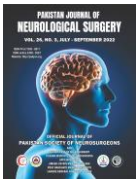

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Original Article

Comparison of the Efficacy of Fusion with Non-Fusion Treatment for Recurrent Lumber Disc Herniation (RLDH)

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ABSTRACT

Objective: The study compared the efficacy of fusion with non-fusion treatment for recurrent lumbar disc herniation.

Materials & Methods: 60 patients including 30 – 65 years of either gender, with recurrent disc herniation and radicular pain from at least six months after primary lumbar disc surgery. Epidural scar tissues were separated and partly resected in patients with RLDH (recurrent lumber disc herniation) undergoing standard revision discectomy (Group A). Posterolateral fusion and trans-pedicular screw fixation were used in Group B. Following the implantation of a subcutaneous suction drain, the closure was performed as usual. The effectiveness was evaluated. The Japanese Orthopedic Association's core was used to measure clinical complaints before and after surgery.

Results: Most of the patients (58.33%) were 46 – 65 years old. The mean recurrent time to primary surgery was 11.87 months. 60% of patients reported ≤ 12 months recurrent time in group B, and 66.6% in group A. Right side was noted in 26.67% of patients of both groups. The mean pre and post-operative JOA scores were 22.34 and 8.54, respectively. The mean recovery rate was 59.32%. This study reported the efficacy of non-fusion treatment versus fusion treatment as 16.67% and 63.33%, respectively.

Conclusion: We concluded that the fusion treatment is better than the non-fusion treatment for recurrent lumbar disc herniation.

Keywords: RLDH (Recurrent Lumber Disc Herniation), Japanese Orthopedic Associations Core (JOA) Criteria, Conventional Revision Discectomy, Posterolateral Fusion, Trans-Pedicular Screw Fixation.

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INTRODUCTION

Recurrent lumbar disc herniation (RLDH) is characterized as disc herniation seen at the same

level at least 6 months after the first operation. Recurrent herniation can occur on either the same or opposite side. One of the consequences of primary surgery is recurrent disc herniation. The presence of RLDH is assumed to reflect surgical failure. In the literature, the reported incidence of recurrent disc herniation ranges from 0.5% to 23%. A recurrent herniation is a substantial contributor to crippling pain, disability, and reoperation after primary surgery when it happens, and it is thus a crucial factor in assessing postoperative success. This sort of issue is also quite taxing on the healthcare system.[1-4] Obesity, diabetes, vibration workers, drivers, and psychological variables should all be considered before undergoing surgery for the first time, since they increase the likelihood of recurrence. Following the first lumbar discectomy, the reoperation rate ranges between 4% and 18%. Due to altered anatomical planes and perineural scarring, revision surgery is more difficult than the original surgery.[5]

Surgery is frequently used as a last option since the outcomes are unpredictable. Patients are frequently left with persistent pain and neurological abnormalities that worsen following surgery. Laminotomy is a procedure in which unilateral muscles are separated and just a segment of the Lamina and Facet Joint is removed after a short midline incision, and microdiscectomy is used to remove the prolapsed disc and provide more room for the Lumbar Nerve under a microscope.[2-3] There are currently several techniques for performing posterior spinal decompression, including open laminectomy, hemi laminectomy, split spinous process laminectomy, minimally invasive laminectomy, endoscopic discectomy, laminotomy, and laminoplasty. Microdiscectomy with laminotomy is generally an elective procedure in which the patient is operated on after six weeks of failed conservative treatment.[4-5] Revision discectomy is difficult because adhesion can obscure the dissection plane between neural and scar tissue and extensive examination of posterior structures might result in segmental instability. This issue may result in additional complications such as hemorrhage, dural rupture, nerve damage, and insufficient decompression.[6] Many surgeons would consider fusion in addition to discectomy since it reduces the potential of disc recurrence and adjacent level instability. Lumbar fusion is routinely used to alleviate uncomfortable instability, which typically manifests as persistent back pain with or without radiculopathy.[5] Functional outcomes in terms of excellent and good outcomes were 27.27% and 63.64%, respectively, for non-fusion therapy, and 75% and 15%, respectively, for fusion treatment. The current study was designed to evaluate the better surgical treatment (fusion or non-fusion surgery) for recurrent disc herniation which can be adopted in the future locally. We hypothesized that the fusion treatment is better than the non-fusion treatment for recurrent lumbar disc herniation. We compared the efficacy of fusion with non-fusion treatment for recurrent lumbar disc herniation.

