Microscopic lumbar discectomy

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Objective
Minimally invasive methods for lumbar discectomy are gaining popularity among surgeons' practice and patients' demands, and outcomes after such procedures have shown results comparable to conventional open discectomies. In this study, a group of patients were studied for outcomes after microscopic lumbar discectomy (MLD) with ligamentum flavum preservation.

Patients and methods
Thirty-four patients diagnosed with lumbar disc herniation resistant to conservative treatment underwent MLD for excision of herniated disc fragments, in addition to nerve root and dural exploration and decompression.

Results
The majority of patients experienced early relief of radicular leg pain and heaviness within 48 h of surgery. Parasthesias resolved 5–8 weeks after surgery. Early follow-up visits showed partial recovery of neural deficits and minor back-pain complaints. Recurrent and residual back-pain and leg pain occurred in six patients.

Conclusion
MLD is an effective and safe procedure that offers a minimally invasive solution for herniated lumbar discs resistant to medical treatment, with better surgical outcomes and faster return to normal activity.

Keywords:
discectomy, ligamentum flavum, lumbar, microscopic, preservation

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Introduction

Lumbar disc herniation is a common disease that usually presents itself with low back and leg pain and sometimes with serious neurologic symptoms as a result of root nerve or cauda equina compression. Mixter and Barr [1] described a disc excision technique for the treatment of sciatica due to disc herniation in 1934; however, they observed that the operation had not released patients from chronic low-back pain. Historically, radical discectomy operations were performed; endplates were removed with disc tissue, by means of curettes. None of these operations prevented lower back pain and continuous sciatica. The observed rate of continuous or recurrent sciatica was as high as 40% [2]. Notably, the reported rate of recurrent disc herniation is 25%, and on average 10% of patients undergo reoperation because of recurrent pain. After radical discectomy, subtotal discectomy techniques involving the removal of disc tissue by means of curettes, without the endplates being touched, were developed [3–7].

The purpose of these modified techniques together was to prevent low-back pain without disrupting segmental stability. The standard microdiscectomy technique, which is still commonly used today, was first described in 1978 by Williams [3], who reported for the first time, encouraging results after removing minimal intervertebral disc tissue from a small group of patients who had free disc fragments compressing the nerve root. Spengler [4] described a less invasive limited discectomy. In this technique, only extruded disc fragments and tender disc tissues were to be removed. Curettes were not used in limited discectomy; only disc fragments were removed.

In 2003, Carragee *et al*. [2] described a lumbar disc herniation classification system based on the degree of annulus affection and the presence of extruded/free disc fragments. They published limited discectomy results based on the disc herniation type. In this classification system, they described four groups of disc herniation:

(a) Fragment-fissure herniation (disc herniation with minimal annular defect and presence of one extruded or sequestered fragment);
(b) Fragment-defect herniation (presence of extruded or sequestered fragments with wide annular rupture; rupture>6 mm);
(c) Fragment contained herniation (intact annulus but with one or more fragments below the annulus; such fragments are removed by oblique incision to the annulus); and
(d) No fragment contained herniation (annulus is intact and without free fragments under the annulus). Carragee *et al*. [2]

Observed high rates of recurrent and persistent continuous sciatica after limited discectomy in the latter three groups.

Patients and methods

Thirty-four patients, 23 male and 11 female patients, aged 22–42 years (with a mean of 29 years) underwent a microscopic lumbar discectomy (MLD) for a lumbar disc herniation from January 2005 to April 2011. Approval have been taken verbally from the patients.

Inclusion criteria

Indications for surgery were neurological deficit or leg pain refractory to conservative nonsurgical interventions (activity modification, NSAIDs medications, physical therapy, and epidural steroid injections). Patients were deemed refractory after 6–10 weeks of nonsurgical treatment.

Sciatica was the predominant complaint, although low back pain was present in 80% of the patients (with variable degrees).

Exclusion criteria

(1) Patients with previous back surgery for previous disc herniation.
(2) Patients with spinal canal stenosis.
(3) Patients with symptoms lasting more than 6 months.
(4) Patients with more than single level herniation needing surgery.

