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# Effectiveness and Functional Outcome of Fenestration and Discectomy by Mini-Incision for the Prolapsed Lumbar Intervertebral Disc

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**Abstract** **Original Research Article**

***Background:*** Lumbar intervertebral disc herniation is a common health problem in our country. Majority of the surgeries of the spine are done due to disc herniation in Bangladesh. Discectomy can be limited to partial discectomy where only extruded and sequestrated portion is removed, subtotal discectomy where the whole of nucleus pulpous is removed and total discectomy where the entire intervertebral disc of the affected level is removed. ***Aim of the study:*** To find out the effectiveness and functional outcome of fenestration and discectomy by mini-incision for the prolapsed lumbar intervertebral disc in our context. ***Material & Methods:*** This prospective observational study was conducted at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh during July 2015 to June 2017. A total of 31 patients with prolapsed lumbar intervertebral disc were included for the study according to inclusion and exclusion criteria. ***Results:*** The mean age was 35.98 ± 8.50 years with the range from 17 to 50 years. In this study, the most common muscle weakness in EHL. Out of 31 patients, 22 (70.96 %) patients were in this group. 08 (25.80%) cases had weakness in FHL and another group 01 (3.22%) had both muscle weakness. Out of 31 patients, 30 (96.78%) patients had preoperative sensory deficit and 03 (09.67%) patients had postoperative sensory deficit, which is statistically significant. In preoperative period, moderate pain in 27 (83.87%) patients, severe pain in 04 (12.90%) patients. In postoperative period had no pain in 22 (70.96%) patients, mild pain was noted in 08 (25.08%) patients, moderate pain in 01 (03.22%) patient. 20 (64.51%) patients had para spinal muscle spasm in the preoperative period, whereas no patient had any spasm in 3 months postoperatively. The success rate was 100% and the result was statistically significant. In this present series, functional outcome was assessed according to Macnab criteria. 08 (25.80%) cases were excellent, 20 (64.51%) were good, 02 (06.45%) were fair, 01 (03.22%) was poor and improved outcome was found in 96.76% of cases. ***Conclusion:*** The average postoperative neurological recovery was better in operative patients, post-operative hospital stay was minimal, lower in number and intensity of pain, lesser complications and early return to activity.

**Keywords:** Fenestration, Discectomy, Mini-Incision, Prolapsed Lumbar Intervertebral Disc.



## INTRODUCTION

Lumbar intervertebral disc herniation is a common health problem in our country. Majority of the surgeries of the spine are done due to disc herniation in Bangladesh. Fenestration means making a hole and in case of discectomy operation fenestration means removal of ligament flavum at the affected level. Discectomy can be limited or partial discectomy where only extruded and sequestrated portion is removed, subtotal discectomy where the whole of nucleus pulpous is removed and total discectomy where the

entire intervertebral disc of the affected level is removed [1]. In minimally invasive procedure incision length vary from 16 mm to 35 mm or even 50 mm depending on the technique used [2]. There are some invasive non operative techniques such as epidural injection of steroid, chemonucleolysis etc. There are so many options of operation in hand now a day. Traditional open procedure with laminectomy or laminotomy or fenestration, minimally invasive procedures mini-incision with fenestration through direct vision, operating loupe or operating microscope (open microdiscectomy), mini-incision with endoscopic discectomy or percutaneous microdiscectomy [2-5]. There are also laser discectomy and arthroscopic discectomy with similar outcomes [6, 7]. Excision of disc followed by repair of posterior longitudinal ligament and annulus fibrosus or replacement of disc space by prosthetic materials are some other latest options [1, 8]. Although back pain as a presenting complaint may account for only 2% of the patients seen by a general practitioner, the cost to society and the patient in terms of lost work time, compensation and treatment is staggering. Identified risk factors for disc disorders of the lumbar spine include genetic factors, age, gender, smoking and to a minimal degree, occupational exposure, physically strenuous work, psychologically stressful work, low educational attainment and workers. These data suggest that aggressive treatment between 4 weeks and 6 months is necessary for patients with low back pain [9]. Disc excision by fenestration technique has superiority over laminectomy in respect of tissue damage, neurological decompression, early postoperative mobilization, early return to work and low incidence of backache. It is safe, effective and reliable surgical technique for treating properly selected patients with the herniated disc. The technique is free from spinal instability. The most recent techniques such as percutaneous lumbar disc decompression (PLDD), percutaneous endoscopic lumbar discectomy (PELD), young endoscopic spine system (YESS), percutaneous laser disc decompression need lots of expertise, experience and it is expensive too [3]. In an open discectomy, a skin incision is made in the posterior midline of back over the affected level between two spinous processes. The length of the incision depends on how many discectomies will be performed. A single level incision is about 1 to 2 inches long. The back muscles are retracted on one side to expose the lamina [10].