Lumbar disk disease is a common cause of lower back discomfort. According to several writers, lumbar disk herniation affects 1 – 10% of the population. The male-to-female ratio is around one to one. Adults between the ages of 25 and 45 are the most typically afflicted. The musculoskeletal system's natural aging process exacerbates acute occurrences. Age, exercise, smoking, obesity, vibrations from car driving, lifestyle, and psychological variables are also risk factors. After an accident, pain may appear quickly or gradually. The discomfort is usually felt bilaterally near the posterior belt line.[6-7] Surgery may be beneficial for those who have a herniated disc that is causing substantial leg pain, limb weakness, bladder difficulties, or loss of bowel control.[8] The total complication rate for the procedure is 2 – 4%. Despite repeated instances of mishaps, doctors continue to operate on the wrong level. As a result, relying on intraoperative

radiographic confirmation of the desired level is strongly advised. Intraoperative bleeding can be profuse and is nearly always caused by malpositioning. Engorged venous epidural pathways might make the procedure much more difficult and riskier. The anterior annulus is seldom torn and a retroperitoneal artery is damaged. It is critical to be aware of this problem. If this happens, the back is blocked up while a vascular surgeon prepares to repair the artery by a laparotomy. Infections, most commonly skin infections, may develop. The increased neurologic deficit is generally moderate and is caused by excessive root retraction. If a nerve root is mistakenly removed for a disc herniation, the resulting harm might be severe. Identify the root and disc in the same field if feasible. A conjoined root can often add substantial technical difficulty to a situation. Unfortunately, a considerable proportion of people who have had lumbar disc surgery experience recurrence or residual pain, which can be difficult to treat. A thorough postoperative assessment is required, with an emphasis on symptom explanation, meticulous examination, and repeat radiographic tests and MRI with contrast. Interestingly, major multicenter research conducted in 2006 discovered that surgical and nonsurgical results at 2 years were comparable, although the surgical group enjoyed quicker pain alleviation. A more recent editorial outlines the study's flaws. According to long-term follow-up research, regular severe physical activity at work significantly affects hospitalization for herniated lumbar disc illness.[9-12]

Lumbar discectomy is the most frequent lumbar-related surgery performed in the United States.[13] According to the research; lumbar discectomy gives excellent therapeutic relief in properly chosen sciatica patients. At short-term follow-up, there is substantial evidence in favor of microdiscectomy surgery over conservative therapy; however, at long-term follow-up, there is no meaningful difference between the two groups of patients with subacute lumbar disc herniation with associated radiculopathy (LDHR).[14] Surgery might also be considered in individuals who have persistent radicular discomfort despite sufficient conservative therapy. There are no definite contraindications to lumbar discectomy. However, before choosing on lumbar discectomy, consider the following issues: clinical/radiological discrepancy, primarily back pain, and inadequate conservative treatment. Complications from lumbar discectomy can be split into two primary types based on when they occur: intraoperative and postoperative. Wrong-level surgery, nerve root damage, and anterior vascular or visceral injuries are examples of intraoperative problems. Iatrogenic nerve injuries are more prevalent in reoperations due to scarring, but they can also occur during first procedures as a result of strong retraction, undiagnosed conjoined nerve roots, and significant disc herniations.[15] The most often reported injury is that of the left common iliac artery produced by maneuvers in the L4/5 disc area. Postoperative complications include infection, recurrent disc herniation, thromboembolic complications, and nerve palsies related to positioning[16]

MATERIALS & METHODS

Study Design

A Randomized controlled trial was performed from 15th March 2022 to 14th August 2022, at the Department of Neurosurgery, Allied Hospital Faisalabad (FMU), Teaching Hospitals of Faisalabad.

