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Original Article

Evaluation of the Outcome of Lumbar Disc Surgeries: Laminectomy Discectomy, Microlumbar Discectomy and Microendoscopic Discectomy

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Abstract

Background: The prevalence of back pain has been reported between 49% and 80%. Except for cases that require immediate surgical intervention, the first-line treatment involves medical choices. 90% of attacks of sciatica respond to conservative management. Surgical intervention when indicated involves discectomy and various operative methods include laminectomy discectomy, microlumbar discectomy, and microendoscopic discectomy. The objective of this study was to evaluate the advantages and disadvantages and outcome of the above-mentioned surgical operations for lumbar disc herniation (LDH) and then, specifically, the outcomes for each of them using Odom's criteria.

Materials and Methods: A prospective study was carried out between April 2015 and April 2017 to compare the advantages/disadvantages and outcome of various surgical interventions in LDH, namely laminectomy discectomy (Group A), microlumbar discectomy (Group B), and microendoscopic discectomy (Group C) with each group consisting of 30 patients. All patients were admitted as per inclusion criteria.

Results: In each group of our study, the mean age and sex distribution were comparable and statistically not significant. Our study showed the post-operative hospital stay and the need for post-operative analgesia was low for microendoscopic surgery, but on long-term evaluation with Odom's criteria, laminectomy achieved better outcomes than other methods.

Conclusion: Our study showed that microlumbar discectomy and microendoscopic discectomy have a better short-term outcome as compared to laminectomy discectomy. However, long-term results are comparable.

Key words: Back pain, Discectomy, Laminectomy, Lumbar disc herniation, Microendoscopic, Microlumbar, Outcome of surgery, Sciatica

INTRODUCTION

Low back pain is a prevalent condition that has many direct and indirect costs in terms of pain and disability as well as the economic burden in terms of lost work days, health-care interventions, and lost productivity time.[1-5] Herniated lumbar disc is the most common specific cause of low back pain.[6] The term "disc herniation" refers to a process in which there has been rupture of the anulus fibers and subsequent displacement of the central mass of the disc in the intervertebral space, common to the posterior or posterolateral aspect of the disc. Young- and middle-aged individuals are the most frequent sufferers of this condition.[7]

About 90% of the attacks of sciatica respond to conservative management.[8] Indications for surgical intervention include cauda equina syndrome (absolute emergency), morphine-resistant hyperalgesic sciatica, paralyzing sciatica, Grade <3 for muscle power as indicated by the Medical Research Council (other than toe muscles, where isolated palsy is not an indication for surgery), and residual disabling pain despite 6–8 weeks of full medical treatment.[9]

Apart from the classical surgery (laminectomy/laminotomy with discectomy), other approaches are (a) microdiscectomy

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and (b) endoscopic microdiscectomy. The average size of the published series of operations (classical, microdiscectomy, and endoscopic microdiscectomy) is only several hundred patients/series, and most series did not attempt assessing the medium to long-term outcome.

Hence, the purpose of the present prospective comparative study was done to evaluate the advantages and disadvantages and outcome of operations for lumbar disc herniation (LDH) and then, specifically, the outcomes for each of the following: Microdiscectomy, endoscopic microdiscectomy, and the classical laminectomy/laminotomy with discectomy.

MATERIALS AND METHODS

We prospectively studied all patients with LDH presenting with low backache and sciatica in our tertiary care center from April 2015 to April 2017.

We included all patients with low backache and sciatica diagnosed to have lumbar disc prolapse were taken as candidates for surgical management and all patients with cauda equina syndrome secondary to lumbar disc prolapse.

Patients with post-traumatic sciatica/cauda equina syndrome and those with the involvement of cervical or thoracic disc along with lumbar discs were excluded from the study.

The patients were divided into three groups as per presenting complaints.

A total of 30 patients were taken in each group.
- Group A: Laminectomy discectomy
- Group B: Microlumbar discectomy
- Group C: Microendoscopic discectomy.

All patients who were included in this study underwent a thorough clinical and neurological examination. They also procured plain X-ray of the lumbosacral spine AP, and lateral and magnetic resonance imaging of the lumbosacral region.

