Management of recurrent lumbar disc herniation with or without ipsilateral transpedicular screw fixation

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Abstract: Recurrent lumbar disc is a major cause of surgical failure with two fundamental surgical problems. First is the disturbance of anatomical planes due to adhesions, while the second is sequels of degenerative changes. Objective: the objective of this study is to evaluate the surgical outcome of recurrent lumbar disc herniation with or without ipsilateral transpedicular screw fixation, with highlights on lumbosacral instability classification. Patients and methods: one hundred patients with recurrent lumbar disc herniation were managed surgically by discectomy, curettage and unilateral transpedicular screw fixation at the offending side (50 patients among 100 patients of recurrent lumbar disc), or discectomy with endplate curettage (50 patients among 100 patients of recurrent lumbar disc). Results: the recovery rate was higher in the first group with less recorded complications.
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1. Introduction

The recurrence in disc herniation is the presence of herniated disc material at the same level, ipsi- or contralateral, in a patient who has experienced a pain-free interval of at least 6 months since surgery (12). Recurrent lumbar disc herniation (RLDH) is a major cause of surgical failure, the incidence of which is reported from 5 to 11%, with an increased incidence as the follow-up period is extended (20). While, Treatment options of first-time disc herniations are multiple (including observation combined with aggressive medical management (pharmacological and physical therapies), chymopapain, intradiscal electrothermal coagulation therapy, laser assisted decompression, laminectomy, laminectomy and discectomy, minimally invasive microdiscectomy and endoscopic discectomy, and laparoscopic discectomy) (3); the surgical choices for disc recurrent herniations are limited by multiple factors, require longer operative time, and are associated with higher rate of complications, so the aim of this study is to evaluate the surgical outcome of recurrent lumbar disc herniation with or without ipsilateral transpedicular screw fixation.

2. Patients and methods

This is a prospective, randomized, comparative study with first time recurrent lumbar disc herniation which was conducted in the period between January 2013 and Jan 2016 at Al Al-Azhar university hospitals. The study included 100 patients with recurrent lumbar disc herniation managed surgically either by discectomy and endplate currettage in addition to ipsilateral transpedicular screw fixation at the offending side (group A = 50 patients), or the same without fixation (group B = 50 patients). The preoperative criteria for all patients were: (1) pain relief after primary lumbar disc surgery for at least 6 months; (2) the presence of unilateral recurrent radicular pain nonresponsive to conservative treatment for at least 6 weeks; and (3) Magnetic resonance imaging (MRI) on lumbosacral spine showing disc herniation at the same level of the primary discectomy. Excluded cases were those with multi-segmental spinal canal stenosis, adjacent level disc herniation, spondylolythesis, or spinal deformities.

The preoperative symptoms included low back pain, unilateral lower limb radicular pain, and intermittent claudication pain. Radiological evaluation included plain X-rays of lumbosacral spine (A-P, Lateral, oblique and dynamic films "lateral with flexion, extension and neutral positions") and MRI with gadolinium enhancement. **Surgical technique**:

Under general anesthesia, all patients were positioned prone on frame. Surgeries were performed through the original scar mark. Laminectomy and discectomy were performed being careful when removing scar from the lamina to make a clear identification of the previous laminotomy edges and curettes were then used to dissect the scar from the osseous margins and to delineate meticulously the bone from scar to avoid violating the dura mater. Identification of the facet then pedicles allowed for clean separation of the scar tissue from bone as well as identification of the disc space. Exposure was carried out laterally, so that the lateral edge of the nerve root

was visualized. The nerve root was then mobilized gently and retracted medially to expose the disc fragment. Occasionally, the nerve root was adhered to the extruded disc fragment or to the ligamentous structures and required sharp dissection for separation. In group B, total facetectomy was done before dissection of the nerve root, until the pedicle was visible. This would facilitate the identification of the nerve root and disc structure for a complete decompression without extensive dissection and retraction of the neural tissues then transpedicular screw fixation was done. In group A just partial medial facetectomy was done without instrumentation. In both groups curettage of end plates of disc was done. A lateral fluoroscopic image projection was obtained throughout the surgery to confirm proper positioning of the screw and the level.. All patients encouraged to ambulate the 6 hours after surgery.