Sampling Technique

A Non-probability, consecutive sampling was considered. 60 patients were included, with 30 patients in each group.

Inclusion Criteria

Male and female patients aged 30 – 65 years were included. Patients included recurrent disc

herniation and radicular discomfort for at least 6 months following main lumbar disc surgery. Those cases included whom conservative therapy was ineffective for at least 6 weeks.

Exclusion Criteria

Cauda equina syndrome cases were omitted. Reoperations for infections in the early postoperative period were not included. Patients having spinal instability at the time of the initial operation and recurring prolapsed lumbar intervertebral disc (PLID) at more than two levels were excluded. Other diseases such as infection, malignancy, multi-segmental spinal canal stenosis, adjacent level disc herniation, spondylolisthesis, and spinal deformities were also excluded.

Data Collection

Patients who met the inclusion criteria were included after receiving clearance from the hospital ethics committee, and informed consent was obtained. Patients were divided into two equal groups randomly using a computer-generated random number table. Patients in Group A had non-fusion surgery (conventional revision discectomy alone), whereas those in Group B had fusion surgery (revision discectomy with transforaminal lumbar interbody fusion – TLIF) and transpedicular screw fixation. Both surgeries were carried out by a specialist neurosurgeon.

Surgical Management

Patients were set in a prone posture on a frame or rolling with modified kneeling under general anesthesia with intubation to prevent abdominal pressure, limiting epidural venous dilatation and intraoperative hemorrhage. All revision operations were conducted at the same location as the first surgery. Epidural scar tissues were separated and partly resected in individuals with RLDH (recurrent lumber disc herniation) who had conventional revision discectomy (Group A). After removing the remaining ligamentum flavum and completing the discectomy, the nerve root and disc structure for a full decompression without substantial dissection and retraction of the neural tissues were found. Posterolateral fusion and trans-pedicular screw fixation were done on Group B patients. Following the insertion of a subcutaneous suction drain, the wound was closed as usual.

Clinical symptoms were assessed before and after surgery using the "Japanese Orthopedic Associations core" (JOA) criteria. The sensory disturbance was evaluated using a brush, and the leg pain was evaluated using the visual analog scale (VAS; 10-point scale). Manual muscle testing was used to assess and grade motor abnormalities. Follow-up was done by obtaining the patient's contact number. We gathered all of the data on a custom constructed proforma. The recurrent lumbar disc herniation was evaluated with a lumbosacral spine MRI, which revealed disc herniation at the same level as the original discectomy. These results were categorized into the following scale: excellent, good, fair, and poor.

Statistical Analysis

The data was entered and analyzed in SPSS version 25. Mean values, frequencies, and percentages were calculated for the variables (age, recurrent time, BMI, pre/post-JOA scores, gender, diabetes mellitus, hypertension, tobacco intake, occupation level, side involved, and efficacy) through SPSS v25. The data was stratified and assessed the significant/insignificant difference for each effect modifier and efficacy between the two patient groups, chi-square test was applied.

RESULTS

Age Distribution

The age range was from 30 to 45 years with a mean age of 46.63 ± 8.73 years. The mean age of women in group A was 45.80 ± 8.50 years and in group, B was 47.90 ± 8.95 years. The majority of the patients 35 (58.33%) were between 46 to 65 years of age (Table 1).

Table 1: Age groups.

Age (Years)	Group A		Group B		Sum	
	N	%	N	%	N	%
30 – 45	14	46.67	11	36.67	25	41.67
46 – 65	16	53.33	19	63.33	35	58.33
Mean ± SD	**45.80 ± 8.50**		**47.90 ± 8.95**		**46.63 ± 8.73**	

Gender Distribution

41 (68.33%) were males and 19 (31.67%) were females with male to female ratio of 2.16:1 (Table 2).

Table 2: Gender distribution (n = 60).

