

Risk Factors and Prognosis of Surgical Procedures for Lumbar Disc Herniation Observed in a Clinical Study

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ABSTRACT

BACKGROUND

The incidence of lumbar intervertebral disc prolapse (LDP) is increasing in the current practice of neurosurgery. But prospective studies to assess the risk factors in the final outcome of surgical procedures adopted while treating LDP are not many. We wanted to analyze the risk factors and their role in the prognosis and functional improvement after surgery in patients with Lumbar Disc Herniation.

METHODS

200 patients with LDP subjected to different surgical procedures were studied prospectively in the Department of Neurosurgery, in a tertiary teaching hospital during the period of April 2017 to March 2019. The demographic profile, risk factors and the surgical procedures adopted were noted. The Macnab criteria were used to determine the clinical outcome after surgery. All patients were followed for a period 6 months postoperatively for the presence of complications and final functional outcome after surgery.

RESULTS

Mean age of the patients was 44.7 ± 4.65 years. Males were 113 / 200 (56.50 %) and females were 87 / 200 (43.5 %). Low back pain was present in 187 (93.50 %) patients, radicular pain was seen in 171 / 200 (85.5 %) patients. L4 - L5 interspace was involved in 122 / 200 (61.0 %) patients; disc was extruded in 91 / 200 (45.5 %) patients; disc protrusion was observed in 81 / 200 (40.5 %) patients. According to Macnab criteria, in this study excellent outcome was seen in 129 / 200 patients (64.5 %); the outcome was Good in 56 patients (22.5 %), Fair in 8 (4 %) patients, and Poor in 7 cases (3.5 %). Better surgical outcomes were associated with younger patients ($p < 0.001$), non-diabetics ($p = 0.024$), absence of bowel and bladder involvement ($p < 0.001$), protruded disc prolapse ($p = 0.036$), and disc prolapse precipitated by lifting inappropriate weight ($p = 0.001$). 85.4 % of the MIS group had excellent outcomes, when compared to 39.1 % in the laminectomy group ($p < 0.001$).

CONCLUSIONS

Lumbar Disc Herniation was commonly observed in the middle age with a male predilection. Risk factors like age, overweight, high BMI and diabetes mellitus had poor outcomes. Surgery for LDH was safe with a success rate of (92.5 %).

KEYWORDS

Intervertebral Disc, Prolapse, Radicular Pain, Low Back Ache

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BACKGROUND

The commonest symptom of LDP requiring the patient to take a physician's consultation in recent times was Sciatica. The lifetime incidence of sciatica varies from 13 to 40 % respectively. The annual incidence of an episode of sciatica ranges from 1 to 5 %^{1,2,3} Failure of conservative management with rest, analgesics, physical therapy and trans-foramina or epidural corticosteroid injections, leads to adopting surgery in 10 % of patients.⁴ Absolute indications for disc surgery include: 1. neurological deficit with weakness of functionally important muscles such as hip abductors, ankle dorsi-flexors, ankle plantar-flexors, Cauda equina syndrome.^{4,5,6} Lesser common indications were persistent pain refractory to conservative care and poor quality of life.^{7,8} The risk factors reported from studies resulting in recurrence following surgeries were age, gender, body mass index (BMI), smoking, herniation type, diabetes, and herniation level. Kim et al⁹ reported that men were at a higher risk than women. No such correlation between male gender and Disc surgeries was observed by others.^{10,11,12} Smoking according to some studies increased the recurrence.^{13,14} Intra-discal procedures were reported a success rate from 70 to 80 %.¹⁵ Immediate pain relief was reported in 75 % of the patients with microscopically assisted percutaneous nucleotomy (MAPN),¹⁶ 81.8 % success rate was achieved without leg pain as per Macnab criteria with endoscopic procedures.¹⁷ Japanese Orthopedic Association reported significant improvements on visual analog scale following hemi-laminoplasty.¹⁸ The standard discectomy showed recovery rate of 73.56 %.¹⁹ In this context the present prospective study was conducted to analyze the risk factors and their role in the prognosis of surgical procedures currently used for Lumbar disc herniation.

METHODS

Study Design

This is a prospective, observational study conducted over a period of two years from April 2017 to March 2019 in a tertiary Hospital. Patients admitted in neurosurgery ward for surgical management were included.

