

# Fusion versus nonfusion treatment for recurrent lumbar disc herniation

## ABSTRACT

**Background:** Recurrent lumbar disc herniation (RLDH) is one of the major causes for failure of primary surgery. The optimal surgical treatment of RLDH remains controversial.

**Aim:** Retrospectively, we evaluate 135 patients and compare the clinical outcomes between fusion and nonfusion treatment of RLDH.

**Methods:** Records of 75 men and 35 women aged 28–60 years for conventional revision discectomy alone (nonfusion) and 15 men and 10 women aged 30–65 years for revision discectomy with transforaminal lumbar interbody fusion (TLIF) and transpedicular screw fixation (fusion) were reviewed. Demographics, surgical data, and complications were collected and pre- and postoperative assessment were done by the Visual Analogue Scale (VAS) scale and Japanese Orthopaedic Association (JOA) score. The results after surgery were assessed according to the recovery rate as excellent, good, fair, and poor.

**Results:** The mean follow-up period was 28.8 and 24.6 months in Group A (nonfusion) and Group B (fusion group), respectively. The preoperative data between both the groups showed no statistically significant difference. The postoperative mean VAS and JAO scores, recovery rate, and satisfaction rate showed no statistically significant difference except postoperative low back pain and occasional radicular pain and neurological deficit in nonfusion group which was significantly higher than that of fusion group. In comparison to fusion group, nonfusion group required significantly less operative time, less intraoperative blood loss, less postoperative hospital stay, no blood transfusion, and less total cost of the procedure. Satisfaction rate was 80% and 88% in nonfusion and fusion groups, respectively.

**Conclusions:** Both conventional revision discectomy (nonfusion) and discectomy with instrumented fusion (TLIF) surgery are effective in patients with RLDH.

**Keywords:** Conventional revision discectomy alone (Non fusion), recurrent lumbar disc herniation, transforaminal lumbar interbody fusion and stabilization

## INTRODUCTION

Recurrent lumbar disc herniation (RLDH) is a common complication of primary surgery for lumbar disc herniation. Revision surgery is more challenging than primary surgery due to alter anatomical planes and perineural scarring.<sup>[1,2]</sup> RLDH is defined as disc herniation at the same level, regardless of ipsilateral or contralateral herniation, with a pain-free interval of at least 6 months from the initial surgery.<sup>[1,3,4]</sup> Various risk factors for recurrent herniation have been identified, patient factors and surgical factors.<sup>[5]</sup> The symptoms and signs of patients with RLDH were not different from those with primary disc prolapse and the typical sciatic pain was often the predominant complaint of the patients.<sup>[6]</sup> The incidence


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of RLDH is reported in the range of 0.5%–25% of patients.<sup>[7,8]</sup> Options of surgical treatment of a symptomatic RLDH include simple conventional revision discectomy or discectomy with instrumented fusion. Controversy still exists on which is the better treatment option or when fusion would be advantageous over simple revision discectomy for a recurrent symptomatic lumbar disc herniation. The aim of the study is to compare the clinical outcomes and surgical complications between conventional revision discectomy (without fusion) and discectomy with instrumented transforaminal lumbar interbody fusion (TLIF) for RLDH.

## METHODS

We retrospectively evaluated 2780 patients from October 2003 to December 2019 in our hospital (BSMMU) through investigating the medical records, radiological data, and questionnaires at an outpatient basis. One thousand one hundred patients were treated primarily by limited discectomy (LD), which means removal of the offending disc fragment alone without or with little invasion of the disc space<sup>[9-11]</sup> and 1680 patients were treated primarily by aggressive discectomy (AD), which included removal of the offending herniated disc fragment as well as repeated invasion of disc space (curettage) to remove the loose or fragmented disc from normal disc.<sup>[9,11,12]</sup> Of these, recurrent disc herniation developed in a total of 155 (5.58%) patients (in case of LD 70 (6.36%) patients and AD 85 (5.05%) patients). Finally, 135 patients included in our study. Among them, 75 men and 35 women aged 28–60 (mean, 41.7 ± 9.34) years for conventional revision discectomy alone (Group A, 81.48%) and 15 men and 10 women aged 30–65 (mean, 47.2 ± 9.4) years for revision discectomy with TLIF and stabilization with transpedicular screw (Group B, 18.52%) were reviewed. The study was approved by the local research ethics committee and informed consent was obtained from all patients prior to their inclusion in the study. Inclusion criteria for this study were (1) patients with recurrent low back pain with radiculopathy at least 6 months after primary lumbar disc surgery; (2) failure of conservative treatment for at least 6 weeks; (3) the presence of recurrent low back pain with progressive neurological deficit; and (3) magnetic resonance imaging (MRI) on lumbosacral spine showing disc herniation at the same level of the primary discectomy. Exclusion criteria in this study were (1) patients with spinal instability at the first surgery; (2) recurrent prolapsed lumbar intervertebral disc (PLID) at >2 levels; (3) cauda equina syndrome (4) patients with disc herniation with other pathologies such as infection, tumor, multisegmental spinal canal stenosis, adjacent level disc herniation, spondylolisthesis, and spinal deformities. We also eliminated (a) three patients from the study who were lost during follow-up; (b) two patients who died due to unrelated medical illness; (c) four patients treated conservatively; (d) six patients

associated with instability; and (e) five patients (3.23%) where recurrent disc herniations occurred within 1–6 month (considered as a failed surgery or early recurrence rather than a true disc recurrence). The decision of treatment either by conventional discectomy alone or by discectomy with instrumented fusion was merely based on the surgeon's assessment and discussion with the patient on the merits and demerits of each surgical modality.

