduction in post-operative back pain VAS of the interlaminar group, together with a shorter hospital stay (1.80 ± 0.92 days) and faster return to work (13.9 ± 3.03 days) when compared to the conventional approach, with a similar complication rate.

Conclusion: Interlaminar lumbar discectomy is a safe and effective approach for treatment of lumbar disc herniation and provides a better preservation of the normal spine anatomy and a faster recovery.

Key Words: Lumbar disc prolapse – Discectomy.

Introduction

OPEN lumbar disc surgery is a frequent and important surgical intervention even with many newly developed surgical techniques. It entails removal of ligamentum flavum and extensive resection of the lamina to access the pathological disc. Microdiscectomy allows disc access by only removing part of lamina and part of ligament, together with minimal damage to the surrounding non-pathological structures [1].

Interlaminar lumbar discectomy may be considered as the gold standard procedure for the treatment of lumbar disc prolapse. It involves removal of part of the lamina, ligamentum flavum, and medial facet joints [2]. With availability of better instruments, minimally invasive techniques have advanced making interlaminar lumbar discectomy a popular approach. It has several advantages over conventional discectomy including less paravertebral muscle injury, lower risk of post-surgical instability and rapid recovery [3,4].

This study aimed to evaluate the outcomes of open versus interlaminar discectomy in patients with lumbar disc prolapse in terms of pain relief, recovery, hospital stay, recurrence rate, and complications (including discitis, post operative back pain and persistent radicular pain).

Patients and Methods

Study design:

A prospective randomized controlled single blinded clinical study of patients with lumbar disc prolapse who were randomized to one of the two treatment groups.

1- Group (A): Conventional open discectomy:

The spinous process and the laminae of the involved segment(s) as well as the medial aspects of the facet joints were resected.

2- Group (B): Interlaminar discectomy:

The bone from the inferior aspect of the cranial lamina and, to a minimal degree, from the superior aspect of the subjacent lamina was resected. Subsequent ligamentum flavum resection was performed to expose the disc. The medial aspect of the facet joint was resected to decompress the lateral recess. The spinous process, the supra- and

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interspinous ligaments, and a most of the lamina were preserved.

Inclusion criteria:

- Patients with herniated lumbar disc entrapping lumbar nerve root, not responding to conservative treatment.
- MRI of the lumbar spine showing lumbar disc prolapse.

Exclusion criteria:

- Recurrent cases.
- X-ray dynamic views showing lumbar spondylolisthesis.
- Cases with spinal canal stenosis.

Sample size:

Using Superiority Tests for the Difference Between Two Proportions ($H_0: p_1 - p_2 \leq D_0$ vs. $H_1: p_1 - p_2 = D_1 > D_0$) with a power of 80 % and an alpha error of 0.05 and based on the previously reported risk difference between conventional open discectomy (p_1) and Interlaminar discectomy (p_2) of 0.33, group sample sizes of 8 patients achieved 84.325% power to detect a difference between the group proportions of 0.73. The Group 2 proportion is 0.005. The Group 1 proportion was assumed to be 0.3350 under the null hypothesis and 0.7350 under the alternative hypothesis. The statistic test used was the one-sided Z-test (unspooled). The significance level of the test was targeted at 0.05. The significance level achieved by this design was 0.0862. For an assumed dropout rate of 20%, the sample size was decided to be 10 patients in each group, with a total of 20 patients in our study.

Data collection:

Pre-operative full medical history was obtained and full neurological examination was performed. MRI and X-rays of the lumbosacral spine, together with routine pre-operative laboratory investigations were performed for all patients.

Operative data including operative duration, estimated blood loss and incidental durotomies were recorded.

Post-operative data collected included visual analogue scale (VAS) for pain, wound status, neurological condition, symptom improvement and hospital stay.