## METHODOLOGY AND MATERIALS

This prospective observational study was conducted at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh during July 2015 to June 2017. A total of 31 patients with prolapsed lumbar intervertebral disc were included for the study according to following inclusion and exclusion criteria. Aim of the study was to evaluate the fenestration and discectomy for prolapsed lumbar intervertebral disc by minimally invasive procedure. Follow up visits has been carried out at 15 days, 1 month, 3 months, 6 months, 9 months and 12 months postoperatively. A 3cm incision was made in midline on back centering the desired space of the spine. Skin and subcutaneous tissue were incised along the line of skin incision. Deep fascia and supraspinatus ligaments were cut by unipolar diathermy. Para spinal muscles were dissected subperiosteally from spinous process and lamina at the desired level and side to be explored. The muscles were then retracted by self-retaining retractor from the midline. Data was collected, compiled and tabulated according to key variables and functional assessment scoring system. The analysis was done according to the standard statistical analysis system. Paired t-test for quantitative data and wilcoxon signed-ranked test for qualitative data were done for significance test, and P value $< 0.05$ was regarded as statistically significant. Prior to commencement of this study, the research protocol was approved by the Institutional Review Board of ethics of National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR). The results of fenestration and discectomy through mini-incision were evaluated by Macnab criteria for the outcome.

**Inclusion Criteria**

- Traumatic and degenerative cause of prolapsed lumbar intervertebral disc.
- Single level of disc involvement
- Positive radiology and imaging – MRI or CT scan.
- Patient of both sex – male and female.
- Age – between 16 - 55 years.

**Exclusion Criteria**

- Disc herniation from tumour and infection.
- Two or more level of disc involvement.
- Age below 16 years and above 55 years.
- Uncontrolled comorbidity – such as uncontrolled hypertension, uncontrolled diabetes mellitus.
- Patient having previous single or more level discectomy.

## RESULTS

In this series, out of 31 patients 3 patients (09.67%) were aged below 25 years, 11 (35.48%) aged 26-35 years, 13 (41.93%) aged 36-45 years and 4 (12.90%) aged 46-55 years. Mean age was 35.98 ± 8.50 years with the range from 17 to 50 years [Table I]. Out of 31 patients, 26 (83.87%) patients were male and 05 (16.12%) were female [Figure I]. Out of 31 patients 01 (03.22 %) had prolapse at the level of L3-L4, 23 (74.19%) had at the level of L4-L5 and 07 (22.58%) had at the level of L5-S1 [Figure II]. The most common type of muscle weakness in EHL is showed here. Out of 31 patients, 22 (70.96 %) patients were in this group. 08 (25.80%) cases had weakness in FHL and another