Preoperative patient management

After 6–10 weeks of failed conservative treatment, MRI and plain radiographies were performed. Patients were offered the surgical procedure. Preoperative anesthetic evaluation was performed and appropriate investigations were performed. Patients were instructed to stop any anticoagulant medication, shift to subcutaneous injections, or stop NSAIDs at least 7–10 days before the day of the operation. Those who were at a high risk for cardiac, cerebrovascular, or peripheral vascular events were shifted on enoxaparin 40–60 mg subcutaneously once daily at least 7 days before the operation.

The surgical procedure

Patient positioning

This procedure is performed under general anesthesia with the patient in the prone position over a discectomy frame. This puts the lumbar spine in flexion, which widens the interlaminar space to minimize the need for excess bone excision from the inferior edge of the cephalad lamina. The patient's abdomen is checked to lie freely mobile so as to avoid retrograde flow through the Batson's plexus from the intra-abdomal veins into the epidural veins.

The skin is sterilized and draped, and the level to be operated upon is marked using a syringe needle inserted vertically paraspinous and visualized on the lateral view using the C-arm image intensifier.

A 2–2.5 cm skin incision is performed centered on the needle entry, but in the paramedian position rather than in the midline position (it will usually start at the upper limit of the disc space). The subcutaneous fat is bluntly dissected and the thoracolumbar fascia exposed. A curved incision is performed in the thoracolumbar fascia from the cephalic to the caudal spinous process being convex outward, to avoid injury to the supraspinous and interspinous ligaments. The muscles are bluntly dissected subperiosteally from the spinous process from a medial to lateral direction and from caudal to cranial direction. A blade-type retractor is placed over the interlaminar area with the spike of the retractor medially, caudal to the spinous process, and the blade dorsal to the facet joint. The targeted disc level is rechecked with the C-arm in lateral view. The microscope is centered over the field and adjusted to focus on the laminae.

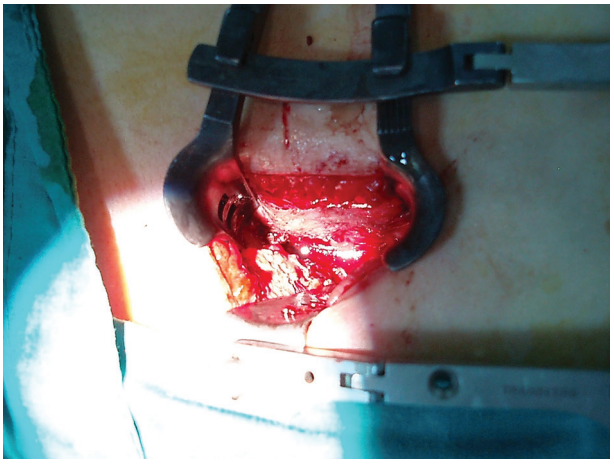
For a caudally extruded disc fragment, the ligamentum flavum is detached from the cephalad edge of the caudal lamina. A small portion of the ligamentum flavum is resected, as is the cephalad edge of the caudal lamina. The ligament is then detached laterally, allowing entry into the epidural space.

First, the nerve root is identified, followed by the pedicle and then the prolapsed disc fragment, which is then removed. The annular perforation is identified and entered with a discectomy forceps, removing any loose fragments. We used special retractors to help obtain a clear field for the operative microscope (Fig. 1). We intended to remove only the herniated/sequestrated disc fragments (Fig. 2) and avoided curetting any disc material from the disc space.

Especially in well-hydrated lumbar discs on MRI (Figs 3 and 4), preserving the nonherniated disc material would be beneficial in terms of the preservation of the vitality of this motion segment [7].

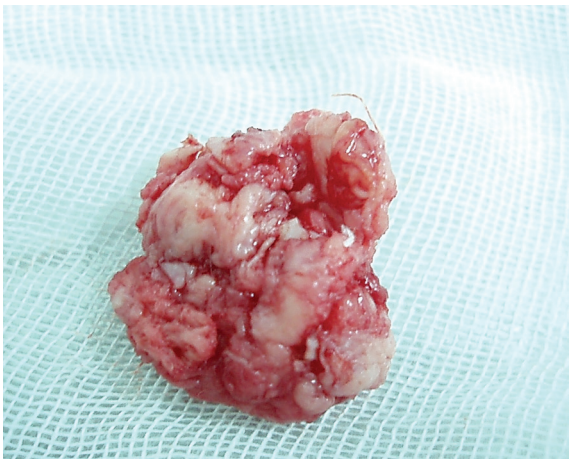
A short, blunt right-angled Penfield dissector is used to explore the floor of the canal and the foramen to remove any loose fragments and to check for foraminal clearance.