Gender	Group A		Group B		Sum	
	N	%	N	%	N	%
Male	20	66.67	21	70.0	41	68.33
Female	10	33.33	09	30.0	19	31.67

Distribution of Effect Modifiers

The mean recurrent time to primary surgery was 11.87 ± 2.87 months. It was noticed that 60% of patients reported ≤ 12 months recurrent time in group B and 66.6% in group A (Table 3). The mean BMI was 29.39 ± 3.43 kg/m^2 in both groups. In both groups, 70% of patients had BMI > 27 (Table 4).

The distribution of patients for HTN & DM is shown in Tables 5 & 6 respectively. 70% of patients did not report hypertension from group B and 66.6% of patients in group A. Overall, 70% of patients

Table 3: Distribution according to recurrent time to primary surgery.

Recurrent Time (Months)	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
≤ 12 Months	20	66.67	18	60.0	38	63.33
> 12 Months	10	33.33	12	40.0	22	36.67
Mean ± SD	**10.80 ± 2.81**		**11.33 ± 2.97**		**11.87 ± 2.87**	

Table 4: Distribution according to BMI.

BMI (kg/m^2)	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
≤ 27	09	30.0	09	30.0	18	30.0
> 27	21	70.0	21	70.0	42	70.0
Mean ± SD	**29.37 ± 3.51**		**29.40 ± 3.41**		**29.39 ± 3.43**	

Table 5: Distribution according to hypertension.

Hypertension	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
Yes	10	33.33	08	26.67	18	30.0
No	20	66.67	22	73.33	42	70.0

Table 6: Distribution according to diabetes mellitus.

DM	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
Yes	14	46.67	13	43.33	27	45.0
No	16	53.33	17	56.67	33	55.0

in both groups was not hypertensive. 53.3% and 56.67% of patients in groups A and B were not diabetic. Overall, 55% of patients were not diabetic in both groups.

The distribution of patients according to tobacco users, occupation & side involved is shown in Tables 7, 8 & 9 respectively. 78.3% of patients were not tobacco users in both groups. The majority of patients (48.3%) were having a medium level of occupation in both groups, with 50% in group B. Right side was noted in 26.67% of patients of both groups, followed by the left side (25%), ipsilateral (25%) and contralateral (23%).

Table 7: Distribution according to tobacco users.

Tobacco Users	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
Yes	07	23.33	06	20.0	13	21.67
No	23	76.67	24	30.0	47	78.33

Table 8: Distribution according to occupation.

Occupation	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
Heavy	06	20.0	06	20.0	12	20.0
Medium	14	46.67	15	50.0	29	48.33
Light	10	33.33	09	30.0	19	31.67

Table 9: Distribution according to side.

Side	Group A		Group B		Total	
	Prevalence	%	Prevalence	%	Frequency	%
Right	08	26.67	08	26.67	16	26.67
Left	07	23.33	08	26.67	15	25.0
Ipsilateral	08	26.67	07	23.33	15	25.0
Contralateral	07	23.33	07	23.33	14	23.33

Table 10: Comparison of efficacy.

Efficacy	Group A		Group B		P value
	N	%	N	%	
Yes	05	16.67	19	63.33	0.0001 (significant result)
No	25	83.33	11	36.67	

Recovery Rate and Efficacy

In groups, mean pre/post-operative JOA scores were 22.34 ± 4.33 and 8.54 ± 5.12 respectively. The mean recovery rate was 59.32 ± 8.43%. This study has shown the efficacy (p-value: 0.0001) of non-fusion treatment versus fusion treatment as 05 (16.67%) and 19 (63.33%) respectively (Table 10).

Stratification of Efficacy W.R.T Effect Modifiers

Stratification of efficacy concerning age, recurrent time to primary surgery, BMI, gender, diabetes mellitus, hypertension, tobacco users, occupation, and side involved is shown in Table 11. The efficacy (yes/no) was found significant in groups A & B, concerning age groups (30-45 years & 46 – 65 years), gender male, recurrence time (≤ 12 months & > 12 months), BMI (≤ 27 & > 27), absence of hypertension, presence & absence of diabetes, non-users of tobacco, level of occupation (high, medium, & low) and insides (right, left and ipsilateral).