group 01(3.22%) was both muscle weakness. All patients had muscle weakness at affected level but postoperatively 04 (12.89%) patients had muscle weakness ($p < 0.05$) [Table II]. Most of the patients 17(54.83%) patients had the sensory deficit at L5. Sensory deficit at the level of L4 was 02(06.45%) and that of S1 was 08(25.80%). Sensory deficit at the level of both L5 &S1 was 03(09.67%) and 01 (03.22%) patient had no sensory deficit. Out of 31 patients, 30 (96.78%) patients had preoperative sensory deficit and 03 (09.67%) patients had postoperative sensory deficit, which is statistically significant [Table III]. The distribution of patients for the status of preoperative pain and postoperative pain after 3 months is also reported here. In preoperative period, moderate pain in 27 (83.87%) patients, severe pain in 04 (12.90%) patients. In postoperative period had no pain in 22 (70.96%) patients, mild pain was noted in 08 (25.08%) patients, moderate pain in 01 (03.22%) patient. Statistical paired t-test value was significant; P value was < 0.05 [Table IV]. 20 (64.51%) of patients had para spinal muscle spasm in the preoperative period, whereas no patient had any spasm in 3 months postoperatively. The success rate was 100% and the result was statistically significant [Table V]. The mean SLR in preoperative period was 45.97 ± 11.137 degree with the range from 30º-60º. Postoperative mean SLR was 81.94 ± 4.774 degree and range was 70º-90º, which was significantly improved [Table VI]. 20 (64.51%) patients had restricted spine movement preoperatively, but 29 (93.54%) patients had normal spine movement and 02 (06.45%) patients had restricted movement after 3 months of follow up, the success rate was 90% and the result was statistically significant [Table VII]. 02 (06.45%) were followed up to 12 months, 18 (58.06%) were up to 9 months and 11 (35.48%) followed up to 6 months. The minimum period of duration for follow up was 3 months and maximum duration of follow up was 12 months [Table VIII]. In postoperative complications, 02 (06.45%) of patients had discitis, 01(03.22%) of patients had bowel and bladder problems. The total complication was in 03 (09.67%) patients. The side of prolapse was also noted preoperatively and most 23 (74.19%) of the prolapse were found on posterolateral aspect & 08(25.80%) patients had a central prolapse. Most of the patients, 22 (70.96%) were discharged at 2$^{nd}$ postoperative day. Another 09 (29.03%) patients were discharged between 2 - 7 days. Mean ± SD was 2.29 ± 1.18 days with minimum duration 2 days and maximum duration was 7 days. All patients except one returned to work. Out of 31 patients, 19 (61.29 %) were returned to their previous work, 11 (35.48%) patients were returned to other than previous work and 01 (3.22%) patient had remained unemployed after 03 months postoperatively [Figure III]. According to Macnab criteria, the patients were classified as excellent, good, fair and poor. 20 (64.51%) patients showed good outcome followed by excellent in 08 (25.80%) patients, 02 (06.45%) patients had fair outcome and 01 (03.22%) patient had poor outcome [Table IX].

**Table I: Frequency of the patients by age (n=31)**

| Age (years) | Frequency | Percentage |
|---|---|---|
| **16-25** | 3 | 09.67 |
| **26-35** | 11 | 35.48 |
| **36-45** | 13 | 41.93 |
| **46-55** | 4 | 12.90 |
| **Total** | 31 | 100 |
| **Mean ± SD (range)** | 35.98 ± 8.50(17-50 years) | |