All the patients were sent to the ward post-surgery, if not required intensive care monitoring. For laminectomy discectomy, injection Pidimol 1 g IV 12 hourly was given as post-operative analgesia for 3 days followed by Tab Enzoflam TDS for the subsequent days depending on the requirement. Patients who underwent MLD and MED were put on Injection Pidimol 1 g IV 12 hourly for the first 3 days and then Tab Enzoflam 50 SOS depending on the requirement. The requirement of analgesia was noted as nil when the patient did not require any analgesia for 3 days. Injection Omnatax 1 gm IV stat was given at the time of induction of anesthesia; no antibiotics were given post-operative. All the patients in the study were operated under spinal anesthesia.

The follow-up was carried out in the 1st, 6th, 12th weeks, and 6th month post-operative based on Odom's criteria:

- Grade I: (Poor) No improvement, increased deficit
- Grade II: (Fair) Mild improvement, mild residual deficit
- Grade III: (Good) Moderate improvement, mild residual deficit
- Grade IV: (Excellent) Marked improvement, no deficit.

To compare the mean of the three groups, analysis of variants and "f" statistic were used with appropriate degree of freedom and level of significance. Observations were represented as pie charts and bar diagrams. Intergroup comparison was carried out, wherein two groups were compared for the difference in the mean value using Student's *t*-test.

RESULTS

The mean age in Group A, Group B, and Group C was 43.5 ± 12.78, 45.5 ± 11.29, and 44.4 ± 12.59 years [Table 1]. The age of the patients between groups was comparable and statistically not significant as per Student's *t*-test ($P > 0.05$).

Majority of the patients in the groups were females while male constituted 23.3%, 20%, and 26.7%, respectively, of the study groups [Table 2]. The sex of the patients between groups was comparable and statistically not significant as per Chi-square test ($P > 0.05$).

In Group A, the most common type was the right paracentral type of disc herniation accounting for 14 (46.7%) patients followed by central disc herniation seen in 9 (30%) patients and left paracentral seen in 7 (23.3%) [Table 3].

In Group B, the most common type was the right paracentral type of disc herniation accounting for 13

Table 1: Distribution of patients according to age

Age (years)	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
18–20	2 (6.7)	1 (3.3)	3 (10)
21–30	4 (13.3)	3 (10)	2 (6.7)
31–40	3 (10)	4 (13.3)	3 (10)
41–50	10 (33.3)	9 (30)	10 (33.3)
51–60	11 (36.7)	13 (43.4)	12 (40)
Total	30 (100)	30 (100)	30 (100)
Mean age	43.5±12.78	45.5±11.29	44.4±12.59
P value		>0.05	

(43.3%) patients followed by central disc herniation seen in 11 (36.7%) patients and left paracentral seen in 6 (20%) [Table 3].

In Group C, the most common type was the right paracentral type of disc herniation accounting for 15 (50%) patients followed by central disc herniation seen in 8 (26.7%) patients and left paracentral seen in 7 (23.3%). The difference between groups was comparable and statistically not significant as per Chi-square test ($P > 0.05$) [Table 3].

The patients in Group A had a mean hospitalization of 8.7 ± 0.4 days while patients in Group B and Group C had a mean hospitalization of 5.8 ± 0.8 and 4.5 ± 0.3 days, respectively. The difference between the groups was statistically significant as per Student's *t*-test ($P < 0.05$) [Table 4].

The patients in Group A required analgesia for 5–7 days (mean 6.1 ± 0.8 days), whereas the patients in Group B and Group C required analgesia for 1–2 days (mean 1.5 ± 0.5 days) and 1 day (mean 1 ± 0 day), respectively. The difference between the groups was statistically significant as per Student's *t*-test ($P < 0.05$) [Table 5].

Table 2: Distribution of patients according to sex

Sex	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Male	7 (23.3)	6 (20)	8 (26.7)
Female	23 (76.7)	24 (80)	22 (73.3)
Total	30 (100)	30 (100)	30 (100)
P value		>0.05	

Table 3: Distribution of patients according to the type of disc herniation

Disc herniation	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Right paracentral	14 (46.7)	13 (43.3)	15 (50)
Central	9 (30)	11 (36.7)	8 (26.7)
Left paracentral	7 (23.3)	6 (20)	7 (23.3)
Total	30 (100)	30 (100)	30 (100)
P value		>0.05	

Table 4: Distribution of patients according to the duration of hospitalization

Duration of hospitalization	Group A	Group B	Group C
	Mean±SD	Mean±SD	Mean±SD
Duration of hospitalization	8.7±0.4	5.8±0.8	4.5±0.3
P value		<0.05	

DISCUSSION

A prospective, comparative study was conducted with 90 patients to analyze the advantages and disadvantages and outcome of operations for LDH and then, specifically, the outcomes for each of the following: Laminectomy discectomy (Group A), microlumbar discectomy (Group B), and microendoscopic discectomy (Group C). The patients were divided into the following three groups of 30 patients each.