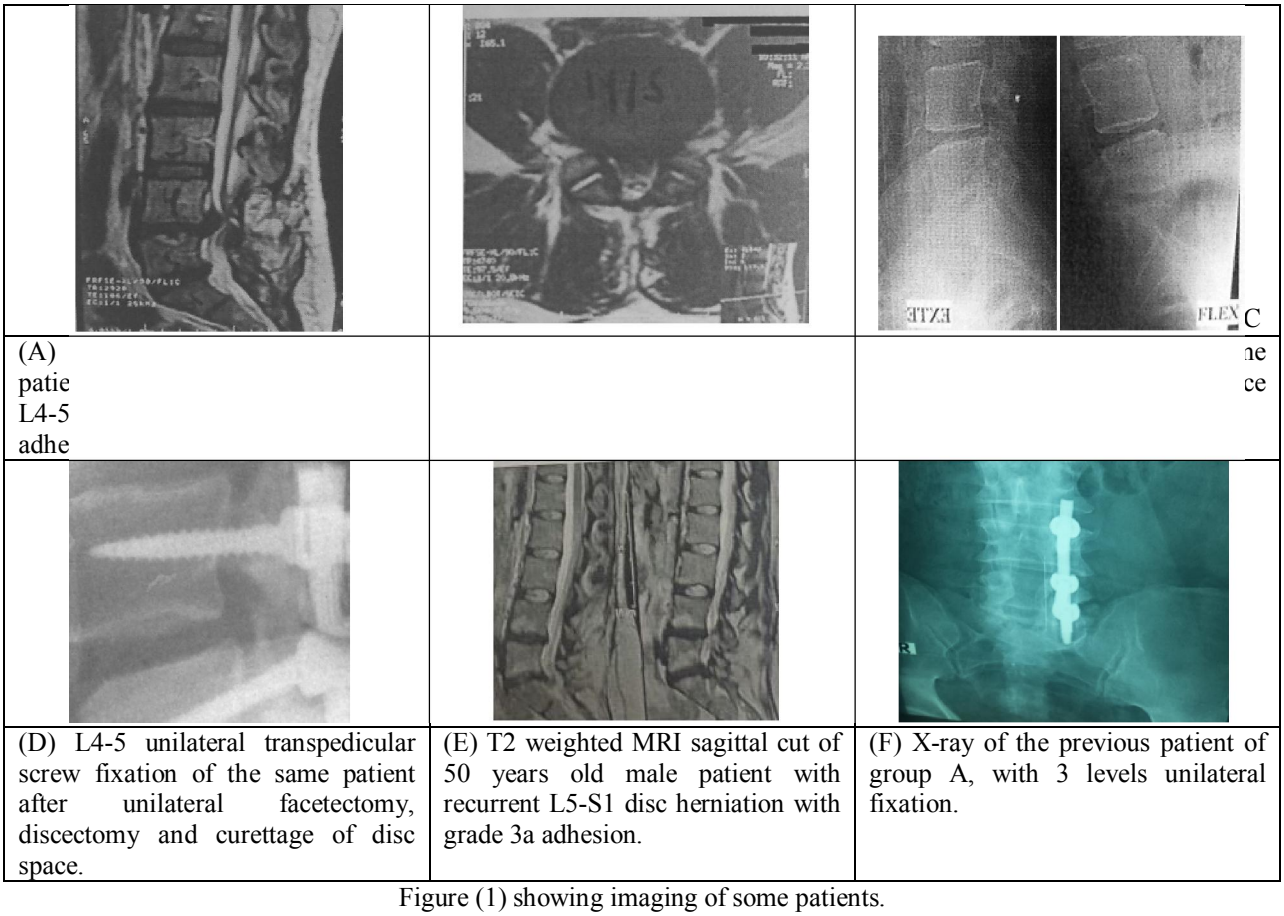
3. Results

The first group composed of 26 men and 24 women with a mean age of 45 years (range, 35 -60 years). The involved levels in this group were L4-L5 (30), L5-S1 (15), L3-L4 (3), L2-L3 (1) and L1-L2 (1). figure of one case.

The second group composed of 30 men and 20 women with a mean age of 40 years (range, 30 – 65 years). The involved levels in this group were L4-L5 (25), L5-S1 (20), L3-L4 (1), L2-L3 (1) and L1-L2 (1).

Table (1) showing preoperative criteria of both groups.

	Group A	Group B
Mean age (years)	45	40
Sex (male/female)	26/24	30/20
Period before recurrence (years)	8.5 (4-12)	6 (3-15)
Level of L5-S1	15	20
Level of L4-5	30	25
Level of L3-4	3	1
Level of 2-3	1	1
Level of L1-2	1	1
Duration of follow up (months)	36 (24-48)	36 (24-48)
Total preoperative JOA score	15.5	16



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(D) L4-5 unilateral transpedicular screw fixation of the same patient after unilateral facetectomy, discectomy and curettage of disc space.

(E) T2 weighted MRI sagittal cut of 50 years old male patient with recurrent L5-S1 disc herniation with grade 3a adhesion.