After evaluation of medical records of all patients, we documented all demographic features including age, sex, and body mass index (BMI), associated conditions, pain-free interval, side and extent of herniation, and surgical data which include operating time, intra-operative blood loss, length of hospital stay, total cost of the procedure, complications during and after operation, and pre- and post-operative VAS for pain. Radiographic evaluation was done by plain X-rays of lumbosacral spine anteroposterior, lateral, and dynamic films “flexion, extension and oblique” view pre- and postoperatively and Brantigan, Steffee, Fraser (BSF) classification of interbody fusion success is used to evaluate the fusion of the interbody segments.<sup>[13]</sup> MRI with gadolinium enhancement before operation was done in all cases. Postoperative MRI was done only in cases with recurrence of symptoms and complicated cases.

All the patients were followed up at regular intervals for at least 2 years. Clinical symptoms and signs were evaluated pre- and postoperatively using the criteria of the Japanese Orthopaedic Association (JOA) score [Table 1]<sup>[11]</sup> and the results after surgery were assessed according to the recovery rate as described by Hirabayashi *et al.*<sup>[14]</sup>

Recovery rate (%)

$$= \frac{\text{postoperative score} - \text{preoperative score}}{\text{normal score (29)} - \text{preoperative score}} \times 100$$

These results were classified into a four-grade scale: excellent improvement ≥90%, good 75%–89%, fair 50%–74%, and poor ≤49%.<sup>[15]</sup>

All the data were compiled and sorted properly. The quantitative data were analyzed statistically using the Statistical Package for the Social Science (SPSS, version-25, Armonk, NY, IBM Corp.) Paired Student's *t*-test was performed to compare the differences between pre- and postoperative clinical scores in all patients and Fisher's exact test was used to evaluate the differences of clinical outcomes between the two groups. *P* ≤ 0.05 were accepted as statistically significant.

## Surgical procedure

Written informed consent was obtained from all the patients. Under general anesthesia with intubation, patients were

**Table 1: Criteria of the Japanese Orthopaedic Association' Evaluation System for low back pain syndrome (JOA score)<sup>[1]</sup>**

Clinical picture	Evaluation	Score
Subjective symptoms (9 points)		
Low back pain (3 points)	None	3
	Occasional, mild	2
	Continuous, mild or occasional severe	1
	Continuous, severe	0
Leg pain and or tingling (3 points)	None	3
	Occasional, mild	2
	Continuous, mild or occasional severe	1
	Continuous, severe	0
Ability to walk (3 points)	Normal	3
	Able to walk farther than 500 m with symptoms*	2
	Able to walk farther than 100 m but less than 500 m	1
	Unable to walk farther than 100 m	0
Objective signs (6 points)		
Straight leg raising test (2 points)	Normal	2
	30°-70°	1
	<30°	0
Sensory disturbance (2 points)	None	2
	Slight	1
	Marked	0
Motor disturbance (2 points)	None	2
	Slight (manual muscle testing 4)	1
	Marked (manual muscle testing 3-0)	0
Restriction of daily activities (14 points)		
Turn over while lying (2 points)	Easy	2
	Difficult	1
	Impossible	0
Sitting about 1h (2 points)	Easy	2
	Difficult	1
	Impossible	0
Standing up (2 points)	Easy	2
	Difficult	1
	Impossible	0
Leaning forward (2 points)	Easy	2
	Difficult	1
	Impossible	0
Lifting or holding heavy object (2 points)	Easy	2
	Difficult	1
	Impossible	0
Washing face (2 points)	Easy	2
	Difficult	1
	Impossible	0
Running (2 points)	Easy	2
	Difficult	1
	Impossible	0
Urinary bladder function (0 point)	Normal	0
	Mild dysuria	-3
	Severe dysuria	-6

\*Pain, tingling, numbness and or weakness. Total JOA score 29 points. JOA - Japanese Orthopaedic Association

placed in a prone position on frame or rolls with modified kneeling to avoid abdominal pressure, minimizing epidural venous dilation and intraoperative bleeding. All the revision surgeries were performed from the original site of the primary surgery. In patients with RLDH who underwent conventional

revision discectomy (Group A) [Figure 1], epidural scar tissues were detached and partially resected.

