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Retrospective analysis on correlation factors of preserving the ligamentum flavum in microendoscopic discectomy

Shuwen Li[a,b,c], Hong Xia[a,c,*], Changxu Han[b]

[a] Southern Medical University, Guangzhou 510000, China
[b] Department of Minimally Invasive Spine Surgery, the Second Affiliated Hospital of Inner Mongolia Medical University, Hohhot 010030, China
[c] Department of Orthopedics, Guangzhou General Hospital of Guangzhou Military Command, Guangzhou 510010, China

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ABSTRACT

Objective: The present study was conducted to investigate the correlation factors of successful preservation of the ligamentum flavum (LF) in microendoscopic discectomy.
Methods: This retrospective review was carried out on 78 consecutive patients who underwent single segment microendoscopic discectomy projecting to preserve the LF between January 2012 to January 2013. The demographic and clinical data including age, gender, duration of disease, area of interlaminar space, disc level and position type of lumbar disc herniation were recorded. Intraoperative outcomes including duration of operation and peri-operative bleeding were recorded. Clinical outcomes were assessed by Oswestry disability index (ODI) and visual analog scale (VAS), and fibrosis formation was detected using computed tomographic scans with IV iopamidol injection. The follow up lasted six months.
Results: LF was successfully preserved in 54 patients (69.2%) and 24 patients (30.8%) underwent microendoscopic discectomy without preservation of LF. In multivariate logistic analysis, factors including age (OR, 1.17; 95% CI, 1.07–1.28; $P < 0.001$) and area of the laminar space (OR, 0.09; 95% CI, 0.01–0.67; $P = 0.018$) significantly associated with the preservation of LF. Other factors including gender, duration of ill course, disc level and position type seemed not associated with the preservation of the LF. In addition, there was no significant difference of the duration of the operation ($P = 0.689$) as well as the peri-operative bleeding ($P = 0.147$) between patients with preservation of the LF and patients without. However, patients with preservation of the LF showed significantly improved clinical outcomes (ODI: $P = 0.006$, VAS: $P = 0.035$) and less fibrosis formation than those without LF ($P = 0.018$).
Conclusions: Microendoscopic discectomy with preservation of the LF could achieve better clinical outcomes and less epidural fibrosis, while elder patients with smaller area of the laminar space should be deliberated on the preservation of the LF during the microendoscopic discectomy.

1. Introduction

Lumbar disc herniation is a common problem, and if non-operative treatments were not successful, patients may require surgery [1]. Traditional open discectomy, sometimes facilitated by microscope, loupe magnification or illumination, is the most common surgical methods for treating patients with lumbar disc herniation [2,3]. However, there is a disturbing problem in most surgical interventions – that is the postoperative epidural fibrosis and adhesions [4–6]. This problem can compress or tether the nerve roots, leading to recurrent radicular pain and even neurological dysfunction in patients [7]. As previously reported, patients with low back problems who required reoperation without additional bone or disc pathology were found with extensive epidural-perineural fibrosis and adhesions [8–10]. Therefore, prevention of postoperative epidural fibrosis and adhesions is considered a significant factor of satisfactory outcome in low-back surgery.

Many minimally invasive spine surgery techniques have been developed to prevent the occurrence of postoperative epidural fibrosis and adhesions. Microendoscopic discectomy, which was introduced by Kambin and Gellman in 1983, is a minimally invasive spinal surgery procedure [11]. This technique has been increasingly popular that benefits from the advances in endoscopic visualization and instrumentation as well as the increased demand of patients for more minimally invasive procedures [12]. In addition, previous studies have shown that preservation of the ligamentum flavum

* Corresponding author at: Department of Orthopedics, Guangzhou General Hospital of Guangzhou Military Command, No. 111 Liuhua Road, Guangzhou 510010, China.
E-mail address: xiah_orth@163.com (H. Xia).

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(LF) is an important method to minimize the formation of fibrosis and adhesions of nerve root and dura [7,12]. However, different from the conventional open discectomy, there are difficulties in preserving the LF under endoscope with 1.6 cm lens, and lots of spine surgeons failed to complete preservation of the LF during microendoscopic discectomy due to inadequate visualization or decompression or both [13]. Therefore, we conducted the present retrospective study to explore the correlation factor associated with successful preservation of the LF in patients who underwent lumbar microendoscopic discectomy. We hope our results would provide a reference for spine surgeons to determine whether to preserve the LF or not during the lumbar microendoscopic discectomy.

2. Materials and methods

2.1. Study population

From January 2012 to January 2013, 78 patients who underwent a unilateral single-level lumbar microendoscopic discectomy in our hospital were included in this study. The inclusion criteria were as follows: first lumbar surgery; main symptom of low back pain with radiating pain in the lower limbs; positive for straight leg raising test; a lesion of a single nerve root identified by electromyography; computed tomography correlated with single-level disc herniation; and no response to at least 2 weeks of conservative treatment. Patients with double nerve root involvement, stenosis, lumbar instability syndrome, cauda equina syndrome, multilevel or far lateral disc herniation, and scoliosis were excluded. The Institutional Ethics Board of Southern Medical University approved our study.