DISCUSSION

This study compared the effectiveness of fusion therapy against non-fusion treatment for recurrent lumbar disc herniation. The average age of the patients in our research was 46.63 8.73 years, similar to the findings of Pradhan et al[17] and Mostafa et al,[18] who found mean ages of 47

and

Table 11: Stratification of efficacy concerning recurrent time to primary surgery, BMI, gender, diabetes mellitus, hypertension, tobacco users, occupation, and side involved.

		Group A Efficacy		Group B Efficacy		P-value
		Yes	No	Yes	No	
Age (years)	30 – 45	01 (7.14%)	13 (92.86%)	06 (54.55%)	05 (45.45%)	0.009*
	46 – 65	04 (25.0%)	12 (75.0%)	13 (68.42%)	06 (31.58%)	0.011*
Gender	Male	02 (10.0%)	18 (90.0%)	13 (61.90%)	08 (38.10%)	0.0006*
	Female	03 (30.0%)	07 (70.0%)	06 (66.67%)	03 (33.33%)	0.110
Recurrence time (months)	≤ 12	03 (15.0%)	17 (85.0%)	11 (61.11%)	07 (38.89%)	0.003*
	> 12	02 (20.0%)	08 (80.0%)	08 (66.67%)	04 (33.33%)	0.029*
BMI (kg/m^2)	≤ 27	02 (22.22%)	07 (77.78%)	07 (77.78%)	02 (22.22%)	0.018*
	> 27	03 (14.29%)	18 (85.71%)	12 (57.14%)	09 (42.86%)	0.004*
HTN	Yes	02 (20.0%)	08 (80.0%)	05 (62.50%)	03 (37.50%)	0.066
	No	03 (15.0%)	17 (85.0%)	14 (63.64%)	08 (36.36%)	0.001*
DM	Yes	02 (15.38%)	11 (84.62%)	08 (61.54%)	05 (38.46%)	0.016*
	No	03 (17.65%)	14 (82.35%)	11 (64.71%)	06 (35.29%)	0.005*
Tobacco users	Yes	02 (28.57%)	05 (71.43%)	02 (33.33%)	04 (66.67%)	0.853
	No	03 (13.04%)	20 (86.96%)	17 (70.83%)	07 (29.17%)	0.0001*
Occupation	High	00 (0.0%)	06 (100.0%)	03 (50.0%)	03 (50.0%)	0.046*
	Medium	04 (28.57%)	10 (71.43%)	10 (66.67%)	05 (33.33%)	0.040*
	Low	01 (10.0%)	09 (90.0%)	06 (66.67%)	03 (33.33%)	0.011*
Side	Right	02 (25.0%)	06 (75.0%)	06 (75.0%)	02 (25.0%)	0.046*
	Left	01 (14.29%)	06 (85.71%)	07 (87.50%)	01 (12.50%)	0.005*
	Ipsilateral	01 (12.50%)	07 (87.50%)	04 (57.14%)	03 (42.86%)	0.067*
	Contralateral	01 (14.29%)	06 (85.71%)	02 (28.57%)	05 (71.43%)	0.515

*Significant result

48 years, respectively. There were 41 (68.33%) men and 19 (31.67% females) among the 60 patients, for a male-to-female ratio of 2.16:1. These findings are consistent with the findings of several prior research, which have indicated that males had a two-fold higher prevalence of lumbar disc herniation than women.[19-21] Previous studies reported the effectiveness of non-fusion therapy against fusion treatment was 05 (16.67%) versus 19 (63.33%) in our research. Functional outcomes in terms of excellent and good outcomes were 27.27% and 63.64%, respectively, for non-fusion therapy, and 75% and 15%, respectively, for fusion treatment.[22-24]