Then, the nerve root and disc structure for a complete decompression without extensive dissection and retraction of the neural tissues

were identified. In patients who underwent a lumbar fusion with TLIF, a PEEK cage or titanium banana cage (usually 9/10/11 mm size, Universal Orthosystem, India) was used [Figure 2].

## RESULTS

The mean follow-up period was 28.8 (range: 24–70) and 24.6 (range: 24–74) months in Group A and Group B, respectively. The mean pain-free interval until a recurrence in Group A was  $17.18 \pm 8.47$  STD (range, 6–60) months, and in Group B, it was  $18 \pm 6.01$  STD (range, 6–60) months. The mean symptom duration prior to the second surgery was 3.5 months for the revision discectomy group (Group A) and 4.5 months for the instrumented fusion group (Group B). The operated level was L4–L5 in 70 (63.64%) and 16 (64%) patients and L5–S1 in 40 (36.36%) and 9 (36%) patients in Group A and B, respectively. The operated side was the left side in 72 (65.45%) and 15 (60%) patients and the right side in 38 (34.55%) and 10 (40%) Group A and Group B respectively; ipsilateral was 98 (89.09%) and 22 (88%) or contralateral was 12 (10.91%) and 3 (12%) patients in Group A and Group B, respectively. Heavy workers were 70 (63.64%) and 16 (64%), medium strenuous workers were 28 (25.25%) and 6 (24%), and light workers were 12 (10.91%) and 3 (12%) in Group A and Group B, respectively. Eighty-six (78.18%) and 20 (80%) patients had BMI  $>30$  kg/m<sup>2</sup> in Group A and B and 24 (21.82%) and 5 (20%) had 30 or  $<30$  kg/m<sup>2</sup> in Group A and B, respectively. In Group A, 73 (66.36%) patients were tobacco user, 46 (41.82%) were diabetic, and 52 (47.27%) were hypertensive. In Group B, 17 (68%) patients were tobacco user, 11 (44%) were diabetic, and 13 (52%) were hypertensive. Modic endplate changes in Group A and Group B were type II in 58 (52.73%) and 14 (56%) and type I in 24 (21.82%) and 8 (32%), respectively. All details are shown in Table 2. VAS score for back pain and radicular pain was significantly improved postoperatively from  $7.53 \pm 1.73$  and  $7.59 \pm 1.64$  to  $2.47 \pm 1.93$  and  $1.95 \pm 1.65$ , respectively, in Group A and from  $7.86 \pm 1.36$  and  $7.30 \pm 0.77$  to  $1.06 \pm 1.01$  and  $1.50 \pm 0.504$  in Group B, respectively [Table 3]. The mean overall JOA score of the patients improved significantly from  $8.79 \pm 3.03$  to  $23.00 \pm 2.87$  postoperatively with an estimated mean difference of 14.21 (95% confidence interval [CI] 16.57–12.78,  $P < 0.001$ ) in Group A and from  $9.36 \pm 2.25$  to  $24.95 \pm 2.06$  in Group B with an estimated mean difference of 15.59 (95% CI 14.50–16.67,  $P < 0.001$ , pair Student's *t*-test was used) [Table 3].

The mean operative time was  $95.0 \pm 9.0$  (range: 65–125) min and  $188 \pm 16.82$  (range: 155–240) min, mean blood loss: 120 ml (range: 85–250 ml) and 550 ml (range, 480–650 ml), average

length of postoperative hospital stay was 5 days (range, 4–8 days) and 8 days (range, 7–14 days), and average total cost of the procedure in taka 30,000 (\$ 350) and 62,000 (\$ 750) in Group A and Group B, respectively [Table 4].

In patients underwent discectomy with instrumented fusion (Group B), postoperative fusion by the evidence of bridging bone according to the BSF classification<sup>[13]</sup> and lack of motion on flexion/extension films was achieved in 23 (92%) patients at 12–15 months from surgery, whereas two patients (8%) did not achieve interbody fusion and showed radiographic signs of pseudoarthrosis without any symptoms. The preoperative data between both the groups showed no statistically significant difference with regard to age, sex, mean duration of recurrence, symptom duration, disc level, and disc side; associated factors; association of Modic changes; and preoperative VAS and JAO scores. The postoperative mean VAS and JAO scores and recovery rate and satisfaction rate showed no statistically significant difference except postoperative low back pain and radicular pain which was significantly higher pain in Group A than in Group B. Revision discectomy alone (Group A) required significantly less operative time (188 vs. 95 min,  $P \leq 0.001$ , unpair *t*-test), less intraoperative blood loss (550 vs. 120 ml,  $P \leq 0.05$ ), less postoperative hospital stay (8 vs. 5 days,  $P < 0.005$ ), and less total cost of the procedure (\$ 750 vs. \$ 350), compared to instrumented fusion (Group B). The mean postoperative recovery rate was 78.6% ( $\pm 19.26$ ) and the satisfaction rate was 80% in Group A, and in Group B, the recovery rate was 82.8% ( $\pm 32.25$ ) and the satisfactory rate was 88% [Tables 3 and 4]. In Group A, 36 (32.73%) patients developed postoperative complications including re-recurrence lumbar disc herniation in 8 cases (7.27%), postoperative instability in 3 cases (2.73%), discitis in 5 (4.55%) cases, superficial wound infection in 4 (3.64%) cases, dural tear in 8 (7.27%) cases, and neurological deficit in 7 (6.36%) cases. In Group B, 7 (28%) patients developed postoperative complications including dural tear in 2 (8%), discitis in 1 (4%), superficial wound infection in 1 (4%), neurological deficit in 1 (4%), and pseudoarthrosis in 2 (8%) cases [Table 5]. Blood transfusion was needed in 11 (44%) patients of the fusion group; no transfusion was required in revision discectomy (Group A). Dural tear was repaired intraoperatively and there was no subsequent CSF leakage. Discitis and superficial wound infections were resolved after antibiotic treatment except one discitis patient in Group B, who had persisting pain and difficulty in walking and needed further surgery. Two patients of discitis in Group A, though infection subsides with antibiotic, required analgesic time to time for occasional pain. Patients with transient neurological deficits and altered sensation on the same side of operation were treated conservatively and recovered completely at the end of follow-up. RLDH and postoperative instability