Figure 1



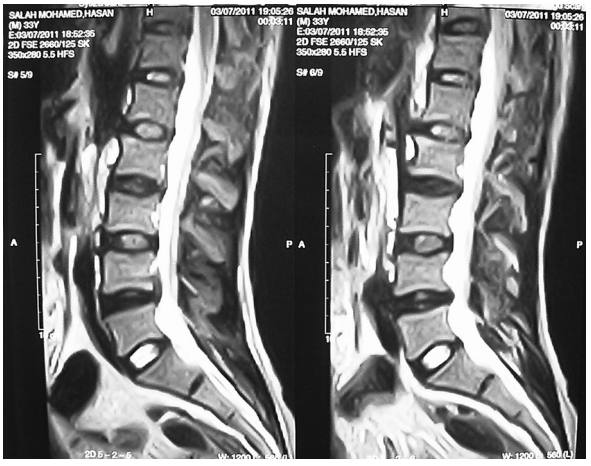
The operative field with special retractors in place to clear a 2 cm incision for the operative microscope.

Figure 2



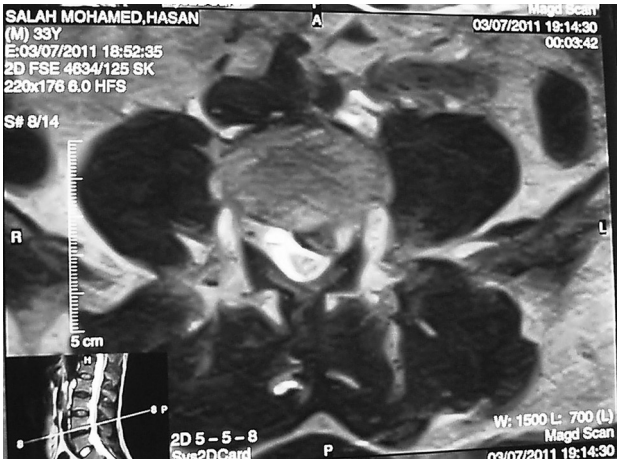
A sequestrated huge disc fragment was removed without curetting any disc material with immediate relief of radicular symptoms and early resolution of back pain after surgery.

Figure 3



A partially hydrated lumbar disc (L4–L5) on sagittal T2-weighted image with a cranially migrated disc fragment.

Figure 4



A cranially migrated L4–L5 disc fragment with lateral recess and foraminal obliteration.

In four of our patients, the herniation was cephalad to the disc space, so the interlaminar area was exposed and a high-speed drill was used to perform a laminotomy up to the cephalad insertion of the ligament.

The ligament was then removed, the epidural space entered and the fragment removed. This was followed by the same aforementioned procedure. In five patients, who had lateral recess stenosis, portion of the medial aspect of the facet, as well as more of the lateral part of ligamentum flavum, were removed in order to adequately decompress the nerve root simultaneously preserving stability.

Once proper decompression is complete and hemostasis ensured, saline irrigation with garamycin is carried out, followed by instillation of a mixture of 1 ml triamcinolone and 1 ml bupivacaine into the epidural space, and the fascia and skin are closed tightly without drains.

Postoperative care and follow-up

Patients were allowed to start ambulation as soon as back-pain occurred. Patients were discharged on the third postoperative day. Follow-up was carried out 1 week after discharge and was repeated on 3-weekly intervals until 7 weeks, and then on 3 monthly intervals thereafter. Back-pain and leg pain visual analog scores were recorded at each follow-up visit.

Patients were instructed to avoid prolonged sitting or standing until 4 weeks postoperatively. In uneventful follow-up, return to light duty work was allowed at 8 weeks. Heavy-duty work and sports activity were

allowed at 4 months. However, swimming was allowed at 4 weeks postoperatively.