In the 8 decades, since the publication by Mixter and Barr,[10] many studies of the surgical management of LDH with radiculopathy have been published showing the results of laminectomy/laminotomy with discectomy[11,12]. Another operative approach was described over the 4 decades later, i.e., microdiscectomy.[13-15] Later still, another surgical approach to LDH was developed with the advent of endoscopic microdiscectomy.[16]

Dohrmann and Mansour[17] conducted a study where each of these operations was observed in an attempt to improve the outcome using different operative approaches and techniques; however, there was no real difference in the long-term outcome with the above operations. Good/excellent outcomes were 79% overall and 84% for microdiscectomy, 80% for endoscopic microdiscectomy, and 78% for the classical operation (laminectomy/laminotomy and discectomy). All of the operations analyzed have good/excellent results of around 79%. Different approaches and different techniques did not appear to have made any real difference in the long-term outcome.

Cinotti *et al.*[18] and Lemaire *et al.*[19] observed that an attempt at improving the outcome was the use of the prosthetic disc; however, in long-term studies (46 patients at 3.2 years of follow-up and 105 patients at 4.3 years of follow-up), the good/excellent results were 77% and 79%, respectively.

The short-term results after surgical treatment of symptomatic LDH have previously been reported to have a high success rate (70–95%), evaluated by validated outcome scores, health-related quality of life, and patients satisfaction.[18,20-23] There have been several studies on the long-term outcome of LDH surgery.[24-31]

The mean age in Group A, Group B, and Group C was 43.5 ± 12.78, 45.5 ± 11.29, and 44.4 ± 12.59 years. The age of the patients between groups was comparable and statistically not significant.

Brinjikji *et al.*[32] in a systematic review observed disc degeneration prevalence ranged from 37% of asymptomatic individuals 20 years of age to 96% of those 80 years of age,

Table 5: Requirement of post-operative analgesia between groups

Parameter	Group A	Group B	Group C
	Mean±SD	Mean±SD	Mean±SD
Requirement of post-operative analgesia	6.1±0.8	1.5±0.5	1±0.0
P value		<0.05	

with a large increase in the prevalence through 50 years. Disc signal loss ("black disc") was similarly present in more than half of individuals older than 40 years of age, and by 60 years, 86% of individuals had disc signal loss. Disc height loss and disc bulge were moderately prevalent among younger individuals, and the prevalence estimates for these findings increased steadily by approximately 1% per year. Disc protrusion and annular fissures were moderately prevalent across all age categories but did not substantially increase with age. The authors rarely reported facet degeneration in younger individuals (4–9% in those 20 and 30 years of age), but the prevalence increased sharply with age.

Majority of the patients in the groups were female while male constituted 23.3%, 20%, and 26.7%, respectively, of the study groups. The sex of the patients between groups was comparable and statistically not significant.

Sedighi and Haghnegahdar[33] in a retrospective cohort study observed that mean pre-operative visual analog scale (VAS) for back pain was higher in women than men (female = 7.26 ± 4.03 standard deviation [SD], male=6.03 ± 4.54 SD, $P = 0.125$). However, the difference was not present on pre-operative VAS for radicular pain (Female = 9.09, Male = 9.07, $P = 0.35$).

In Group A, the most common type was right paracentral type of disc herniation accounting for 14 (46.7%) patients followed by central disc herniation seen in 9 (30%) patients and left paracentral seen in 7 (23.3%).

In Group B, the most common type was the right paracentral type of disc herniation accounting for 13 (43.3%) patients followed by central disc herniation seen in 11 (36.7%) patients and left paracentral seen in 6 (20%).

In Group C, the most common type was the right paracentral type of disc herniation accounting for 15 (50%) patients followed by central disc herniation seen in 8 (26.7%) patients and left paracentral seen in 7 (23.3%). The difference between groups was comparable and statistically not significant as per Chi-square test ($P > 0.05$).