**Table 2: Demographics in patients with revision discectomy alone and instrumented fusion group**

Characteristics	Revision discectomy alone, Group A (n=110) (%)	Discectomy with instrumented fusion, Group B (n=25) (%)	P
Mean age (years)	41.7±9.34 (range, 28-60)	41.7±9.34 (range, 30-65)	0.468
Sex			
Male	75 (68.18)	15 (60)	0.586
Female	35 (31.82)	10 (40)	
Occupation			
Heavy workers, for example, farmer, weight lifter	70 (63.64)	16 (64)	0.980
Mediums strenuous workers, for example, housewives	28 (25.45)	6 (24)	
Light workers, for example, sedentary workers	12 (10.91)	3 (12)	
BMI (kg/m <sup>2</sup> )			
> 30 kg/m <sup>2</sup>	86 (78.18)	20 (80)	1.000
30 or < 30 kg/m <sup>2</sup>	24 (21.82)	5 (20)	
Associated factors			
Tobacco user	73 (66.36)	17 (68)	0.920
DM	46 (41.82)	11 (44)	1.000
HTN	52 (47.27)	13 (52)	0.841
Involved level			
L4-L5	70 (63.64)	16 (64)	0.841
L5-S	40 (36.36)	9 (36)	
Involved side			
Right side	72 (65.45)	15 (60)	
Left side	38 (34.55)	10 (40)	
Ipsilateral	98 (89.095)	22 (88)	
Contralateral	12 (10.91)	3 (12)	
Modic changes			
No change	28 (25.45)	3 (12)	0.280
Type I	24 (21.82)	8 (32)	
Type II	58 (52.73)	14 (56)	
Pain-free interval (month)			
6-24	43 (39.09)	9 (36)	0.956
25-48	55 (50.00)	13 (52)	
49-60	12 (10.91)	3 (12)	
Mean±SD	17.18±8.47	18±6.01	0.574
Mean duration of symptoms (month)	3.5	4.5	0.082
Mean follow-up (months)	28.8 (range, 24-70)	28.6 (range, 24-74)	

BMI - Body mass index; DM - Diabetes mellitus; HTN - Hypertension; SD - Standard deviation

that occurred in Group A required further discectomy with instrumented fusion.

## DISCUSSION

Lumbar discectomy is the most commonly performed surgical procedure for patients experiencing lower back pain or radicular symptoms.<sup>[11]</sup> Lumbar fusion is commonly performed for the treatment of painful instability, usually manifesting as chronic back pain with or without radiculopathy.<sup>[16,17]</sup> Patients with a RLDH can be treated successfully either by a second discectomy alone or a discectomy combined with fusion. However, there is a paucity of data in the literature that directly compares discectomy alone versus discectomy with fusion and stabilization. Revision discectomy alone as a treatment for recurrent disc herniation has been reported in

many studies and shown to have relatively simple, effective, and good results<sup>[15,18,19]</sup> but with a relative risk of re-recurrence and development of instability. Therefore, many surgeons would consider the addition of fusion with discectomy which eliminates the risk of disc recurrence and adjacent level instability<sup>[1,20]</sup> but with its own set of risks and complications including loss of a motion segment, pseudoarthrosis, and potential risk of adjacent segment disease.<sup>[21]</sup>

Although the early study showed that revision discectomy had less satisfactory outcomes for recurrent disc herniation,<sup>[2,22]</sup> recent studies showed that results are more comparable with those for primary disc surgery.<sup>[3,14,19-25]</sup> Suk *et al.*<sup>[3]</sup> found comparable clinical improvement between revision and primary discectomy patients (71.1% vs. 79.3%), but the operation time lasted longer in revision discectomy. Cinotti *et al.*<sup>[18]</sup> found no