Results

Two independent consultants analyzed the patients as regards age, weight, sex, level operated on, complications, operative time, blood loss, length of stay, pain scores, and immediate neurological outcome. Clinical follow-ups were reviewed for outcome also. All patients in the follow-up were asked a series of standard questions as regards pain intensity and frequency (worse, same, better), ability for uninterrupted sleep and ability to perform the simple activities of daily living.

The average age of the patients at the time of surgery was 29 years (range, 22–42 years). Twenty-three patients were male (23/34 = 67.6%) and 11 were female (11/34 = 32.4%). All patients presented with leg pain, with variable degrees of low back pain. Twenty patients reported leg pain greater than back pain, six patients reported back pain greater than leg pain, and eight patients reported equal back and leg pain. The average duration of symptoms before initial presentation was 3 weeks (range, 1–11 weeks). Only three patients had a neurologic deficit (3/34 = 8.8%).

The majority of patients (26/34 = 76.5%) experienced early significant relief of radicular leg pain (more than 85% relief) and heaviness within 48 h of surgery. Parasthesias resolved at 6 weeks (range, 5–8 weeks) after surgery in the same group of patients.

The average time from surgery to return to full functional activity of light duty work was 4.5 months (range, 3.2–8.5 months) and to heavy-duty work was 6.5 months (range, 5–8.2 months).

Until the time of full recovery, residual symptoms after surgery included mild leg pain (three patients) and occasional back pain without the need for medications (five patients). After maximal recovery, four patients had predominant residual back pain, whereas two patients had predominant residual leg pain responding to medication without compromising their activity.

Follow-up was carried out at 1 week postoperatively, on 3-weekly intervals until 7 weeks and then on 3 monthly intervals thereafter. The average follow-up period was 18 months (range, 12–48 months).

At the latest follow-up, all patients without neurological deficit at presentation had full recovery. In two out of three patients with neurologic deficit, full recovery occurred at 8 months postoperatively. However, the third patient had only moderate recovery (from grade 2 up to grade 3 motor power and residual parasthesia).

Discussion

MLD has been reported to be a successful procedure, with up to 88% recovery in some series [7–11]. Kambin *et al*. [6] reported that 88.2% of patients undergoing arthroscopic microdiscectomy had a satisfactory result. Yeung and Tsou [12] reported an 89.3% satisfactory result in patients undergoing posterolateral endoscopic excision for lumbar disc herniation.

We find our results comparable to the above-mentioned studies despite the fact that many of our patients presented after several weeks of disc herniation.

We intended to remove only the herniated/sequestrated disc material (fragments) and avoided curetting any disc material from the disc space. Total discectomy was found to be ineffective in decreasing the rates of recurrence of lumbar disc herniation. Moreover, it can lead to disc space collapse with subsequent segmental hypolordosis and facet joint overloading, dysfunction and degeneration [7,13].

Epidural fibrosis after lumbar discectomy may cause failed back syndrome in 5–12% of the patients [13]. Preservation of the ligamentum flavum (with epidural fat and vascular structures) has been shown to limit epidural fibrosis, and allows to achieve a favorable long-term outcome, helping the surgeon to reoperate eventual recurrences. In the series reported by Aydin *et al*. [7], none of the patients operated on with preservation of ligamentum flavum underwent reoperation for the occurrence of fibrosis. The microsurgical techniques of ligamentum flavum preservation reported in the literature consist in the detachment without removal, of the ligament from the laminae, or only in a partial removal of the ligament [7–11].

We were able to preserve the ligamentum flavum in all patients except in nine. In those nine patients, we sacrificed unilaterally the ligamentum flavum in order to gain proper visualization of the dura, nerve root, and herniated disc, thus minimizing the chance of missing any sequestrated disc material. We found no difference in the patients' outcomes as regards residual back pain or radicular symptoms. The authors assume that better outcomes were obtained due to unilaterally sacrificed ligamentum flavum, in addition to the local injection mixture of steroid and local anesthetic at the end of the procedure.

The trend toward minimally invasive techniques is largely patient driven, and we await studies that will

clarify the perceived benefits in terms of hospital stay, cost, and return to activity.

Conclusion

After this study, we conclude that MLD is an effective alternative to traditional open discectomy. It provides pain relief, shorter hospital stay, and early patient recovery. The procedure is time consuming at the beginning of practice. Proper instrumentation and familiarity with the microscope are keystones to mastering this procedure.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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