Suk et al,[25] discovered equivalent improvement between revision and initial discectomy patients although revision discectomy took longer. Cinotti et al[26] and Papadopoulos et al,[27] discovered no difference in clinical outcome between individuals receiving revision discectomies and those undergoing original discectomies. Jung et al[28] and Ahsan et al,[24] indicated that conventional discectomy provided excellent to good alleviation in up to 90% of the patients. El-Shazly et al,[29] conducted prospective research that evaluated discectomy alone to discectomy and fusion with TLIF or PLIF and discovered no significant differences between the three groups. The average duration of follow-up was 37 months. Galal et al,[30] compared the outcomes of discectomy alone versus discectomy and TLIF. The postoperative back pain was marginally higher in the discectomy group at the last follow-up, and satisfaction was rated as excellent in the simple discectomy group as compared to the discectomy and fusion group.

Fu et al,[31] examined the effects of discectomy alone against discectomy and PLIF in patients with RLDH. The clinical result was evaluated as excellent or satisfactory in 78.3% of discectomy patients and 83.3% of fusion patients. The difference between the fusion and nonfusion groups was small, although the fusion group had increased blood loss, time of surgery, and hospital stay. Agharee et al,[32] observed no statistically significant differences in results between discectomy alone and discectomy with posterolateral interbody fusion-PLIF (82.3% vs. 87.5%). Guan et al,[33] investigated two groups of patients with RLDH who were treated with repeat discectomy or instrumented fusion and found that the clinical results were equivalent after a short period of follow-up. Patients undergoing repeat discectomy had considerably shorter surgical times and hospital stays, as well as significantly cheaper hospital expenses. Dower et al,[34] discovered equal percentages of good results in individuals receiving discectomy alone versus discectomy with fusion. However, substantial improvements in back pain ratings were observed in fusion patients compared to isolated discectomy patients, emphasizing the potential benefit of fusion in patients with prior back discomfort. Chitnavis et al,[35] included patients with recurrent LDH who had symptomatic back pain or symptoms of instability and used posterior lumbar interbody fusion (PLIF) with carbon cages. The authors reported excellent satisfaction ratings, with 92% reporting considerable symptom reduction after 6 months to 5 years of follow-up.

Additional advantages of transforaminal lumbar interbody fusion (TLIF)[36] include dissection through virginal tissue, little dural sac retraction, and a reduced risk of postoperative radiculitis. The authors discovered considerable reductions in leg pain, with JOA scores increasing from 9.3 preoperatively to 25.0 at the final follow-up and satisfaction ratings of 86%. Clinical outcomes were likewise comparable to other types of interbody fusion, with 53.5% of patients reporting great results, 32.6% acceptable results, and 13.9% had fair results. Li et al. recently analyzed patients who had TLIF revision surgery after conventional discectomy for symptomatic recurrent LDH (lumbar disc herniation). They indicated TLIF as an effective treatment in the management of recurrent LDH.[37] Choi et al, examined the use of anterior lumbar interbody fusion (ALIF) for recurrent disc herniation in 22 patients and discovered an 86.3% satisfaction rate with significant improvements in pain, back, and functional status after revision surgery.[38]

CONCLUSION

For recurrent lumbar disc herniation, this study indicated that fusion treatment is superior to non-fusion treatment. As a result, we urge that fusion therapy be done in every patient with recurrent lumbar disc herniation to limit morbidity in these patients.

REFERENCES

1. Taha A, Youssef M. Surgical outcome of fusion in recurrent lumbar disc herniation. Open J Mod Neurosurg. 2020; 10: 157-66.
2. Dave BR, Degulmadi D, KrishnanA, Mayi S. Risk factors and surgical treatment for rectnent lumbar disc prolapsed: a review of the literature. Asian Spine J. 2020; 14: 113-21.
3. Guan J, Ravindra VM, Schmidt MH, Dailey AT, Hood RS, Bisson EF. Comparing clinical outcomes of repeat discectomy versus fusion for recurrent disc herniation utilizing the N 2 QOD. J Neurosurg Spine, 2017; 26: 39-44.
4. Shepard N, Cho W. Recurrent lumbar disc herniation: a review. Global Spine J. 2019: 402-9.
5. Ahsan K, Khan S, Zaman N, Ahmed N, Montemurro N, Chaurasia B. Fusion versus non fusion treatment for recurrent lumbar disc herniation. J Craniovertebr Junction Spine, 2021; 12: 44-53.
6. Björnsdóttir S, Jónsson S, Valdimarsdóttir U. Functional limitations and physical symptoms of individuals with chronic pain. Scand J Rheumatol. 2012.
7. Gregory DS, Seto CK, Wortley GC, Shugart CM.