**Table 3: Clinical outcome assessment by visual analog score and Japanes Orthopaedic Association score**

Clinical criteria	Group A (n=110)		P	Group B (n=25)		P
	Preoperative	Postoperative		Preoperative	Postoperative	
VAS score						
Back pain	7.53±1.73	2.47±1.93	0.001	7.86±1.36	1.06±1.01	<0.001
Radicular pain	7.59±1.64	1.95±1.65	<0.001	7.30±0.77	1.50±0.504	0.017
JOA score criteria						
Low back pain	0.26±0.45	1.95±0.71*	<0.001	0.25±0.42	2.82±0.65*	<0.001
Leg pain and or tingling	0.26±0.45	1.95±0.71	<0.001	0.27±0.45	2.41±0.60	<0.001
Ability to walk	0.26±0.45	1.95±0.71	<0.001	0.41±0.49	2.27±0.62	<0.001
SLRT	0.26±0.45	1.42±0.51	<0.001	0.35±0.48	1.86±0.34	<0.001
Sensory disturbance	0.84±0.37	1.63±0.50	<0.001	0.78±0.42	1.74±0.45	<0.001
Motor disturbance	0.26±0.45	1.74±0.45	<0.001	0.50±0.50	1.85±0.34	<0.001
Restriction of daily activities	7.26±0.81	12.37±1.17	<0.001	7.36±0.88	12.00±0.72	<0.001
Urinary bladder function	-0.63±1.26	0.00±0.00	0.032	-0.55±1.16	0.00±0.00	0.032
Total JOA score**	8.79±3.03	23.00±2.87	<0.001	9.36±2.25	24.95±2.06	<0.001

**Results after surgery according to recovery rate (by Hirabayashi *et al.*<sup>[14]</sup>) and graded into four grades according to Fu *et al.*<sup>[15]</sup>**

	Group A (n=110) (%)	Group B (n=25) (%)	P
Excellent	30 (27.27)	8 (32)	
Good	58 (52.73)	14 (56)	
Fair	11 (10)	2 (8)	
Poor	11 (10)	1 (4)	
Satisfactory	Excellent + good=80	Excellent + good=88	0.516

\*\*The mean overall JOA score of the patients improved significantly from 8.79±3.03-23.00±2.87 postoperatively with an estimated mean difference of 14.21 (95% CI: 16.57-12.78  $P<0.001$ ) in Group A and in Group B improved from 9.36±2.25-24.95±2.06 postoperatively with an estimated mean difference of 15.59 (95% CI 14.50-16.67,  $P<0.001$ ). \*Results were expressed as mean±SD. Paired Student's *t*-test was performed to compare pre and final postoperative follow-up. Level of significance was calculated at confidence interval of 95% and  $P<0.05$ . JOA - Japanes orthopaedic association; SLRT - Straight leg raising test; VAS - Visual analog score; CI - Confidence interval

**Table 4: Surgical data in patients with revision discectomy alone and instrumented fusion group**

Characteristics	Revision discectomy alone, Group A (n=110)	Discectomy with instrumented fusion, Group B (n=25)	P
Mean operative time (min)	95.0±9.0 (range, 65-125)	188±16.8 (range 155-240)	<0.001
Mean intraoperative blood loss (ml)	120 ml (range, 85-250 ml)	550 ml (range, 480-650 ml)	<0.001
Length of hospitalization (d)	5 days (range, 4-8)	8 days (range, 7-14)	<0.001
Need for blood transfusion (%)	No required	11 (44) patients	
Total cost of the procedure	Taka 30,000 (\$350)	Taka 62,000 (\$750)	<0.001

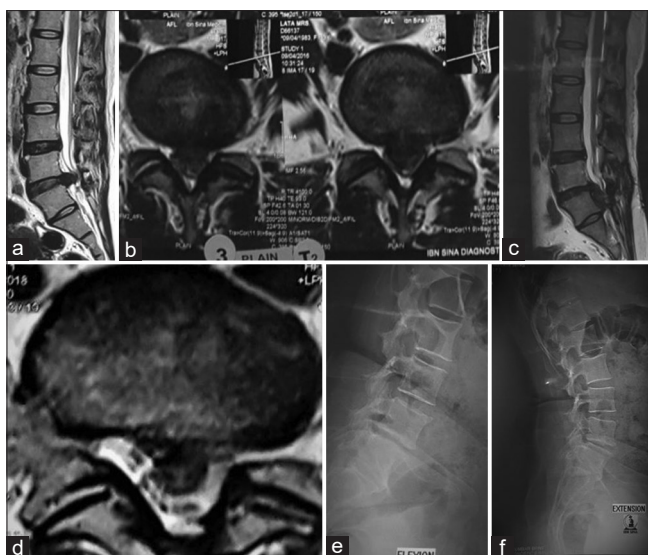
**Table 5: Complications**

Complications	Revision discectomy alone (Group A), n=36 (32.73%)	Discectomy with instrumented fusion (Group B) n=7 (28%)
Re-recurrence disc prolapse	8 (7.27)	No
Postoperative instability	3 (2.73)	No
Dural tear	8 (7.27)	2 (8)
Discitis	5 (4.55)	1 (4)
Superficial wound infection	4 (3.64%)	1 (4)
Neurological deficit	7 (6.36)	1 (4)
Pseudoarthrosis	No	2 (8)