Dohrmann and Mansour[17] in a study determined the long-term follow-up of the various operations for LDH in a large patient population observed of the 39,048 operations, 95% of LDHs were at the lowest two levels of the lumbar spine, and 49 and 46% were at L 4–5 and L 5–S1, respectively. Of the remaining 5% LDHS, 0.15% were at L 1–2, 0.65% were at L 2–3, and 4.2% were at L 3–4.

The patients in Group A had a mean hospitalization of 8.7 ± 0.4 days while patients in Group B and Group C had a mean hospitalization of 5.8 ± 0.8 and 4.5 ± 0.3 days, respectively. The difference between the groups was statistically significant.

Rogers[34] observed that the average duration of hospitalization for MLD was 2.76 days and 7.14 days for laminectomy discectomy. Henry[35] observed 24 h for MED.

Sedighi and Haghnegahdar[33] observed a significant correlation ($P = 0.001$) between duration of hospital stay and surgical approach. The majority of our cases were discharged 24–48 h after the operation.

The patients in Group A required analgesia for 5–7 days (mean 6.1 ± 0.8 days), whereas the patients in Group B and Group C required analgesia for 1–2 days (mean 1.5 ± 0.5 days) and 1 day (mean 1 ± 0 day), respectively. The difference between the groups was statistically significant.

The follow-up of patients was based on Odom's criteria.

Majority of the patients in Group A ($n = 29$; 96.7%) were in Grade II and 1 (3.3%) patient in Grade I of Odom's criteria in the 1st week [Table 6]. 23 (76.7%) patients of Group B were in Grade II and 7 (23.3%) patients were in Grade III. 20 (6.75%) patients of Group C were in Grade II and 10 (33.3%) patients were in Grade III. The difference between groups was statistically significant as per Chi-square test ($P < 0.05$).

In the 6th week [Table 7], 23 (73.7%) patients in Group A were in Grade III and 7 (23.3%) patients were in Grade II, whereas 27 (90%) patients of Group B were in Grade III and 3 (10%) patients were in Grade II. Among the patients of Group C, 26 (86.7%) patients were in Grade III, 3 (10%) patients were in Grade II, and 1 (3.3%) patient was in Grade IV. The difference between groups was statistically significant as per Chi-square test ($P < 0.05$).

In the 12th week [Table 8], 24 (80%) patients in Group A were in Grade III and 6 (20%) patients were in Grade IV, whereas 21 (70%) patients of Group B were in Grade III and 9 (30%) patients were in Grade IV. Among the patients of Group C, 22 (73.3%) patients were in Grade III and 8 (26.7%) patients were in Grade IV. The difference between groups was statistically not significant as per Chi-square

Table 6: 1-week post-operative follow-up between groups

Odom's criteria	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Grade I	1 (3.3)	0	0
Grade II	29 (96.7)	23 (76.7)	20 (66.7)
Grade III	0	7 (23.3)	10 (33.3)
Grade IV	0	0	0
Total	30 (100)	30 (100)	30 (100)
P value		<0.05	

Table 7: 6-week post-operative follow-up between groups

Odom's criteria	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Grade I	0	0	0
Grade II	23 (76.7)	3 (10)	3 (10)
Grade III	7 (23.3)	27 (90)	26 (86.7)
Grade IV	0	0	1 (3.3)
Total	30 (100)	30 (100)	30 (100)
P value		<0.05	

Table 8: 12-week post-operative follow-up between groups

Odom's criteria	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Grade I	0	0	0
Grade II	0	0	0
Grade III	24 (80)	21 (70)	22 (73.3)
Grade IV	6 (20)	9 (30)	8 (26.7)
Total	30 (100)	30 (100)	30 (100)
P value		>0.05	

Table 9: 6-month post-operative follow-up between groups

Odom's criteria	Group A	Group B	Group C
	n (%)	*n* (%)	*n* (%)
Grade I	0	0	0
Grade II	0	0	0
Grade III	12 (40)	0	0
Grade IV	18 (60)	30 (100)	30 (100)
Total	30 (100)	30 (100)	30 (100)
P value		<0.05	

test ($P > 0.05$).