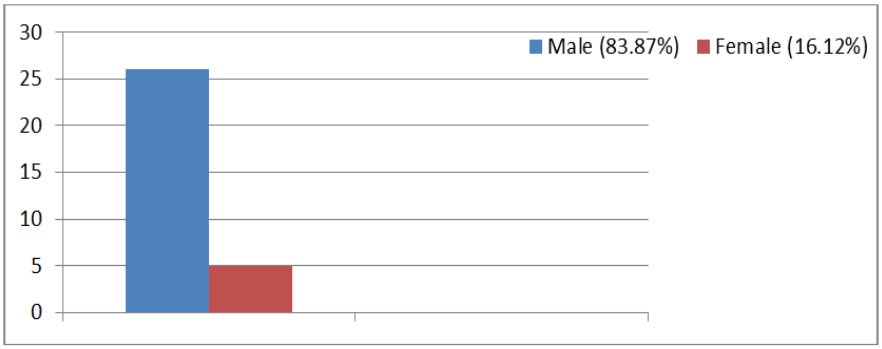


**Figure I: Frequency of the patients by sex (n=31)**

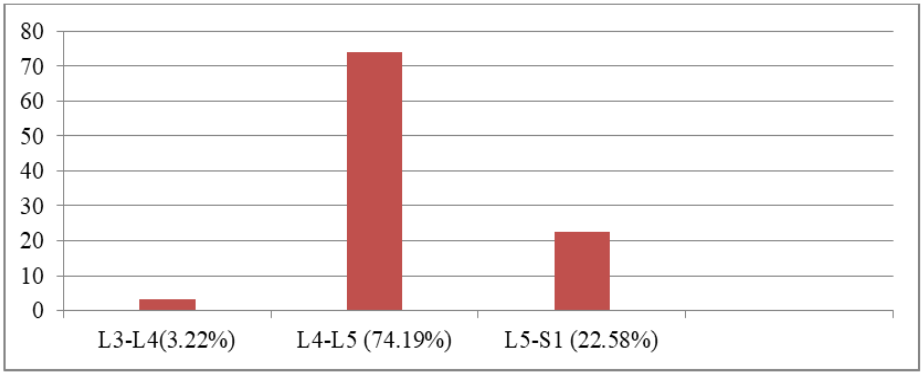


**Figure II: Frequency of patients by level of disc prolapse (n=31)**

**Table II: Comparison of motor weakness in before and after operation (n=31)**

| Muscle power | Preoperative | | Postoperative | | P value |
|---|---|---|---|---|---|
| | No. of patient | Percentage | No. of patient | Percentage | |
| **EHL** | 22 | 70.96 | 02 | 6.45 | |
| **FHL** | 08 | 25.80 | 01 | 3.22 | |
| **Both EHL & FHL** | 01 | 3.22 | 01 | 3.22 | < 0.05 |
| **Total** | **31** | **100** | **04** | **12.89** | |

N.B.: EHL – Extensor Hallucis Longus.
FHL – Flexor Hallucis Longus.
Significance test was done using paired t-test.

**Table III: Comparison of preoperative and postoperative sensory deficit (n=31)**

| Level of sensory deficit | Preoperative | | Postoperative | | P value |
|---|---|---|---|---|---|
| | No. of patient | Percentage | No. of patient | Percentage | |
| **L4** | 02 | 06.45 | 00 | 00 | |
| **L5** | 17 | 54.83 | 01 | 3.22 | |
| **S1** | 08 | 25.80 | 01 | 3.22 | |
| **L5 & S1** | 03 | 09.67 | 01 | 3.22 | **< 0.05** |
| **None** | 01 | 03.22 | 28 | 90.32 | |
| **Total** | **31** | **100** | **31** | **100** | |

Significance test was done using Wilcoxon signed-ranked test.

**Table IV: Comparison of pain score in before and after operation (n=31)**

| Sl. No. | Preoperative VAS Score (mm) | Postoperative VAS Score (mm) | P value | Sl. No. | Preoperative VAS Score (mm) | Postoperative VAS Score (mm) | P value |
|---|---|---|---|---|---|---|---|
| **1** | 50 | 0 | < 0.05 | 17 | 80 | 30 | < 0.05 |
| **2** | 50 | 0 | | 18 | 60 | 0 | |
| **3** | 60 | 0 | | 19 | 70 | 20 | |
| **4** | 50 | 30 | | 20 | 70 | 0 | |
| **5** | 60 | 0 | | 21 | 60 | 0 | |
| **6** | 50 | 20 | | 22 | 70 | 0 | |
| **7** | 50 | 0 | | 23 | 60 | 20 | |
| **8** | 60 | 0 | | 24 | 70 | 0 | |
| **9** | 50 | 0 | | 25 | 70 | 0 | |
| **10** | 50 | 0 | | 26 | 60 | 0 | |
| **11** | 55 | 0 | | 27 | 60 | 0 | |
| **12** | 60 | 0 | | 28 | 70 | 30 | |
| **13** | 60 | 40 | | 29 | 70 | 50 | |
| **14** | 70 | 0 | | 30 | 50 | 0 | |
| **15** | 80 | 0 | | 31 | 60 | 0 | |
| **16** | 90 | 0 | | | | | |

| VAS scale | Preoperative | | Postoperative | | P value |
|---|---|---|---|---|---|
| | frequency | % | frequency | % | |
| **No pain** | 00 | 00 | 22 | 70.96 | |
| **Mild** | 00 | 00 | 08 | 25.08 | |
| **Moderate** | 27 | 83.87 | 01 | 03.22 | < 0.05 |
| **Severe** | 04 | 12.90 | 00 | 00 | |
| **Total** | 31 | 100 | 31 | 100 | |
| **Mean ± SD** | 63.258 ± 8.32 | | 11.306 ± 11.48 | | |

(N.B.: VAS – Visual Analog Scale
Significance test was done using paired t-test).