statistically significant difference in clinical outcome between patients undergoing revision or primary discectomies. A retrospective study conducted by Papadopoulos *et al.*<sup>[19]</sup> found no statistical significance in terms of overall satisfaction between revision and primary discectomy (85% vs. 80%). A study by Jung *et al.*<sup>[24]</sup> and Ahsan *et al.*<sup>[25]</sup> reported their results of conventional discectomy for RLDH and found excellent to good relief in 78%–96% of the patients. Dural tear

was the most commonly reported complication, followed by a superficial wound infection.

In this study, we retrospectively evaluated a total of 2780 patients who underwent primary disc surgery. Among those patients, 155 (5.58%) patients developed RLDH, reason why 70 (6.36%) patients of recurrence occurred from limited discectomy and 85 (5.05%) patients



**Figure 1: Revision discectomy. (a and b) sagittal and axial view T2 W magnetic resonance imaging showing disc herniation at L4-L5 level and left-sided primary discectomy done on April 2016. (c and d) sagittal and axial view T2W magnetic resonance imaging at the same level showing recurrent disc prolapse at L4-L5 level, revision discectomy done on February 13, 2018, (e and f) flexion and extension view shows no signs of instability**

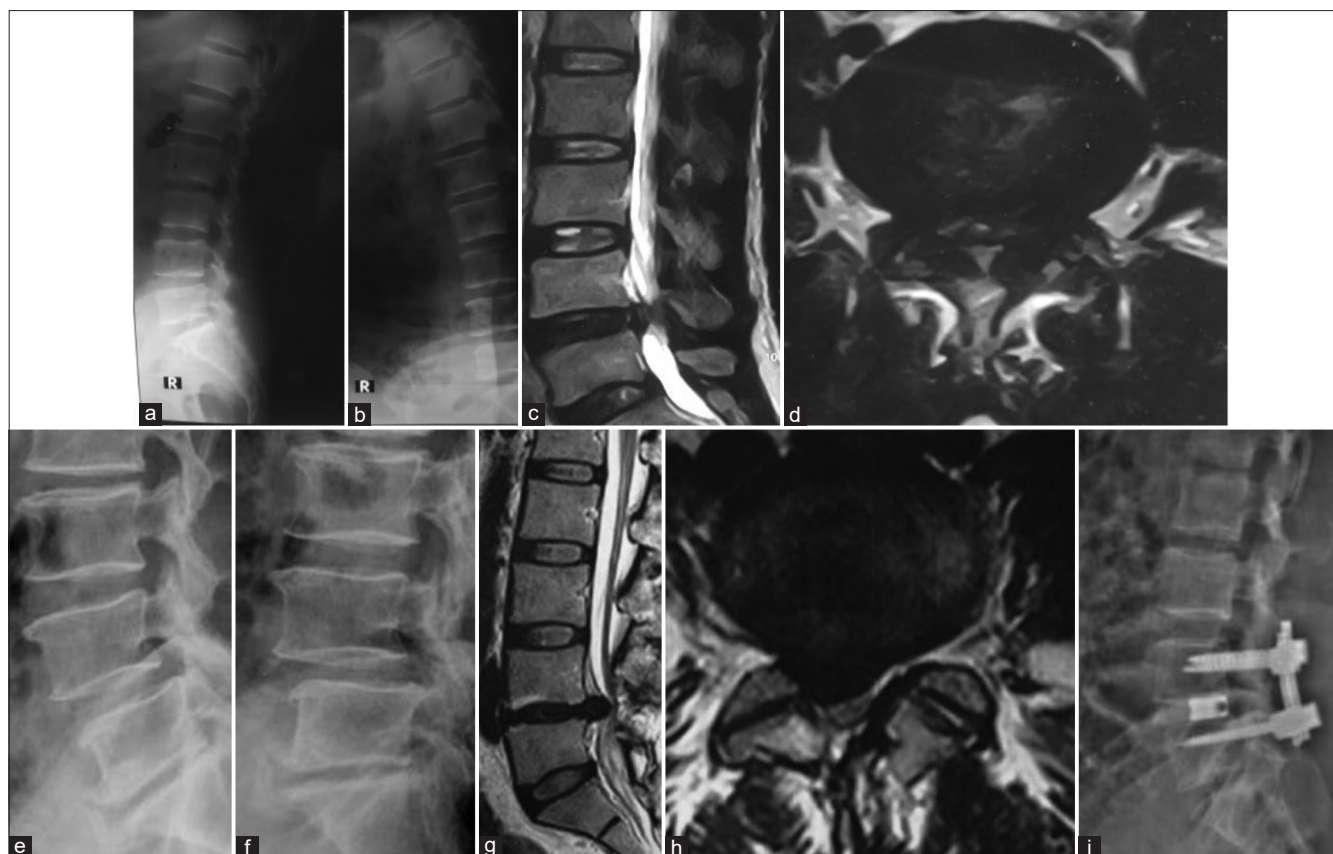
from AD. After eliminating 20 patients, we finally studied 135 patients after excluding spinal instability and other pathologies such as infection, tumor, multisegmental spinal canal stenosis, adjacent level disc herniation, spondylolisthesis, and spinal deformities. Among them, 110 (81.48%) patients were treated by revision discectomy alone (Group A) and 25 (18.52%) patients treated by revision discectomy with TLIF and instrumentation (Group B). Revision discectomy alone for RLDH can be very successful and may approach the success rate for initial operations (82.5% in our study),<sup>[9]</sup> provided proper patients' selection. After a mean follow-up period of 28.8 months, the satisfactory rate was 80%. These results have shown similar to those seen in patients operated on for a primary herniated disc, which are overall favorable.<sup>[3,18,19]</sup>