Surgical techniques:

The procedure was performed under general anesthesia in the prone position. Intra-operative C-arm fluoroscopy was used to localize the required

level. A midline skin incision was performed. Monopolar electro cautery was used to dissect the para spinal muscles so that the facet capsules, but not transverse processes were exposed bilaterally at each level. Care was taken not to violate the facet capsules.

Patients were then randomized into one of the two treatment groups:

1- Group (A): Conventional open discectomy:

Laminotomy was performed as necessary. In order to decompress the nerve root, the herniated disc was removed as much as possible through a unilateral transflavum approach. Foraminotomy was done on affected side. The wound will be closed in layers with a suction drain when necessary.

2- Group (B): Interlaminar discectomy:

The ligamentum flavum was dissected and removed from the superior and inferior laminae. Foraminotomy was performed as necessary. The lamina, facet, and facet capsule were left intact. After the root was exposed, the exiting nerve root was retracted medially to expose the disc space. The disc was incised to allow the entry of a punch into the disc space and removal of the herniated portion of the disc material. The spinal canal was examined for additional extruded or sequestered fragments. After meticulous hemostasis, fascia and skin were closed.

Statistical analysis:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the non-parametric Mann-Whitney test. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. p -values less than 0.05 were considered as statistically significant.

Results

This randomized controlled trial was conducted at Cairo University Hospitals from March 2021 to December 2021, to compare the safety and the clinical outcomes after interlaminar discectomy compared to conventional open discectomy in patients with lumbar disc prolapse who were randomly allocated to one of the two interventional groups:

- Group (A) underwent conventional open discectomy.
- Group (B) underwent interlaminar discectomy.

Ten cases were allocated to each study group, A (open discectomy) and B (interlaminar discectomy). The mean age of cases for group A was 49.5 years and for group B was 40.3 years. 15 cases were males (75%) and 5 were females (25%), 3 females for group A (30%) and 2 females for group B (20%).

We assessed visual analogue scale (VAS) for back pain and sciatic pain each preoperative, immediately postoperative, one month, and after 6 months after the operation for both groups. Both back pain and sciatic Pain showed remarkable relief immediately after the operation compared to before the operation (Table 1). Mean back pain scores were 6.2 ± 1.14 SD for group A and 6 ± 0.94 SD for group B preoperative, $2.2 \pm .063$ SD for group A and 2 ± 00 for group B immediately postoperative, 1.6 ± 1.35 SD for group A and 2.4 ± 1.26 for group B one month postoperative, and 2.6 ± 1.65 SD for group A and 2 ± 1.33 SD for group B six months postoperative.

Mean and SD for hospital stay were 2.50 ± 071 SD for group A (open discectomy) and 1.80 ± 0.92 for group B (interlaminar discectomy).

Mean and SD for early recovery to daily activity were 3.4 ± 0.70 SD for group A and 2.10 ± 1.10 for group B, mean and SD for early recovery to work were 16.20 ± 2.74 SD for group A and 13.9 ± 3.03 for group B (Table 2).

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group B, mean and SD for early recovery to work were 16.20 ± 2.74 SD for group A and 13.9 ± 3.03 for group B.

There was no significant difference in complications between the two groups. Out of twenty cases of our study 3 cases were complicated with incidental intraoperative dural tears, 2 cases in group A and 1 case in group B that caused minimal CSF leak intra-operatively. These tears were repaired by primary stitches. The fascia was closed in a watertight fashion with drain insertion, and no suction applied. Post operatively, those patients were instructed for bed rest in a flat prone position. Acetazolamide 250mg tablets every 8 hours, were prescribed for three days. The daily dressing showed no leak from the wound, the drain was removed after three days, with no further complications in all three cases.

Two cases in our study were complicated by surgical site superficial infection one week after surgery, one case in each group. CRP was elevated, which improved with intravenous antibiotics and repeated dressing for ten days, then stitches were removed at the outpatient clinic. MRI lumbosacral postoperative showed no evidence of deep infection.