Inclusion Criteria

- Patients with radicular pain and evidence of nerve root irritation were included.
- Patients with motor deficit.
- Patients with sensory deficit.
- Patients with radiological signs of herniated disc.

Exclusion Criteria

- Patients who have undergone prior lumbar surgery,
- Patients with scoliosis more than 15°
- Patients with segmental instability.

- Patients with Vertebral fractures.
- Patients with spine infection or tumor or inflammatory spondylo-arthritis.
- Patients with post-polio paralysis / motor neuron disease / connective tissue disorders.

Sample Size

The sample size was calculated by using online sample size calculator (<https://www.calculator.net/sample-size-calculator.html>) wherein the confidence level was taken as 95 %, margin of error as 5 %, population proportion was taken as 85.4 % and population size as unlimited. This meant 192 or more measurements / surveys were needed.

Methods

For the 200 selected patients the demographic profile, clinical profile, radiological profile and the surgical interventions done were studied. After the initial clinical assessment, MRI of the lumbar spine was done in all patients to assess the position, level, and type of herniation of the intervertebral disc. Surgical procedures consisted of classical microdiscectomy, minimally invasive discectomy, and Laminectomy and discectomy. All patients were followed up at least 12 months after surgeries for the presence of persistence of symptoms, neurological deficit and complications. The Macnab criteria²⁰ were used to determine the clinical outcome after Surgery. The reporting was graded as excellent, good, fair, or poor. Excellent Result: No complaints and was able to return to full working capacity. Good Result: Full working capacity but slight low back and leg pain. Excellent results or good results were regarded as satisfactory outcomes. Fair Result: Patient does not have normal working capacity, low back and leg pain were reduced but the patient still required the administration of analgesics. Poor Result: The degree of pain was unchanged or worse and the patient required regular administration of analgesics.¹⁰

Statistical Analysis

All the clinical data was entered in excel sheets and analyzed using www.socialscistatistics.com on the internet. The mean values, Standard deviation and percentages were calculated to express the incidences in the study.

RESULTS

Age (Yrs.)	No. of Patients	%	Male - 113 56.5 %	Female - 87 43.5 %
21 - 30	31	15.5	19 (09.5 %)	12 (06 %)
31 - 40	51	25.5	33 (16.5 %)	18 (09 %)
41 - 50	61	30.5	36 (18 %)	25 (12.5 %)
51 - 60	42	21.0	30 (15%)	12 (06 %)
> 60	15	07.5	10 (05 %)	05 (02.5 %)

Table 1. Age and Gender Distribution of the Study Subjects (n = 200)

Among the 200 patients, 31 patients were aged 21 to 30 years (15.5 %), 51 patients were aged 31 to 40 years (25.5 %), 61 patients were aged 41 to 50 years (30.5 %), 42 patients were aged 51 to 60 years (21 %) and 15 were aged above 60 years (07.5 %). The youngest patient was aged 21 years and the eldest patient was aged 67 years with a mean age of 44.25 ± 3.20 years. Out of 200 patients 113 / 200 (56.5 %) were males and 87 / 200 (43.5 %) were females with a male to female ratio of 1.29:1 (Table 1).

The Risk factors among the different age groups in both genders in Table 2 showed 44 / 200 (22 %) males and 21 / 200 (10.5 %) females were having their weights and BMI within normal values and the remaining 69 (34.5 %) males and 66 (33 %) females were in the obese category. Smoking habits were observed in 38 (19 %) males and 06 (03 %) females. Diabetes mellitus was observed in 38 / 200 (19.0 %) patients out of which 22 (11 %) were males and 16 (08 %) were females. Among the 200 patients majority of patients had involvement of L4 - L5 spinal level in 122 / 200 (61 %), followed by L5 - S1 in 55 / 200 (27.5 %), L3 - L4 spinal level in 20 / 200 (10 %) and least involvement was observed in L2 - L3 level 03 / 200 (1.5 %) of the patients (Table 3). Out of 200 patients, 91 / 200 (45.5 %) patients had extruded disc, protruded disc was present in 81 / 200 (40.5 %) and the least type was sequestered type 28 / 200 (14 %), (Table 3). Out of 200 patients, 03 / 200 patients (1.5 %) had lumbarization and 22 / 200 (11 %) had sacralisation of spine (Table 3).