Although various techniques for interbody fusion were developed, all those techniques immobilize the painful degenerated spinal segments and restore disc height and root canal dimensions, as well as load bearing ability of the anterior structures.<sup>[24,26]</sup> Although several comparative studies described in the literature between the discectomy and fusion techniques,<sup>[15,25,26]</sup> only two comparative studies found in the literature that comparing discectomy alone versus discectomy with TLIF and transpedicular fixation.<sup>[11,21]</sup> In our study, the mean preoperation JOA score was 8.79 ( $\pm 3.03$ ) in the discectomy alone group versus 9.36 ( $\pm 2.25$ ) for the fusion group that improved to 23.00 ( $\pm 2.87$ ) and 24.95 ( $\pm 2.06$ ), respectively. Clinical outcome was rated good to excellent in 80% of patients of the revision discectomy group and 88%

of the discectomy with instrumented fusion (TLIF) group at the final follow-up which was almost similar to the findings of El Shazly *et al.*,<sup>[11]</sup> Galal A *et al.*,<sup>[21]</sup> and other studies.<sup>[15,27,28]</sup>

El Shazly AA *et al.*<sup>[11]</sup> prospective study compared discectomy alone versus discectomy and fusion with TLIF or posterolateral interbody fusion (PLIF) and found no statistically significant differences in outcomes among all three groups. The mean follow-up was 37 months. Galal A *et al.*<sup>[21]</sup> compared the results of discectomy alone versus discectomy and TLIF and found no statistically significant difference between preoperative VAS and JAO scores, but postoperative back pain at the last follow-up was slightly higher in the discectomy group without statistical significance and satisfaction was rated as excellent in 96% of simple discectomy group versus 77.2% of discectomy and fusion group. Fu TS *et al.*<sup>[15]</sup> compared the results of discectomy alone versus discectomy and PLIF in 41 patients for RLDH. The clinical outcome was rated excellent or good in 78.3% of patients of the discectomy group ( $n = 23$ ) and 83.3% of the fusion group ( $n = 18$ ). The difference between the fusion and nonfusion groups was insignificant, but blood loss, length of operation, and hospital stay were more in fusion group. Agharee HN *et al.*<sup>[27]</sup> compared the outcomes of discectomy alone versus discectomy and posterolateral interbody fusion (PLIF) and found no statistically significant differences in outcome (82.3% vs. 87.5%). The mean follow-up was 13.9 months for the discectomy group and 15 months for the discectomy and PLIF group. Guan J *et al.*<sup>[28]</sup> compared two groups of patients with RLDH treated by repeat discectomy (25 patients) or instrumented fusion (12 patients) and showed similar clinical outcomes at short-term follow-up. Patients undergoing repeat discectomy had significantly shorter operative times and shorter length of hospital stay, and they incurred dramatically lower hospital charges.

There are other studies reported on the outcomes of open TLIF for RLDH without comparison with revision discectomy.<sup>[29-31]</sup> Excellent to good results were noted in 74.6%–91.5% of the patients. Fusion rates were 100% in two studies and 93.2% in a third study. No instrument failures were reported. Dural lacerations with persistent cerebrospinal fluid leak were noted in all the studies. Partial neurological injury was reported in studies by Omid-Kashani *et al.*<sup>[29]</sup> and Li *et al.*<sup>[30]</sup> Three patients required revision surgery for adjacent level pathology.<sup>[29,30]</sup> Li *et al.*<sup>[30]</sup> compared endoscopic and open surgery in terms of fusion and concluded that both the operative methods can obtain good clinical results; however, TLIF using microendoscopic discectomy offers the advantages of lower trauma, less pain, and better functional recovery. Percutaneous minimally invasive TLIF has also been reported to have similar advantages when compared to open TLIF. The