In 6 months [Table 9], 12 (40%) patients in Group A were in Grade III and 18 (60%) patients were in Grade IV, whereas all patients of Group B and Group C were in Grade IV. The difference between groups was statistically significant as per Chi-square test ($P < 0.05$).

Quigley *et al.*[36] performed a prospective study of 374 patients undergoing unilateral single-level microdiscectomies. Using univariate and multivariate logistical regression analysis, they found Workman's Compensation claim and length of symptoms – >6 months ($P < 0.0001$ for both) affects the surgical outcome. However, the duration of follow-up for the study was short (6 months).

Hurme and Alaranta[37] evaluated patients at 1 and 6 months postoperatively and reported that the operative finding of protrusion predicted a poor result. Moranjkic *et al.*[38] found that extrusion-type disc implied better outcome. Folman *et al.*[39] reported better outcome for non-contained herniation as compared with contained herniation.

Sanderson *et al.*[40] in unique characteristics of "upper" LDHs concluded that surgical outcome in terms of post-operative back and radicular pain was worse for herniated discs at L1–L2 and L2–L3 compared with those at L3–L4. den Boer *et al.*[41] in a systematic review of biopsychosocial risk factors found that lower level of education was a predictor of unfavorable outcome. Olson *et al.*[42] in a Spine Patient Outcomes Research Trial found that surgical outcomes did not differ by the level of education.

Sedighi and Haghnegahdar[33] in a retrospective cohort study observed that mean follow-up time of the study was 35.54 ± 15.60 months (minimum 12 months). Mean pre-operative VAS for radicular pain and low back pain were 9.12 ± 1.87 (SD) and 6.69 ± 4.31 SD, respectively. The authors observed that all three surgical approaches resulted in a significant decrease ($P = 0.001$) in the intensity of pre-operative radicular pain and low back pain, but intergroup variations in the outcome with regard to the aforementioned outcome tools were not achieved.

As indicated by JOABPEQ low back pain and lumbar function functional scores, laminectomy achieved significantly ($P = 0.001$) better outcomes in comparison with other methods. Outcome of surgery did not significantly differ by age, sex, level of education, pre-operative VAS for back pain, pre-operative VAS for radicular pain, return to previous job, or level of herniation.

Dohrmann and Mansour[17] observed in an analysis of Long-Term Results of Various Operations for LDH, the mean follow-up period in this series was 6.1 years. Of all patients (39,048), 30,809 (78.9%) had good/excellent outcomes. Microscopic discectomy was performed on 3400 (18.7%) patients with a mean follow-up of 4.1 years. Good/excellent results occurred in 32,917 (84.3%) patients. The endoscopic microdiscectomy group consisted of 1101 (3.6%) patients with a mean follow-up period of 2.9 years, and 845 (79.5%) patients had good/excellent results.

Of the 39,048 patients, 34,547 (88.5%) had the classical operation (laminectomy/laminotomy with discectomy). The mean follow-up was 6.3 years. The patients had 78.3% good/excellent results.

However, patients assigned to early surgery have previously been demonstrated to obtain a faster pain relief and recovery in short term but less in long term.[43-47]

CONCLUSION

Patient satisfaction is an important outcome after surgically treated LDH and satisfaction is closely related to both expectations and given information in this patient group. If a decision is made about surgery, when conservative treatment has failed, it is important to give disc herniation patients appropriate information which causes realistic expectations. Patients of today themselves seek information from many sources, for example, the internet and health-care providers need to be aware of this and advice and discuss more around this than traditionally has been done.

Surgery for LDH is an effective treatment in terms of reducing radicular pain (93.4%). All three surgical approaches resulted in a significant decrease in the intensity of pre-operative radicular pain and low back pain, but intergroup variations in the outcome were not achieved. As indicated by JOABPEQ low back pain and lumbar function functional scores, laminectomy achieved significantly better outcomes compared with other methods. Relief of radicular pain was associated with subjective satisfaction with the surgery among our study population, as evidenced by the decrease in radicular pain and the subjective satisfaction with the operation.