(F) X-ray of the previous patient of group A, with 3 levels unilateral fixation.

Figure (1) showing imaging of some patients.

Table (2) showing the clinical outcome based on JOA score.

Clinical outcome	Group A (discectomy with unilateral fixation)	Group B (discectomy without instrumentation)
Recurrence (second Recurrence)	0	2 (2/50 = 4%)
Dural tear	1	2(2/50 = 4%)
Root injury	1	2(2/50 = 4%)
Spinal instability	0	1(1/50= 2 %)

Table (3) showing the recovery rate

Recovery rate	Group A	Group B
(postoperative score – preoperative score) /(normal score – preoperative score)	(27.5-15.5)/(29-15.5)=0.88889%	(26.5-16)/(29-16) =0.8076923%

The recurrent time to the primary surgery ranged from 10-30 months with a mean duration of 18 ±6.01 months. The preoperative JOA score ranged from 3-22 with a mean JOA score of 16.4 ±5.07. The operated side was the left side in 60 (60 %) patients and the right side in 40 (40%) patients. The duration of follow-up ranged from 24-54 months with a mean follow-up of 37 ±7.85 months.

Statistical analysis of the preoperative data showed good results of the first group regarding clinical outcome, but there is no significant difference regarding age, sex, duration of recurrance, disc level, disc side, and preoperative JOA score (Table 2).

4. Discussion

The rate of recurrent disc herniation after lumbar discectomy is 5 to 15%. (5). So that, Recurrent lumbar disc herniation (RLDH) is a major cause of surgical failure (7).

The optimal surgical approach for recurrent disc herniation remains a subject of controversy (8).

Two fundamental points may be attributed for this controversy in recurrent lumbar surgery: The first point is the presence of indistinct anatomical planes and perineural scarring (6) while the other one is the degenerative cascade either at the previously operated level (20). or at the adjacent segment in cases of rigidly fused segments.

Regarding the first point, as the recurrent lumbar surgery is a surgery of fibrotic or adhesive tissue, so we must decide the degree of adhesion and fibrosis, according to the affected layer (skin and muscle, bony layer, neural layer, or all), so the limited definition of Recurrent lumbar disc herniation to re-herniation of disc on the same site and Same level where a previous discectomy had been performed, (3) must be modified to include any scar or adhesion from skin down to neural tissue, so the definition by Kim(13) who defined recurrent lumbar disc as disc herniation at a previously operated disc level, regardless of ipsilateral or contralateral herniation, in patients who experienced a pain-free interval of at least 6 months after surgery is more accepted and more applied (13).

Considering the previous point, the definition of recurrent disc must be more accurate to define the degree of scarring, is it only superficial or extending down to the neural tissue and saying is it at the same side or the opposite side. So we can graduate the recurrent disc as adhesive surgery with three grades according to the following table by Mohamed Hasan:

So, for more accurate definition, the grade of adhesion must be reported for each recurrent case. All cases operated in this study were of grade 3 adhesion).

Regarding the second point of recurrent lumbar surgery, which is postoperative degenerative changes after the conventional discectomy, like gradual disc space subsidence and impingement of the superior facet leading to foraminal stenosis, with more attention to the degenerative changes of the facet itself which mandate surgeon to do medial facetecomy in most cases aiming to release the root and /or facetal pain, keeping in mind the possibility of spondiololythesis. Padua et al., 1999 decided that: If a large portion of the joint was removed during the primary procedure, destabilization of the joint might be anticipated during revision discectomy and this would lead to postoperative mechanical instability (16).

Table (4) showing grade of adhesions.

Grade	Extension
Grade I	Superficial adhesions - not extended to muscle - regardless of the cause (either spine surgery or others like superficial burn or healed wound not extending to bone)
Grade II	Scar extending to muscle with intact lamina (unilateral or bilateral).
Grade III	Extended down to include neural tissue after laminectomy (unilateral bilateral).

The concept of vertebral instability has evolved in the last years, given the last scientific evidences on the degenerative cascade. Another concept has been developed in a parallel way to the one of the vertebral instability: it is the concept of microinstability, intended as biomechanical dysfunction of the motor spinal unit, responsible for clinical symptoms but not showed by dynamic X-Rays. The introduction of the concept of microinstability has increased the diagnostic capacities towards low back pain and, subsequently, the therapeutic choices, but has increased the number of medico-legal issues related to the diagnostic and therapeutic pathway of this condition (1).

If it is true that microinstability is often the cause of low back pain, is true also that a surgical treatment with pedicle screw placement and fusion without an evident spondylolisthesis showed by dynamic X-Rays can rise some medico-legal issues (14).