64 patients underwent Laminectomy and discectomy 43 (67.18 %) and 43 of them (67.18 %) belonged to the age groups of 41 to 60 years. 37 patients underwent Hemilaminectomy and discectomy and 26 (70.27 %) of them belonged to the 41 to 60 years age group. 58 patients

underwent. Micro lumbar discectomy out of whom 40 / 58 (68.96 %) patients belonged to 31 to 50 years old. 41 subjects underwent minimally invasive Discectomy (MIS) 36 (87.80 %) belonged to 21 – 40 years age group (Table 3) This observation was found to be statistically significant with p value at < 0.001 (p significant at < 0.05); implying that MIS was accepted by younger age groups than Micro lumbar discectomy accepted by elderly age groups (41 - 50 years), (Table 3).

Dural tear was observed exclusively in Laminectomy and Hemilaminectomy group, out of 19 / 64 (29.68 %) patients whereas recurrent disc prolapse was observed in 5 / 58 (08.62 %) patients of MIS group and 4 / 41 (09.70 %) patients of Micro lumbar discectomy group. This observation was found to be statistically significant ($p < 0.001$), (Table 4).

Type of Surgery	21 - 30 Yrs.	31 - 40 Yrs.	41 - 50 Yrs.	51 - 60 Yrs.	> 60 Yrs.
Laminectomy and discectomy - 64					
Number	01	09	21	22	11
Percentage	1.6	14.1	32.8	34.4	17.2
Hemilaminectomy & discectomy - 37					
Number	03	07	13	13	01
Percentage	8.1	18.9	35.1	35.1	2.7
Micro lumbar discectomy - 58					
Number	10	16	24	05	03
Percentage	17.2	27.6	41.4	8.6	5.2
Minimally invasive discectomy - 41					
Number	17	19	03	02	00
Percentage	41.5	46.3	07.3	4.9	00
x2	79.030				
df	12				
p value	< 0.001				

Table 3. Type of Surgery Adopted in Different Age Groups of the Subjects (n = 200)

Variable	21 - 30 Yrs. (M - 19, F - 12) 31	31 - 40 Yrs. (M - 33, F - 18) 51	41 - 50 Yrs. (M - 36, F - 25) 61	51 - 60 Yrs. (M - 30, F - 12) 42	> 60 Yrs. (M - 10, F - 05) 15
Mean Weight in Kg					
Males	66.45 \pm 1.30	71.60 \pm 2.05	74.45 \pm 1.65	74.25 \pm 3.10	69.15 \pm 3.10
Females	58.25 \pm 1.40	67.40 \pm 2.10	68.30 \pm 1.75	68.55 \pm 2.35	64.15 \pm 3.05
Mean Body Mass Index Kg / m ²					
Below 18	M - 03, F - 01	M - 05, F - 03	M - 03, F - 02	M - 03, F - 01	M - 01, F - 01
18.5 to 25	M - 03, F - 02	M - 06, F - 03	M - 10, F - 05	M - 08, F - 02	M - 02, F - 01
25 to 30	M - 07, F - 05	M - 10, F - 06	M - 14, F - 12	M - 11, F - 05	M - 04, F - 03
30 and above	M - 06, F - 04	M - 05, F - 03	M - 09, F - 06	M - 08, F - 04	M - 03, F - 02
Mean value	31.25 \pm 0.75	33.04 \pm 2.10	32.05 \pm 2.70	33.10 \pm 1.65	31.21 \pm 2.36
Smoking - 38					
Male - 32	07	05	08	07	05
Female - 06	01	02	03	0	0
Herniation type					
Protrusion - 81: M - 51, F - 30	M - 07, F - 05	M - 15, F - 07	M - 15, F - 13	M - 11, F - 04	M - 03, F - 01
Extrusion - 91: M - 59, F - 32	M - 09, F - 05	M - 14, F - 09	M - 18, F - 11	M - 14, F - 05	M - 04, F - 02
Sequestration - 28	M - 03, F - 02	M - 04, F - 02	M - 03, F - 01	M - 05, F - 03	M - 03, F - 02
Diabetes - 38					
Males - 22	0	03	07	06	06
Females - 16	0	03	03	05	05
Spinal level Herniation					
L2 - L3 - 03	03	1.5	M - 0, F - 0	M - 00, F - 0	M - 01, F - 0
L3 - L4 - 20	20	10	M - 03, F - 1	M - 01, F - 01	M - 01, F - 0
L4 - L5 - 122	122	61	M - 11, F - 10	M - 14, F - 11	M - 13, F - 11
L5 - S1 - 55	55	27.5	M - 08, F - 05	M - 07, F - 05	M - 03, F - 02