2.2. Assessment and definitions of correlation factors

Demographic and clinical characteristics of patients were collected: age, gender, duration of disease, area of the interlaminar space, disc level and position of disc herniation. The duration of disease was the period between the date of first appearance of low back pain with radiating pain in the lower limbs in patients and the date of this treatment. The images of interlaminar space from the anteroposterior view were taken using X-ray technique (plain films). Then these images were input into computers and the area of interlaminar space was calculated according to the original scale in X-ray films using efilm workstation software version 3.0 (Merge Healthcare Co Ltd, Chicago, IL, USA). All protrusion of lumbar intervertebral disc occurred in the lumbar spinal canal and two types of disc herniation position were found among included patients: central type and post-lateral type.

2.3. Surgical technique

After continuous spinal epidural anesthesia and intubation, the patient was placed in the prone position on the Wilson spinal frame, with the abdomen free and the spine flexed. The MetRx Microendoscopic System (MetRx MED, Medtronic Sofamor Danek, Memphis, TN, USA) was used for all procedures in our study. A Kirschner wire was passed through the skin 0.8 cm lateral to the midline and placed on the caudal border of the rostral lamina in the appropriate interspace. A liner 16-mm-long incision was made relative to the entry point of the wire. A portable c-arm X-ray system was used to verify the disc level. The paravertebral muscles were dissected using progressively increasing sizes of dilator cannulas. Then an endoscopic light source with a camera was placed to the tubular retractor (16–18 mm diameter) after removing the dilators. After removing the rest soft tissues by rongeur, the upper and inferior hemilaminas and the LF were exposed under endoscope

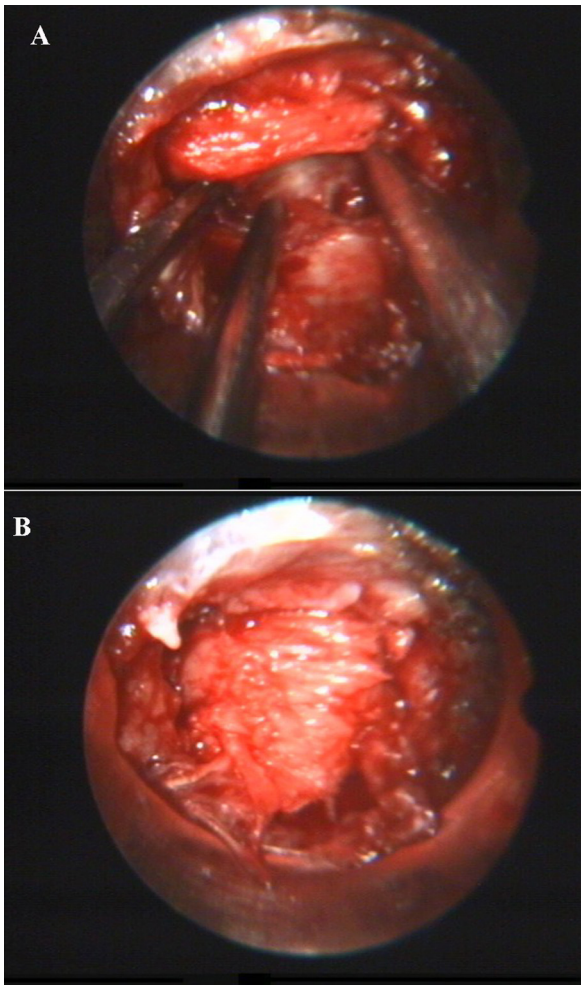

Fig. 1. Microscopic view of the surgical procedure (lumbar microendoscopic discectomy for L5-S1 herniated disc). (A) The ligamentum flavum curl, dural sac and nerve roots were pulled to medial side together with nerve retractors. (B) The preserved ligamentum flavum was covered on the dural surface after removal of nucleus.

(Fig. 1). Then the superficial layer of the LF was detached, while the deep layer was preserved. Afterwards, the deep LF was freed from the underside of the upper lamina and bone was removed up to the freed border of the ligament with a Kerrison rongeur. Next, a tiny osteotome was used to cut off the deep LF from the upside of the lower lamina to expose the lateral border of the deep LF. Subsequently the LF was freed laterally and hinged medially. Then the superior, inferior and lateral sides of the deep LF were all freed and a three-sided LF was obtained. This three-side free ligament flap was not dissected from the epidural tissue. The flap was retracted medially to form a barrier to protect the normal anatomic structures and restored smoothly after disc was removed extensively with pituitary rongeurs and curettes. The nerve roots were checked for the movement to ensure they were free and not entrapped (Fig. 1). After adequate hemostasis, the layers were closed. The scope and sheath were removed and skin sutured.

2.4. Measurement of intraoperative outcomes

The intraoperative outcome including duration of the operation and peri-operative bleeding were recorded in patients underwent lumbar microendoscopic discectomy with or without LF.