REFERENCES

1. Maniadakis N, Gray A. The economic burden of back pain in the UK. Pain 2000;84:95-103.
2. Maetzel A, Li L. The economic burden of low back pain: A review of studies published between 1996 and 2001. Best Pract Res Clin Rheumatol 2002;16:23-30.
3. Katz JN. Lumbar disc disorders and low-back pain: Socioeconomic factors and consequences. J Bone Joint Surg Am 2006;88 Suppl 2:21-4.
4. Hoy D, Brooks P, Blyth F, Buchbinder R. The epidemiology of low back pain. Best Pract Res Clin Rheumatol 2010;24:769-81.
5. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. Spine J 2008;8:8-20.
6. Hansson E, Hansson T. The cost-utility of lumbar disc herniation surgery. Eur Spine J 2007;16:329-37.
7. Schoenfeld AJ, Weiner BK. Treatment of lumbar disc herniation: Evidence-based practice. Int J Gen Med 2010;3:209-14.
8. Gibson JN, Waddell G. Surgical interventions for lumbar disc prolapse: Updated cochrane review. Spine (Phila Pa 1976) 2007;32:1735-47.
9. Blamoutier A. Surgical discectomy for lumbar disc herniation: Surgical techniques. Orthop Traumatol Surg Res 2013;99:S187-96.
10. Mixter WJ, Barr JS. Rupture of the intervertebral disc with involvement of the spinal canal. N Engl J Med 1934;211:210-5.
11. Silverplats K, Lind B, Zoëga B, Halldin K, Rutberg L, Gellerstedt M, *et al.* Clinical factors of importance for outcome after lumbar disc herniation surgery: Long-term follow-up. Eur Spine J 2010;19:1459-67.
12. Suthar P, Patel R, Mehta C, Patel N. MRI evaluation of lumbar disc degenerative disease. J Clin Diagn Res 2015;9:TC04-9.
13. Caspar W. A new surgical procedure for lumbar disc herniation causing less tissue damage through microsurgical approach. Adv Neurosurg 1977;4:74-84.
14. Williams RW. Microlumbar discectomy: A conservative surgical approach to the virgin herniated lumbar disc. Spine (Phila Pa 1976) 1978;3:175-82.
15. Yasargil MG. Microsurgical operation for herniated lumbar disc. Adv Neurosurg 1977;4:81-4.
16. Foleys KT, Smith MM. Microendoscopic discectomy. Tech Neurosurg 1977;3:301-7.
17. Dohrmann GJ, Mansour N. Long-term results of various operations for lumbar disc herniation: Analysis of over 39,000 patients. Med Princ Pract 2015;24:285-90.
18. Cinotti G, David T, Postacchini F. Results of disc prosthesis after a minimum follow-up period of 2 years. Spine (Phila Pa 1976) 1996;21:995-1000.
19. Lemaire JP, Skalli W, Lavaste F, Templier A, Mendes F, Diop A, *et al.* Intervertebral disc prosthesis. Results and prospects for the year 2000. Clin Orthop Relat Res 1997;337:64-76.
20. Hayakawa K, Mizutani J, Suzuki N, Haas C, Kondo A, Otsuka S, *et al.* Surgical management of the pregnant patient with lumbar disc herniation in the latter stage of the second trimester. Spine (Phila Pa 1976) 2017;42:E186-E189.
21. Kanat A, Yazar U, Ozdemir B, Kazdal H, Balik MS. Neglected knowledge: Asymmetric features of lumbar disc disease. Asian J Neurosurg 2017;12:199-202.
22. Dewing CB, Provencher MT, Riffenburgh RH, Kerr S, Manos RE. The outcomes of lumbar microdiscectomy in a young, active population: Correlation by herniation type and level. Spine (Phila Pa 1976) 2008;33:33-8.
23. Gerszten PC, Welch WC, King JT Jr. Quality of life assessment in patients undergoing nucleoplasty-based percutaneous discectomy. J Neurosurg Spine 2006;4:36-42.
24. Rönnberg K, Lind B, Zoëga B, Halldin K, Gellerstedt M, Brisby H, *et al.* Patients' satisfaction with provided care/information and expectations on clinical outcome after lumbar disc herniation surgery. Spine (Phila Pa 1976) 2007;32:256-61.
25. Hakkinen A, Ylinen J, Kautiainen H, Airaksinen O, Herno A, Kiviranta I, *et al.* Does the outcome 2 months after lumbar disc surgery predict the outcome 12 months later? Disabil Rehabil 2003;25:968-72.
26. Asch HL, Lewis PJ, Moreland DB, Egnatchik JG, Yu YJ, Clabeaux DE, *et al.* Prospective multiple outcomes study of outpatient lumbar microdiscectomy: Should 75 to 80% success rates be the norm? J Neurosurg 2002;96:34-44.
27. Atlas SJ, Keller RB, Wu YA, Deyo RA, Singer DE. Long-term outcomes of surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: 10 year results from the Maine lumbar spine study. Spine (Phila Pa 1976) 2005;30:927-35.
28. Barrios C, Ahmed M, Arrótegui J, Björnsson A, Gillström P. Microsurgery versus standard removal of the herniated lumbar disc. A 3-year comparison in 150 cases. Acta Orthop Scand 1990;61:399-403.
29. Graver V, Haaland AK, Magnaes B, Loeb M. Seven-year clinical follow-up after lumbar disc surgery: Results and predictors of outcome. Br J Neurosurg 1999;13:178-84.
30. Loupasis GA, Stamos K, Katonis PG, Sapkas G, Korres DS, Hartofilakidis G, *et al.* Seven to 20-year outcome of lumbar discectomy. Spine (Phila Pa 1976) 1999;24:2313-7.
31. Mariconda M, Galasso O, Secondulfo V, Rotonda GD, Milano C. Minimum 25-year outcome and functional assessment of lumbar discectomy. Spine (Phila Pa 1976) 2006;31:2593-9.
32. Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, Chen LE, Deyo RA, *et al.* Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol 2015;36:811-6.
33. Sedighi M, Haghnegahdar A. Lumbar disk herniation surgery: Outcome and