Table 2. Incidence of Risk Factors among the Subjects (n = 200). (M - Male, F - Female)

Complications	Laminectomy and discectomy	Hemilaminectomy and discectomy	Microlumbar discectomy	Minimally Invasive Discectomy	X ² df p
Dural tear	16 (25 %)	04 (10.8 %)	00 (00 %)	00 (00 %)	
Dural tear+ CSF Leak,	02 (03.1 %)	01 (02.7 %)	02 (03.4 %)	00 (00 %)	
Discitis	01 (1.6 %)	01 (02.7 %)	00 (00 %)	00 (00 %)	
Recurrent disc prolapse	00 (00 %)	00 (00 %)	05 (8.6 %)	04 (09.8 %)	
No Complications	45 (70.3 %)	31 (83.8 %)	51 (87.9 %)	37 (90.2 %)	
Total	64 (100 %)	37 (100 %)	58 (100 %)	41 (100 %)	
Table 4. Correlation between Type of Surgery and Complications in the Study (n = 200)					

A statistically significant association was observed between outcome and age of the patient ($p < 0.001$). 93.5 % of the younger age group (21 - 30) had excellent outcomes whereas only 17 % of elderly (> 60 yrs.) had excellent outcomes. Gender difference did not alter the final outcome statistically (Table 5).

Variable	Excellent		Good		Fair		Poor		X ² df P
Age in Yrs.	N	%	N	%	N	%	N	%	
21 - 30	29	93.5	1	3.2	0	0	1	3.2	64.408 12 < 0.001
31 - 40	34	66.7	12	23.5	02	03.9	03	05.9	
41 - 50	45	73.8	11	18	02	03.3	03	04.9	
51 - 60	19	45.2	23	54.8	0	0	0	0	
> 60	02	13.3	09	60	4	26.7	0	0	2.041 3 0.564
Gender:	76	67.3	31	27.4	03	02.7	03	02.7	
Male	53	60.9	25	28.7	05	05.7	04	04.6	
Female									
Table 5. Demographic Profile Influencing the Surgical Outcome MAC NAB Outcome Scale (n = 200)									

Non-diabetics had a better clinical outcome when compared to diabetics. 68.5 % of the non-diabetics had excellent outcomes compared to 47.4 % of diabetics, which was statistically significant ($p = 0.024$). Smoking did not show correlation with the clinical outcome significantly. ($p = 0.297$), (Table 6).

Risk Factors	Excellent		Good		Fair		Poor		X ² df P
	N	%	N	%	N	%	N	%	
Smoking: Yes	25	65.78	08	19.5	02	4.9	03	7.3	3.688 03 0.297
No	101	63.5	48	30.2	06	3.8	04	2.5	
Diabetes Mellitus:	18	47.4	15	39.5	04	10.5	01	2.6	9.437 03 0.024
Yes	111	68.5	41	25.3	04	2.5	06	3.7	
No									
Table 6. Correlation between MAC NAB Outcome Scale and Risk Factors in the Surgical Outcome of LDH (n = 200)									

The outcome in patients with herniated disc at L4 - L5 level was excellent grade in 66.4 %. In patients with L5 - S1 level lesions, it was excellent grade in lesions at L3 - L4 level it was 60 %. The statistical test for these results was not significant with p at 0.067 (p taken as significant at < 0.05), (Table 7). Patients with protruded type of disc prolapse had excellent grade outcome 70.4 %, good grade in 27.2 % after surgical intervention, compared with patients with Lumbar

disc extrusion pathology where excellent grade was observed in 64.8 %, good grade in 23.1 %. Among the patients with sequestered type of disc prolapse the results were excellent in 46.4 %, good in 46.4 % which showed statistical significance with p at 0.036 (p taken as significant at < 0.05), (Table 7).