**Table V: Comparison of preoperative and postoperative muscle spasm (n=31)**

| Spasm | Preoperative | | Postoperative | | P value |
|---|---|---|---|---|---|
| | Frequency | % | Frequency | % | |
| **Absent** | 11 | 35.48 | 31 | 100 | |
| **Present** | 20 | 64.51 | 00 | 00 | < 0.05 |
| **Total** | 31 | 100 | 31 | 100 | |

**Table VI: Comparison of preoperative and postoperative straight leg raising test finding (n=31)**

| SLR | Preoperative | Postoperative | P value |
|---|---|---|---|
| **Mean ± SD** | 45.97 ± 11.137 | 81.94 ± 4.774 | |
| **Range** | 30º-60º | 70º-90º | < 0.05 |

**Table VII: Comparison of preoperative and postoperative spine mobility (n=31).**

| Mobility | Preoperative | | Postoperative | | P value |
|---|---|---|---|---|---|
| | Frequency | % | Frequency | % | |
| **Normal** | 11 | 35.48 | 29 | 93.54 | |
| **Restricted** | 20 | 64.51 | 02 | 06.45 | < 0.05 |
| **Total** | 31 | 100 | 31 | 100 | |

**Table VIII: Frequency of the patients by postoperative follow-up duration.**

| Range of duration | Frequency | Percentage |
|---|---|---|
| **3 months-6 months** | 11 | 35.48 |
| **6 months-9 months** | 18 | 58.06 |
| **9months-12 months** | 02 | 06.45 |
| **Total** | 31 | 100 |
| **Mean ± SD (range)** | 6.629 ± 1.76 (3-12 months) | |

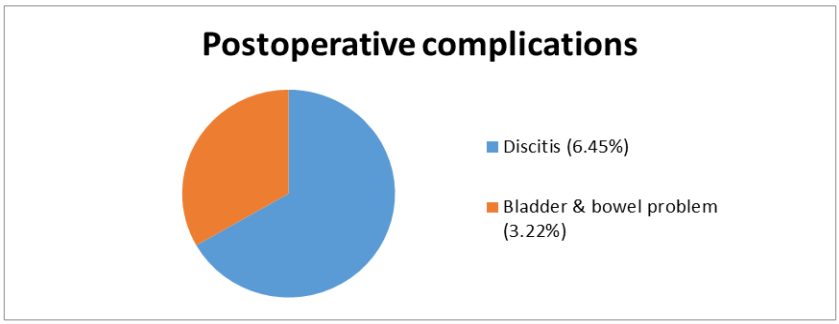


**Figure III: Frequency of the patients by post-operative complications**

**Table IX: Overall functional outcome according to Macnab criteria**

| Result | Frequency | % |
|---|---|---|
| Excellent | 8 | 25.80 |
| Good | 20 | 64.51 |
| Fair | 2 | 06.45 |
| Poor | 1 | 03.22 |