In group B, one case developed recurrence of the same symptoms after three months. Imaging showed recurrence of disc prolapse on the same level of the previous operation, the patient was re-operated upon by open discectomy at the same level, discectomy done with sufficient decompression and the symptoms improved.

Another case in group A reported persistence of pre-operative urinary precipitancy. Gynecological consultation revealed a local cause that was managed accordingly.

Table (1): VASassessment of sciatic pain preoperative, immediately postoperative, 1 month, and 6 months postoperative.

	Group										P-value
	Group A open discectomy					Group B interlaminar discectomy					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Sciatica pain pre op	7.40	1.35	8.00	6.00	10.00	7.60	1.58	8.00	6.00	10.00	0.853
Sciatica pain immediate post op	2.00	0.94	2.00	0.00	4.00	1.60	0.84	2.00	0.00	2.00	0.529
Sciatica pain 1 month post op	1.20	1.69	0.00	0.00	4.00	1.40	2.12	0.00	0.00	6.00	1.000
Sciatica pain 6 month post op	1.40	2.99	0.00	0.00	8.00	1.00	2.54	0.00	0.00	8.00	0.971

Table (2): Hospital stay, early recovery to daily activity, and early recovery to work.

	Group										P-value
	Group A open discectomy					Group B interlaminar discectomy					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Hospital stay (days)	2.50	0.71	2.00	2.00	4.00	1.80	0.92	2.00	1.00	4.00	0.052
Early recovery to daily activity (days)	3.40	0.70	3.00	3.00	5.00	2.10	1.10	2.00	1.00	4.00	0.009
Early recovery to work (days)	16.20	2.74	15.00	14.00	22.00	13.90	3.03	13.00	10.00	20.00	0.035

Discussion

The incidence of lumbar disc herniation peaks between 24 and 45 years of age, where cases requiring surgery are most often between 30 and 39 years [5]. Surgical treatment of lumbar disc disease has challenged the spine surgeons since the first case reported in 1929 by Dandy [6]. Mixer and Barr published the lumbar discectomy technique in 1934, which included an extensive removal of lamina and aggressive curettage of the vertebral end plate [7]. In 1977, Casper and Yasargil introduced the interlaminar approach with partial resection of bony structures, the facet joints, and the ligamentum flavum followed by the removal of the intervertebral disc material. This interlaminar technique is endorsed to be the gold standard procedure for patients requiring surgery for symptomatic lumbar disc herniation, that has not responded to conservative measures [8].

Several surgical techniques for lumbar disc prolapse have been described over last few decades. The aim of surgery for symptomatic lumbar disc prolapse is relief of symptoms by adequate neural decompression while preserving the anatomy and the biomechanical function of the lumbar spine as much as possible [8].

This randomized controlled prospective study compares the safety and outcome of interlaminar discectomy (group B) for lumbar disc prolapse to conventional open discectomy (group A). Discectomy and neural decompression were adequately achieved in all cases.

The main advantages of the interlaminar approach are reduction of the surgical trauma, minimal post operative back pain, higher rates of success, a shorter hospital stay, and quicker return to work and the avoidance of surgically induced instability.

In our study we found that the VAS score of back pain decreased more significantly in group B (interlaminar discectomy) immediate post operative with mean and SD 2 ± 00 for group B while

in group A (open discectomy) was 2.2 ± 0.063 . One month post operative, group B was 1.4 ± 1.26 while group A was 1.6 ± 1.35 . Six months post operative, group B was 2 ± 1.33 while group A was 2.6 ± 1.65 . We reported significant reduction in back pain in interlaminar discectomy compared to open discectomy immediately and one and six months post operative. Back pain VAS scores were more favorable in the group B.