Variable	Excellent		Good		Fair		Poor		X ² df P
	N	%	N	%	N	%	N	%	
MRI Level									15.981 09 0.067
L2 - L3	0	0	03	100	0	0	0	0	
L3 - L4	12	60	12	40	0	0	0	0	
L4 - L5	81	66.4	28	23	08	06.6	05	04.1	
L5 - S1	36	65.5	17	30.9	0	0	02	3.6	
Type Of Hernia									13.460 06 0.036
Protrusion	57	70.4	22	27.2	01	1.2	01	01.2	
Extrusion	59	64.8	21	23.1	05	05.5	06	06.6	
Sequestration	13	46.4	13	46.4	02	07.1	0	0	
Lumbo Sacral			5						3.382 06 0.760
Transition	11	64	0	28.6	07	04	06	03.4	
Not Present	2	33.3	0	66.7	0	0	0	0	
Lumbarization	01		2						
Table 7. Radiological Profile Influencing the Surgical Outcome Using MAC NAB Outcome Scale (n = 200)									

85.4 % of the MIS group had excellent outcomes, when compared to 39.1 % in the Laminectomy group, which show statistical significance with p at < 0.001 (p taken as significant at < 0.05), (Table 8).

Variable	Excellent		Good		Fair		Poor		X ² df P
	N	%	N	%	N	%	N	%	
Laminectomy and discectomy	25	39.1	34	53.1	04	06.3	01	01.6	39.9749 < 0.001
Hemilaminectomy And discectomy	24	64.9	11	29.7	01	02.7	01	02.7	
Microlumbar discectomy	45	77.6	09	15	02	03.4	02	03.4	
Minimally invasive discectomy	35	85.4	02	04.9	01	02.4	03	07.3	
Table 8. Surgical Interventions Influencing the Outcome in Different Types of Surgeries Performed in the Study Using MAC NAB Outcome Scale (n = 200)									

DISCUSSION

The present study was done to assess the risk factors influencing surgical outcome in patients with lumbar disc herniation. Mean age of the patients was 44.25 ± 3.20 years. The maximum numbers of patients were in the age group 41 - 50 years, i. e., 61 cases (30.5 %). Sidram et al,²¹ found the mean age of his patients was 45.9 years and they belonged to 40 - 49 years (33 %). Akbar et al,²² found the majority of their patients were aged between 31 and 45 years. In this study 113 / 200 (56.5 %) were males and 87 / 200 (43.5 %) were females with a male to female ratio of 1.29:1 (Table 1). In the study by Sidram et al²¹ male to female ratio was 1.56, 61 %. Male to female ratio was 2.6:1 in the study done by Akbar et al.²² In the present study out of 200 patients 19 % were diabetics and 19 % were smokers. In the present study majority of patients had involvement of L4 - L5 (61 %), followed by L5 - S1 (27.5 %) involvement. L3 - L4 was involved in 10 % and least involvement in L2 - L3 level (1.5 %). In study by Sidram et al,²¹ L4 - L5 interspace was involved in 138 cases (68.0 %),

L5 - S1 in 52 cases (26.0 %), L3 - L4 in 9 patients (4.5 %), and upper levels in 03 patients (1.5 %). Akbar et al²² observed that L4 - L5 in 48 patients (50 %), L5 - S1 in 35 (36.4 %), L3 - L4 in 10 (10.4 %) and L2 - L3 in 3 cases (3.1 %). In the present study, 45.5 % had extruded discs. Protruded disc was present in 40.5 %. The least was sequestered type 14 %. In study by Sidram et al²¹ the disc was protruded 54 % of the cases, extruded in 28 % of the cases, sequestered in 12 % of the cases and no bulge was observed in 6 % of the cases. In the present study, 1.5 % had lumbarization of vertebra and 11 % had sacralisation was observed. Surgical intervention was done in all; 64 / 200 patients underwent Laminectomy and discectomy (32 %).