Acute lumbar disk pain: navigating evaluation and treatment choices. Am Fam Physician, 2008; 78 (7): 835-42.
8. Manusov EG. Surgical treatment of low back pain. Primary care, 2012; 39 (3): 525–31.
9. Patel S, Psychol C, Friede T, Froud R, Evans DW, Underwood M. Systematic review of randomised controlled trials of clinical prediction rules for physical therapy in low back pain. Spine (Phila Pa 1976). Nov. 5 2012;
10. Carragee E. Surgical treatment of lumbar disk disorders. JAMA. 2006; 296 (20): 2485-7.
11. Deyo RA, Gray DT, Kreuter W. United States trends in lumbar fusion surgery for degenerative conditions. Spine, 2005; 30 (12): 1441-5.
12. Dullerud R, Nakstad PH. CT changes after conservative treatment for lumbar disk herniation. Acta Radiol. 1994; 35 (5): 415-9.
13. Weinstein JN, Lurie JD, Tosteson TD, Skinner JS, Hanscom B, Tosteson AN, et al. Surgical vs nonoperative treatment for lumbar disk herniation: the Spine Patient Outcomes Research Trial (SPORT) observational cohort. JAMA. 2006; 296 (20): 2451-9.
14. Hahne AJ, Ford JJ, McMeeken JM. Conservative management of lumbar disc herniation with associated radiculopathy: a systematic review. Spine (Phila Pa 1976). 2010; 35 (11): E488-504.
15. Bell G. Complications of lumbar spine surgery. In: Wiesel S, Weinstein J. The Lumbar Spine. 2nd. Philadelphia: WB Saunders, 1996.
16. McGirt MJ, Ambrossi GL, Datoo G, Sciubba DM, Witham TF, Wolinsky JP, et al. Recurrent disc herniation and long-term back pain after primary lumbar discectomy: review of outcomes reported for limited versus aggressive disc removal. Neurosurgery, 2009; 64 (2): 338-44.
17. Pradhan RL, Chhabra HS, Paudel B, Arora M. Functional Outcome in Lumber Discectomy Open versus Microendoscopic. Eur Spine J. 2007; 16: 347-52.
18. Mostafa HA, Abd El Rahiem HA, Salem TL, Darwish AM, Fakhr A. Comparative randomized clinical study between open conventional lumbar discectomy and micro-endoscopic lumbar discectomy. Egyptian J Neurosurg. 2007; 22 (3): 1-16.
19. White AA, Panjabi MM (eds). Clinical Biomechanics of the Spine. Philadelphia, Pa: JB Lippincott Company, 1978: 462.
20. Roberts S, Evans H, Trivedi J, Menage J. Histology and pathology of the human intervertebral disc. J Bone Joint Surg Am. Apr. 2006; 88 (suppl. 2): 10-4.
21. Pradhan RL, Chhabra HS, Paudel B, Arora M. Functional Outcome in Lumber Discectomy Open versus Microendoscopic. Eur Spine J. 2007; 16: 347-52.
22. Ahsan K, Hossain R, Khan S, Zaman N, Ahmed N, Montemurro N, et al. Lumbar revision microdiscectomy in patients with recurrent lumbar disc herniation: a single-center prospective series. Surg Neurol Int. 2020; 11: 404.
23. Jung YS, Choi HJ, Kwon YM. Clinical outcome and influencing factor for repeat lumbar discectomy for ipsilateral recurrent lumbar disc herniation. Korean J Spine, 2012; 9: 1–5.
24. Ahsan K, Najmus-Sakeb, Hossain A, Khan SI, Awwal MA. Discectomy for primary and recurrent prolapse of lumbar intervertebral discs. J Orthop Surg (Hong Kong), 2012; 20: 7–10.
25. Suk KS, Lee HM, Moon SH, Kim NH. Recurrent lumbar disc herniation: Results of operative management. Spine (Phila Pa 1976), 2001; 26: 672–6.
26. Cinotti G, Gumina S, Giannicola G, Postacchini F. Contralateral recurrent lumbar disc herniation. Results of discectomy compared with those in primary herniation. Spine (Phila Pa 1976), 1999; 24: 800–6.
27. Papadopoulos EC, Girardi FP, Sandhu HS, Sama AA, Parvataneni HK, O'Leary PF, et al. Outcome of revision discectomies following recurrent lumbar disc herniation. Spine (Phila Pa 1976), 2006; 31: 1473–6.
28. Jung YS, Choi HJ, Kwon YM. Clinical outcome and influencing factor for repeat lumbar discectomy for ipsilateral recurrent lumbar disc herniation. Korean J Spine, 2012; 9: 1–5.
29. El Shazly AA, El Wardany MA, Morsi AM. Recurrent lumbar disc herniation: A prospective comparative study of three surgical management procedures. Asian J Neurosurg. 2013; 8: 139–46.
30. Galal A, Elsayed A M, Ahmed O E. Recurrent Lumbar Disc Herniation: Is Fusion Necessary? The Internet Journal of Neurosurgery, 2019; 15: 1–7.
31. Fu TS, Lai PL, Tsai TT, Niu CC, Chen LH, Chen WJ.