Our results are comparable with those of Sung Kyu Song et al., [9] in their randomized controlled trial. Their study enrolled 56 patients who underwent discectomy at the L5-S1 level, with a minimum one-year follow-up. Patients were allocated to 2 groups: An interlaminar group (n=27; September 2014 to August 2016), or an open discectomy group (n=29; September 2012 to August 2014). Preoperative back pain VAS scores were not significantly different between the 2 groups and decreased progressively during follow-up in both groups. However, back pain VAS scores decreased more significantly in the interlaminar group immediately after surgery, however, the declines at 6 months and one year were not significantly different between the 2 groups. Back pain VAS scores were more favorable in the interlaminar discectomy group than in the open discectomy group at one week postoperatively (mean 1.44 [95% CI, 1.17-1.72] in the interlaminar group versus 2.41 [95% CI, 2.14-2.69] in the open group).

Adequate data of post-operative VAS for low back pain with mean and SD of 11 studies were provided in meta-analysis of Xue-Song Wang [10] for comparing interlaminar minimally invasive discectomy versus conventional discectomy. The eleven studies encompassed 1012 patients. The results of the meta-analysis demonstrate that interlaminar discectomy is superior to open discectomy but there were no significant differences between the two groups in VAS score of post operative back pain.

In our study we found that the VAS score of sciatic pain preoperative were not significantly

different between the 2 groups (mean 7.60 ± 1.58 SD) in the interlaminar group versus (mean 7.4 ± 1.35 SD) in open group, ($p=0.853$), which decreased dramatically after surgery and tended to keep decreasing during follow-up in both groups. The reduction in leg pain VAS scores were not significantly different between 2 groups. Immediate post operative ($p=0.529$) and one month post operative ($p=1.000$) and six month post operative ($p=0.971$). Leg pain VAS scores did not differ significantly between the groups during all follow-up visits. Postoperative VAS for sciatica was equal between the two procedures. Our results are comparable with those of Sung Kyu Song et al., [9] in their randomized controlled trial. Preoperative leg pain VAS scores were not significantly different between their 2 groups (mean 6.48 [95% CI, 5.84-6.98] in the interlaminar group versus 6.41 [95% CI, 5.84-6.98] in the open group, $p=0.913$ and decreased markedly after surgery and kept decreasing during follow-up in both groups ($p<0.001$). The reduction in leg pain VAS scores was not significantly different between the two groups.

In our interlaminar group, the mean duration of hospital stay was 1.8 days and the standard deviation (SD) was ± 0.92 days, while mean duration of early recovery to daily activity was 2.10 ± 1.10 SD days. Early recovery to work was 13.90 ± 3.03 SD days, while in the open discectomy group the mean duration of hospital stay was 2.5 days and the standard deviation (SD) was ± 0.71 days. The mean duration of early recovery to daily activity was 3.40 ± 0.70 SD days. Mean duration for early recovery to work was 16.2 ± 2.74 SD days.

We found that interlaminar discectomy was better than open discectomy regarding hospital stay, early recovery to daily activity and early recovery to work. Our study is compatible with Sung Kyu Song et al., [9] study that demonstrated mean hospital stay and time to return-to-work were significantly shorter in the interlaminar group compared to the open discectomy group [10].

These findings demonstrate that the minimally invasive interlaminar approach is superior to classic open discectomy in terms of preservation of anatomical structures during surgery and rapid recovery after surgery.

Out of twenty cases of our study 3 cases were complicated with an incidental intraoperative dural tear. Two cases in group A and one case in group B, that caused minimal CSF leakage intraoperatively. These dural tears were repaired by primary sutures and then managed conservatively with no further complications.

Two cases were complicated with surgical site superficial infection one week after surgery, one case in each group. The two cases improved with intravenous antibiotics and repeated dressing for ten days. MRI postoperative showed no evidence of deep infection.

Infections in lumbar disc surgery are classified into superficial and deep wound infections according to Postacchini [11]. The superficial infection rate in lumbar disc surgery is 2-3% [11]. Deep wound infections may occur after lumbar disc surgery such as an epidural abscess, however, postoperative spondylodiscitis, is more common. Symptoms start in the first days after surgery, including fever, severe low back pain and a typical blood picture. Spondylodiscitis can also become symptomatic after several weeks due to delayed local infection. A hematogenous spread of microorganisms from a distant part of the body into the wound area may also be the cause in these cases. The risk of infection increases with chronic illnesses such as diabetes as well as steroid intake. Postacchini found the incidence of spondylodiscitis to range from 0.13 to 0.9% [11].