Hemilaminectomy and discectomy was done in 18.5 %, microlumbar discectomy in 29 % and MIS in 20.5 %. A statistically significant association was observed between type of surgery and age of the patient ($p < 0.001$). MIS was done mainly in younger age groups. In MIS group 46 % were of 31 - 40 age group, 41.5 % of 21 - 30 age and only two patients were aged > 50 years, which show statistically significant difference ($p < 0.001$). Microlumbar Discectomy was done mainly in 41 - 50 age groups (41.4 %). Laminectomy and Hemilaminectomy was preferred in elderly patients. In the Laminectomy group 34.4 % were of the 51 - 60 age group. Out of 52 Laminectomy cases only 10 patients were < 40 years. Hemilaminectomy was done mainly in the 41 - 50 age group (35.1 %) and 51 - 60 age group (35.1 %). In study by Sidram et al 92 patients (46 %) underwent Hemilaminectomy, in 74 patients (37 %) Laminectomy was performed, inter laminar fenestration was performed in 22 patients (11 %), and in the remaining 12 patients (6 %) Micro-discectomy was done. Most frequent complication was dural tears which occurred in 20 cases. Next was recurrent disc prolapse,⁹ least occurrence was of Discitis.² No patient had wound infection or surgical site infection there was no mortality in this study. Out of 36 cases with complications, 19 were from Laminectomy group. Only 4 patients of MIS had complications, which was found to be a statistically significant difference ($p < 0.001$). In the study by Sidram et al,²¹ the most common complication was superficial wound infection that occurred in 2.5 % of patients and resolved completely with antibiotic therapy. Neurological deficit showed in 2.5 % of cases and Discitis occurred in 0.5 %. In the study by Akbar et al,²² complication rate was 14.6 % with infection remaining on the top (7.3 %) followed by dural tears, as most of the discs were adherent to the spinal Dura mater. The surgical outcome was measured using Macnab criteria Out of 200 patients, 64.5 % had excellent clinical outcomes after surgery. 28 % had good, 4 % had fair and 3.5 % had poor outcomes. A statistically significant association was observed between outcome and age of the patient ($p < 0.001$). 93.5 % of the younger age group (21 - 30) had excellent outcomes whereas only 13.3 % of elderly (> 60 yrs.) had excellent outcomes. Post-surgical intervention, patients who had developed disc prolapse after non-diabetic patients had a better clinical outcome when compared to diabetics. 68.5 % of the non-diabetic patients had excellent outcomes

compared to 47.4 % of diabetics ($p = 0.024$). No significant difference was noted in clinical outcome with smoking ($p = 0.297$). Patients with crossed SLR had an unfavorable outcome (excellent - 56.5 %, good - 39.1 %) when compared to SLR alone (excellent - 72.6 %, good - 19.7 %), ($p = 0.006$). Patients with sensory and motor involvement had an unfavorable outcome, which was statistically significant ($p < 0.05$). Similarly, patients who had developed disc prolapse at the level of L4 - L5 had better outcome (excellent - 66.4 %) compared with other levels of disc prolapsed (but statistically insignificant, ($p = 0.067$). Patients with protruded type of disc prolapse had better outcome (excellent 70.4 %, good 27.2 %) after surgical intervention compared with extruded (excellent 64.8 %, good 23.1 %) and sequestered type of disc prolapsed (46.4 % excellent, 46.4 % good), ($p < 0.05$). 85.4 % of the MIS group had excellent outcomes, when compared to 39.1 % in the Laminectomy group, which was found to be statistically significant ($p < 0.001$). In the study by Sidram et al, (21) excellent outcome was seen in 146 patients (73 %), good in 45 patients (22.5 %), Fair in 07 patients (3.5 %), and Poor in 02 patients (1 %). The association between factors precipitating disc prolapse, level of disc and type of disc prolapsed with surgical outcome was found to be statistically significant.

CONCLUSIONS

Lumbar Disc Herniation was commonly observed in the middle age with a male predilection. Risk factors like age, overweight, high BMI and diabetes mellitus had poor outcomes. Surgery for LDH was safe with a success rate of (92.5 %). Minimally invasive surgery is the best procedure for the younger age group. The surgical outcome was influenced by age of the patient, level of lesion, type of disc and surgical technique.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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