predictors. Global Spine J 2014;4:233-44.
34. Rogers LA. Experience with limited versus extensive disc removal in patients undergoing microsurgical operations for ruptured lumbar discs. Neurosurgery 1988;22:82-5.
35. Henry H. Schmidek, Schmidek and Sweet Operative Neurosurgical Techniques. 4th ed., Vol. 2. Philadelphia, PA: W. B. Saunders Company; 2000. p. 2255.
36. Quigley MR, Bost J, Maroon JC, Elrifai A, Panahandeh M. Outcome after microdiscectomy: Results of a prospective single institutional study. Surg Neurol 1998;49:263-7.
37. Hurme M, Alaranta H. Factors predicting the result of surgery for lumbar intervertebral disc herniation. Spine (Phila Pa 1976) 1987;12:933-8.
38. Moranjkic M, Ercegovic Z, Hodzic M, Brkic H. Outcome prediction in lumbar disc herniation surgery. Acta Med Sal 2010;39:75-80.
39. Folman Y, Shabat S, Catz A, Gepstein R. Late results of surgery for herniated lumbar disk as related to duration of preoperative symptoms and type of herniation. Surg Neurol 2008;70:398-401.
40. Sanderson SP, Houten J, Errico T, Forshaw D, Bauman J, Cooper PR, *et al.* The unique characteristics of "upper" lumbar disc herniations. Neurosurgery 2004;55:385-9.
41. den Boer JJ, Oostendorp RA, Beems T, Munneke M, Oerlemans M, Evers AW, *et al.* A systematic review of bio-psychosocial risk factors for an unfavourable outcome after lumbar disc surgery. Eur Spine J 2006;15:527-36.
42. Olson PR, Lurie JD, Frymoyer J, Walsh T, Zhao W, Morgan TS, *et al.* Lumbar disc herniation in the spine patient outcomes research trial: Does educational attainment impact outcome? Spine (Phila Pa 1976) 2011;36:2324-32.
43. Weber H. Lumbar disc herniation. A controlled, prospective study with ten years of observation. Spine (Phila Pa 1976) 1983;8:131-40.
44. Ross P, Jelsma F. Postoperative analysis of 366 consecutive cases of herniated lumbar discs. Am J Surg 1952;84:657-62.
55. Jackson RK. The long-term effects of wide laminectomy for lumbar disc excision. A review of 130 patients. J Bone Joint Surg Br 1971;53:609-16.
46. Padua R, Padua S, Romanini E, Padua L, de Santis E. Ten to 15-year outcome of surgery for lumbar disc herniation: Radiographic instability and clinical findings. Eur Spine J 1999;8:70-4.
47. Peul WC, van Houwelingen HC, van den Hout WB, Brand R, Eekhof JA, Tans JT, *et al.* Surgery versus prolonged conservative treatment for sciatica. N Engl J Med 2007;356:2245-56.

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