Long term results of disc excision for recurrent lumbar disc herniation with or without posterolateral fusion. Spine (Phila Pa 1976), 2005; 30: 2830–4.
32. Agharee HN, Azhari S, heidarnejad F. The outcomes of surgical treatment of recurrent lumbar disc herniation with discectomy alone and discectomy with posterolateral interbody fusion. Novel Biomed. 2014; 2: 10–7.
33. Guan J, Ravindra VM, Schmidt MH, Dailey AT, et al. Comparing clinical outcomes of repeat discectomy versus fusion for recurrent disc herniation utilizing the N2QOD. J Neurosurg Spine, 2017; 26: 39–44.
34. Dower, A, Chatterji, R, Swart, A, Winder, MJ. Surgical management of recurrent lumbar disc herniation and the role of fusion. J Clin Neurosci. 2016; 23: 44–50.
35. Chitnavis, B, Barbagallo, G, Selway, R, Dardis, R, Hussain, A, Gullan, R. Posterior lumbar interbody fusion for revision disc surgery: review of 50 cases in which carbon fiber cages were implanted. J Neurosurg. 2001; 95 (2 Suppl): 190–195.
36. Chen, Z, Zhao, J, Liu, A, Yuan, J, Li, Z. Surgical treatment of recurrent lumbar disc herniation by transforaminal lumbar interbody fusion. Int Orthop. 2009; 33: 197–201.
37. Li, Z, Tang, J, Hou, S. Four-year follow-up results of transforaminal lumbar interbody fusion as revision surgery for recurrent lumbar disc herniation after conventional discectomy. J Clin Neurosci. 2015; 22: 331–337.
38. Choi, JY, Choi, YW, Sung, KH. Anterior lumbar interbody fusion in patients with a previous discectomy: minimum 2-year follow-up. J Spinal Disord Tech. 2005; 18:3 47–352.

Additional Information

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AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Muhammad Abdur Rehman	Study Design, Methodology, and Paper Writing.
2.	Saddam Pervaiz	Data Calculation and Data Analysis.
3.	Inamullah Asghar	Interpretation of Results.
4.	Muhammad Jahanzeb	Statistical Analysis.
5.	Muhammad Akmal Hussain	Literature Review.