Out of twenty cases in our study, 2 cases had recurrent or persistent symptoms, one case in each group. In group B, one case developed recurrence of symptoms three months after surgery. Imaging showed recurrence of disc prolapse on the same level of the previous operation. We decided to reoperate with open discectomy at the same level. Symptoms improved after the second surgery. Another case in group A complained of post-operative persistence of urinary symptoms. The condition was found to be secondary to a local gynecological cause and was managed conservatively.

In the series described by Sung Kyu Song et al. [9] Recurrence rate, requirement of additional nerve block, and revision surgery rate were not different between the 2 groups. In the interlaminar group, two of their patients (7.4%) experienced recurrence of disc herniation and underwent revision surgery (one patient at 1.3 months after surgery and one patient at 5 months after surgery). One patient required an additional nerve block for symptom control at 4 months after surgery due to recurrent leg pain. In their open group, three patients (10.3%) experienced recurrence of disc herniation and underwent revision surgery (2 patients within 10 days postoperatively and one patient at one month after surgery), with no requirement of additional nerve block.

Conclusion:

Discherniation is the most common diagnosis among the degenerative abnormalities of the lumbar spine, and it is the major cause of spinal surgery.

The development of minimally invasive surgical techniques is propelled by the need for better patient outcomes.

Interlaminar discectomy is the intervention of choice for lumbar disc prolapse when conservative management is unsuccessful.

This study included 20 patients (10 in each surgical group) and aimed to compare the outcome of conventional versus interlaminar lumbar discectomy. We demonstrated the feasibility of lumbar discectomy by use of the interlaminar approach, providing marked improvement of the preoperative symptoms together with early recovery to normal daily activities and return to work.

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استئصال الغضروف بالجراحة التقليدية المفتوحة مقارنة بالإستئصال ما بين الصفائح العظمية الخلفية في علاج الانزلاق

يعتبر استئصال الغضروف القطني من أكثر العمليات الجراحية شيوعاً في جراحات العمود الفقري القطني. أصبح استئصال الغضروف بين الصفائح العظمية الخلفية هو النهج الأساسي لإستئصال الغضروف القطني المنزلق لأنه يوفر أسلوباً ذو تدخل محدود مما يحافظ على التشريح الطبيعي للعمود الفقري.

هدفت هذه الدراسة إلى مقارنة نتائج استئصال الغضروف القطني بين الصفائح العظمية الخلفية بالطريقة التقليدية المفتوحة لحالات لزلزال الغضروف القطني.

هذه دراسة عشوائية مقارنة أحادية التعمية لـ ٢٠ مريضاً، مقسمة إلى مجموعتين. تم إجراء عملية جراحية على المجموعة (أ) عن طريق استئصال الغضروف القطني المنزلق بالجراحة التقليدية وتعرضت المجموعة (ب) إلى للجراحة بين الصفائح العظمية الخلفية.

أظهرت النتائج إنخفاضاً ملحوظاً في آلام الظهر بعد الجراحة على مقياس VAS لمجموعة الجراحة بين الصفائح العظمية الخلفية، جنباً إلى جنب مع إقامة أقصر في المستشفى (0.92 ± 1.80 يوماً) وعودة أسرع إلى العمل (3.03 ± 13.9 يوماً) مقارنة بالجراحة التقليدية، مع معدل مضاعفات مماثل.

يعتبر استئصال الغضروف القطني بين الصفائح العظمية الخلفية طريقة آمنة وفعالة لعلاج انزلاق الغضروف القطني ويوفر حماية أفضل للتشريح الطبيعي للعمود الفقري والتعافي بشكل أسرع.