**Figure 2: Revision discectomy and Instrumented fusion. (a and b) dynamic X-ray lumbar spine before primary discectomy showing no instability, (c and d) sagittal and axial T2W MRI showing disc prolapse at L4-L5 level, bilateral fenestration and right-sided discectomy was done on October 2015, (e and f) dynamic X-ray lumbar spine before revision discectomy and instrumented fusion showing anterior listhesis L4 over L5, (g and h) sagittal and axial T2W MRI showing recurrent disc herniation at L4-L5 level, (i) showing TLIF with titanium banana cage with bone graft and stabilized by pedicle screw and rod on March 2018**

paraspinal approach with unilateral pedicle screw fixation and TLIF has the advantages of smaller surgical incision, shorter operation time, less intraoperative blood loss, and faster postoperative relief from low back pain when compared to open bilateral screws for selected cases<sup>[32]</sup> El Shazly *et al.*<sup>[1]</sup> in their study showed less postoperative low back pain, less intraoperative risk of dural tear or neural damage, and less postoperative incidence of mechanical instability or re-recurrence following fusion with revision discectomy. TLIF and PLIF have comparable results when used with revision discectomy; however, PLIF has a significantly lower total cost than TLIF.

In our study, the complication rate was 32.73% in Group A and 28% in Group B. In comparing the complications between the two groups, there were 8 cases of re-recurrence (7.27%) and 3 cases of postoperative instability (2.73%) in Group A but no such cases in Group B. No statistically significant difference was found with regard to dural tear, disc space infection, and superficial wound infection. Neurological deficit was slightly higher in the revision discectomy (Group A), even if without statistical significance [Table 5].

One patient of disc space infection in Group B who had persisting pain and difficulty in walking needs further surgery. The incidence of dural tear during repeated lumbar discectomy was reported up to 20% of the patients in different studies<sup>[33,34]</sup> and a study by Choi *et al.*<sup>[35]</sup> reported permanent foot drop developed in one (2.9%) of 35 patients after repeated lumbar discectomy. Fu TS *et al.*<sup>[15]</sup> stated in their series that there were 13.04% in the nonfusion group (3 of 23) and 11.11% in the fusion group (2 of 18) had a dural tear and one patient in the fusion group had a superficial infection (5.56%). Taha A and Youssef M<sup>[36]</sup> also found that 5 patients (12.5%) had dural tear and 1 (2.5%) patients had superficial wound infection in their study of surgical outcome of fusion in RLDH. El Shazly AA *et al.*<sup>[1]</sup> found re-recurrence in 1 (6.7%) case and postoperative instability in 1 (6.7%) case in revision discectomy group, no such complications in fusion group but neurological deficit (13.3% vs. 6.7%) and dural tear (26.7% vs. 13.3%) were more in instrumented fusion (TLIF) group. In our study, the postoperative low back pain and radicular pain were significantly higher in Group A than that of Group B ( $P < 0.05$ ) [Table 3]. On the other hand, significant blood



transfusion was required (44% cases) for the fusion group. There was a statistically significant difference between the two groups with regard to the intraoperative blood loss, operation time, length of postoperative hospital stays, and total cost of the procedure which were significantly less in in Group A than in Group B [Table 5] which were almost similar to other studies<sup>[1,6,15,21,27,28]</sup>

As treatment decision in this series was merely based on the surgeon's assessment, patients however, being nonrandomized, we cannot totally exclude some selection bias of the surgical modality chosen for treatment. It can be noted that in younger patients, a revision discectomy was more likely (mean age was 41.7 years), while a fusion was more likely for older patients (mean age was 47.2 years). This observation, however, did not have any statistical significance. This selection bias may be related to a history of recurrent low backache (back pain is more than leg pain), in association with radiological degenerative changes of the motion segment in question, including significant disc degeneration, facet arthropathy, or reduced foraminal height which would explain the history of recurrent low backache in these patients and hence the tendency for offering fusion in this group.

This study has several limitations. It was a retrospective analysis of a group of patients with lumbar disc recurrence. Another limitation included the selection criteria for the two groups, which, by nature of the study, were not randomized. This selection bias may be related to a history of recurrent low back pain. Hence, this study demonstrated that recurrent lumbar disc patients who have more axial back pain than radicular pain, significant disc degeneration at the motion segment and reduced foraminal height, can be treated successfully via discectomy with TLIF and stabilization with good expected outcomes.

## CONCLUSIONS

Both revision discectomy and discectomy with instrumented fusion with TLIF are effective in patients with RLDH. Proper patients' selection can explain the success rate for initial operations (82.5% in our study). Instrumented fusion with revision discectomy and TLIF in patients with RLDH improves the postoperative low back pain and radicular pain, decreases the nerve root damage, the postoperative incidence of mechanical instability, and re-recurrence but requires more blood transfusion, longer operation time, longer hospital stay, and significantly higher total cost of the procedure compared to revision discectomy alone.

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## Conflicts of interest

There are no conflicts of interest.

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