## DISCUSSION

Lumbar intervertebral disc prolapse usually occurs in the active age group of the population, most frequently from 30-50 years. Nabi *et al*., in their series all the 13 cases were between 30-60 years [11]. In my present series, mean age was 35.98 ± 8.50 years with the range from 17 to 50 years. Lumbar disc prolapse more commonly occurs in male than in the female. Nabi *et al*., in their series all patients were male [11]. In Mariconda *et al*., series out of 180 patients, 128 were men and 52 were women [12]. In this series, out of 31 patients, 26 (83.87%) patients were male. In this series, out of 31 patients, 22 (70.96 %) patients were in EHL weakness group. 08 (25.80%) cases had weakness in FHL and another group was both muscle weakness 01 (3.22%). All patients had muscle weakness at affected level but postoperatively 04 (12.89%) patients had muscle weakness and result was statistically significant (P value < 0.05). In my series, most of the cases prolapse occur at L4-L5 level followed by L5-S1 level. Shapiro reported that 64.28% had prolapse at the L4-L5 level, 21.42% had prolapse at the L5-S1 level, 14.28% had prolapse at L3-L4 level [13]. Postoperatively pain, muscle spasm, gait, deformity of the spine, SLR, muscle power, spine movement, sensory status was assessed. All patients were followed up at least for 3 visits. Pain was evaluated by using visual analog scale (VAS). Chakrabarty reported postoperative VAS score was 2.96 ± 1.02 [14]. In this series, preoperatively pain was present in all cases, but after 3 months of operation pain was absent in 22 cases, mild pain was in 8 cases, moderate pain was in 1 case. Preoperatively pain score was 63.258 ± 8.32 and postoperatively it was 11.306 ± 11.48 which was statistically significant (P < 0.05). Mean SLR in preoperative period was 45.97 ± 11.137 degrees and postoperatively it was 81.94 ± 4.774 degrees, which was significantly improved. Statistical significance is measured by paired t-test and P value was < 0.05. Postoperatively spinal movement and muscle spasm were improved significantly (P < 0.05). Majority of reports suggests the incidence of recurrent disc herniation is 6-13% [15]. In my study period, no patient had recurrent herniation. German et al., reported postoperative hospital stay was 1.44 6 ± 0.09 days [2]. Postoperative hospital stays in our study ranging from 2-7 days with mean ± SD value was 2.29 ± 1.18 days. Out of 09 cases of delayed discharge 01 case had urinary retention, 01 case was kept due to peroperative dural tear and other 07 cases had moderate pain. Minimum follow up duration was 3 months and maximum follow up duration was 12 months with 35.48% cases between 3-6 months, 58.06% cases between 6-9 months, 06.45% cases between 9-12 months with about 64.51 % of patients having at least 6 months follow up. Rish reported total complication rate of 4% out of 205 cases [16]. In this series, postoperative complications, 02 (06.45%) of patients had discitis, 01 (03.22%) patient had bowel and bladder problems and total complication rate was 09.67%. Weber found that at one year the surgical group had much better with 92% good results as compared with 60% in non-surgical group [17]. But at four and ten years follow up there was no statistical difference between the two groups. Weinstein *et al*., found that 79.2% improvement in the surgery group and 51% in the non-operative group at 4 years [18]. Different criteria were analyzed for measuring outcome in different series. Sangwan *et al*., based on modified Macnab criteria out of 26 patients 17 patients showed excellent, 6 good and 2 fair results. One poor result was due to persistent root pain. Chakrabarty *et al*., reported that out of 25 patients based on modified Macnab criteria 13 patients showed excellent, 11 good and 1 fair results.[14] Thomas and Afsar reported satisfactory result in 91% of patients [19]. Agarwal and Bhagwat reported overall success rate was 91.5% [6]. In this present series, functional outcome was assessed according to Macnab criteria. 08 (25.80%) cases were excellent, 20 (64.51%) were good, 02 (06.45%) were fair, 01 (03.22%) was poor and improved outcome was found in 96.76% of cases.

### LIMITATIONS OF THE STUDY

There were some limitations in this study as there were lack of advanced facilities such as operating loupe and microscope. Besides, no post-operative CT or MRI could be done due to socio-economic condition of the patients. Also, the pre-operative hospital stay was long and long-term outcome could not be assessed. However, the outcome would be more accurate if the larger sample can be studied.

## CONCLUSION AND RECOMMENDATIONS

In this study the average postoperative neurological recovery was better in operative patients, post-operative hospital stay was minimal, lower in number and intensity of pain, lesser complications and early return to activity. Hence, neurological recovery, reduce pain and improve working status with early rehabilitation was the strongest part of this present series. By evaluating all aspects fenestration and discectomy by mini-incision, it is a better technique in the context of Bangladesh with the advantage of less tissue injury, good spinal function, and smooth patient recovery, improve working status with early rehabilitation and maintain clinical efficacy. On the basis of results in the present study, it is suggested that the surgical management of prolapsed lumbar intervertebral disc through mini-incision is a relatively safe, effective and a good option for surgeons with limited complications and provides substantial benefit.

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