Considering the previous point, we can consider the stage of microinstability as the grade 1 instability or grade zero spondiololythesis, so we can modify the grading system of spondiololythesis by Meyerding at 1932 to include grade zero spondiololythesis as shown in the following table.

Table 5 showing modification of grading of spondiololythesis by Mohamed Hasan.

Instability	Spondiololythesis	Comment
Grade 1	Grade zero	Grade of mechanical instability = first phase of degenerative cascade microinstability= dynamic low back pain without radiological sliding
Grade 2	Grade 1	Translation of the cranial vertebra of up to 25%
Grade 3	Grade 2	Translation of the cranial vertebra of up to 50%
Grade 4	Grade 3	Translation of the cranial vertebra of up to 75%
Grade 5	Grade 4	Translation of the cranial vertebra of up to 100%
Grade 6	Grade 5	Ptosed vertebra

Grade 5 spondiololythesis was added at 2008 by Hu et al., (10). While grade zero spondiololythesis was added at 2016.

The previous openion is supported also by Nguye et al., 2014 who defined the first phase of degenerative cascade as the phase of unstable dysfunction, also defined as the phase of active discopathy. Also explanation of the pathological alterations of these first phase affecting the constitutive elements of the motor spinal unit which was described by Kikaldy-Willis and Faefan, 1982. which may be manifested radiologically or not manifested, so that the presence of dynamic low back pain in recurrent lumbar surgery was an indication for fusion (fusion alone, or fusion with instrumentation) as it means mechanical instability. Considering the previous data in recurrent surgery, curettage of nucleus pulposus and the involved joint was done in all cases of both groups. The concept of curettage was supported by many surgeons, the most famous one of them was Dandy who states very positively that spinal fusions were absolutely unnecessary and that one had only to curette out the nucleus pulposus and the involved joint (5). The main aim of curettage is enhancing vertebral body fusion.

Other surgeons like Cloward initially described lumbar interbody fusion without posterior instrumentation in 1953(5). Although his procedure was performed by others, it failed to be widely adopted and results were equivocal. The combination of lumbar interbody fusion and posterior lumbar instrumentation improved surgical outcomes for axial lumbar pain (17).

Keeping in mind that spinal fusion is the ultimate goal of spinal instrumentation, so that curettage was done in all cases while instrumentation was done in one group.

The increased stiffness of the fused segments will reduce the bone mineral content in adjacent vertebrae, and biomechanical studies have indicated that increased stress at the levels adjacent to the fusion may increase adjacent segment pathology (19).

To achieve optimal biomechanical conditions in the fused segment and fewer adverse effects in the adjacent levels caused by instrumentation, the use of less rigid systems of fixation is advocated (15). Therefore, unilateral pedicle screw fixation had been considered as a means to decrease the stiffness of the instrumented segment. Chen et al., (9), demonstrated that unilateral fixation was good enough to maintain the stability of the spine in a biomechanics study.

The aim of this study was not directed to compare unilateral versus bilateral fixation in spite of the Presence of a metaanalysis study suggesting that both unilateral and bilateral pedicle screw fixation are effective in one or two segmental lumbar spinal fusion(11).

In this study, discectomy and curettage was done in group A and group B, while transpedicular screw fixation at the offending side was done only in group A.

Regarding the complication (root injury, dural tear, spinal instability and second recurrence), root injury was higher in group B than group A. this is due to aggressive facetectomy in group A, so safe exploration of the nerve root was easy, while in group A, partial facetectomy was done so that the nerve root was vulnerable to injury in this group (2 cases (4%) in group B, while one case (2%) in group A).

Dural tear was higher in group B than group A. this is due to aggressive facetectomy in group A, so safe exploration of the dura was easy, while in group A, partial facetectomy was done so that the dual sac was vulnerable to injury in this group (2 cases (4%) in group B, while one case (2%)in group A).

Regarding spinal instability, one case (2 %) were manifested clinical and radiological in group B, the recorded instability may be attributed to lack of support by screw fixation at the postoperative period, so no good time for internal fusion by bone at the curetted disc to occur.

Regarding recurrence, two cases (4%) were recorded in group B. while in group A, no recorded recurrence. this findings are similar to that done by Shazly et al. (2).

Many studies proposed that fusion across the disc space reduces, if not, eliminates the risk of recurrent herniation at the level of surgery (18).

The outcome in group A was higher than group B as the recovery rate was better in group A than that in group B.

All the previous findings are supporting the concept of facetectomy, discectomy, curettage and unilateral transpedicular screw fixation in recurrent disc surgery.

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