Endoscopic Transforaminal Suprapedicular Approach in High Grade Inferior Migrated Lumbar Disc Herniation

Hyeun Sung Kim, M.D.,1 Chang Il Ju, M.D.,2 Seok Won Kim, M.D.,2 Jong Gue Kim, M.D.2
Department of Neurosurgery,1 Mokpo Hankook Hospital, Korea
Department of Neurosurgery,2 College of Medicine, Chosun University, Gwangju, Korea

Objective: Although endoscopic procedures for lumbar disc diseases have improved greatly, the postoperative outcomes for high grade inferior migrated discs are not satisfactory. Because of anatomic limitations, a rigid endoscope cannot reach all lesions effectively. The purpose of this study was to determine the feasibility of endoscopic transforaminal suprapedicular approach to high grade inferior-migrated lumbar disc herniations.

Methods: Between May 2006 and March 2008, a suprapedicular approach was performed in 53 patients with high grade inferior-migrated lumbar disc herniations using a rigid endoscope and a semi-rigid flexible curved probe. One-to-four hours after surgery, the presence of remnant discs was checked with MRI. The outcomes were evaluated with the visual analogue scale (VAS) score and the Oswestry Disability Index (ODI) one week after surgery.

Results: The L2-3 level was involved in 2 patients and the L3-4 level was involved in 14 patients, while the L4-5 level was involved in 39 patients. There were single piece-type in 34 cases and a multiple piece-type in 19 cases. Satisfactory results were obtained in all cases. The mean preoperative VAS for leg pain was 9.32 ± 0.43 points (range, 7-10 points), whereas the mean ODI was 79.82 ± 4.53 points (range, 68-92 points). At the last follow-up examination, the mean postoperative VAS for leg pain was 1.78 ± 0.71 points and the mean postoperative ODI improved to 15.27 ± 3.82 points.

Conclusion: A high grade inferior migrated lumbar disc is difficult to remove sufficiently by posterolateral endoscopic lumbar discectomy using a rigid endoscope. However, a satisfactory result can be obtained by applying a transforaminal supradisc approach with a flexible semi-rigid curved probe.

KEY WORDS: Migrated disc herniation - Percutaneous endoscopic lumbar discectomy - Rigid endoscope - Flexible curved probe.

INTRODUCTION

A microscopic discectomy has generally been performed as the surgical treatment for lumbar disc diseases2,3,31,47), however, endoscopic discectomy has improved considerably6,7,10,12,18,25,26,30,41,44,46,48).

In endoscopic lumbar discectomy, the lateral approach has been favored primarily for levels higher than L4-510,25,26,41) and the success rate exceeds 90%10,21,26,30,41,44,46,48). The causes of surgical failure include the difficulty in reaching the lesion due to anatomic limitations, excessive foraminal migration, a centrally-located large disc (particular when calcified), the presence of bony osteophytes, the presence of residual epidural scarring from a previous procedure and, especially, when the migrated protrusion is inferior along the nerve root10,26,41). Due to anatomic reasons, lesions located in the epideral space are difficult to reach, thus remnants are readily left and the success rate of surgery is noticeably reduced25,26,41). We applied a transforaminal supradisc approach to a high grade inferior-migrated lumbar disc using a rigid endoscope and a semi-rigid flexible curved probe, and report satisfactory results with a review of the literature.

MATERIALS AND METHODS

Patient

In 2007, Lee introduced a 4-zone classification of the disc migration based on the direction and distance from the disc
space in preoperative surgical MRI images. According to this classification, the high grade inferior migrated lumbar disc herniation was defined as zone 4 with disc material migrated far-downward from the center to the inferior margin of the lower pedicle. Fifty-three cases of high grade inferior-migrated lumbar disc herniation were included in this study.

All patients had severe radiating leg pain, 43 patients had buttock pain, 48 patients had back pain, and 23 patients had paresthesias and numbness along the painful leg dermatome, but there was no motor weakness of the lower extremities, or bladder or bowel dysfunction. Thirty-two migrated extrusion-type cases were beyond the confines of the posterior longitudinal ligament, but were still in continuity with the disc, and there were 21 migrated sequestered-type cases in which the disc material was no longer in continuity with the disc space.

Anesthesia

There is generally a trend in favor of a local anesthetic procedure for nerve root injury monitoring during surgery and for the early assessment of surgical results, nevertheless at our hospital, epidural anesthesia was performed in all cases. Either 100 µg fentanyl and 0.5% pucain were diluted by 1/2 and prepared 0.25% solution and approximately 15-20 cc was injected to the epidural space or 15-20 cc 0.5% pucain stock solution was injected to the epidural space. Anesthesia was assessed by checking the sensory level, and surgery was performed. During surgery, we were able to detect the patient’s sensory and motor changes because this type of anesthetic procedure does not block the nerve root completely.

Surgical technique

The sequence of surgery was identical to the general transforaminal endoscopic procedure. Preoperative imaging studies, in addition to intraoperative fluoroscopy, were conducted to ascertain the entry site. The skin entry point was typically 8-12 cm from the midline. Prior to the procedure, using indigo-carmine dye, evocative chromodiscography was performed. An operative sheath (YESS System: Wolf, Knittlingen, Germany) was installed in the disc space. Immediate suprapedicular approach was preferred for only sequestered migration type disc herniation without continuity to the disc space and disc of origin was not protruded. In suprapedicular approach, after disc extraction, epidural bleeding is inevitable, which greatly impedes performance of subsequent procedures. Therefore, if the case required disc decompression, it was better to first perform decompression identical to the posterolateral procedure. After completion of the decompression, the cannula was removed carefully from the foraminal space, and moved to the upper margin of the lower vertebral pedicle. The pedicle was surrounded by abundant soft tissues, fat, and blood vessels. The superior margin of the pedicle was secured by removing these structures completely using a high voltage bipolar probe manufactured by Ellman (Ellman Innovation, New York, USA) and forceps. If the pedicle and upper margin of the lower vertebrae were properly prepared, a sufficient space to perform the suprapedicular approach could be obtained (Fig. 1). When spondylosis in the upper margin of the lower vertebrae was present, we removed the upper margin of the lower vertebra using a punch to make a sufficient space. Upon performing the procedure, the epidural space and the traversing nerve root are exposed, and occasionally, the ruptured disc material is exposed first and thus it could be removed readily. However, the inferior migrated ruptured material is present below the traversing nerve root in most cases, and care must be exercised so as not to injure the traversing nerve root. In the endoscopic view, the blue-stained disc fragment was visible at the upper quadrant of the view, but a straight probe or forceps could not reach the disc area, so we used a semi-rigid flexible curved probe (RZ Medizin Technik GmbH, Tuttlimigen, Germany) to carefully hook and pull the disc material out to the center of the endoscopic view. Then, a forceps could reach the disc fragment and easily remove it (Fig. 2). If the disc material was extracted and thus nerve root decompression was sufficient, massive bleeding could obscure the structural findings in the endoscopic view. However, this bleeding could be controlled by bipolar coagulation and saline irrigation, and the sufficiently movable traversing nerve root could be assessed. If the disc material stained blue was not detected, the disc material was extracted and the nerve root was decompressed. Finally, the cannula with the endoscope was removed carefully.

Evaluation

Based on MRI and 3D CT with discogram images taken prior to surgery, migration level, lesion type, and the relation with adjacent anatomical structures were analyzed (Fig. 3). Approximately 1-4 hours after surgery, the remnant disc was assessed by checking with MRI. Approximately 1 week after surgery, the improvement of patient was evaluated by Visual Analogue Pain Score (VAS) and Oswestry Disability Scores (ODI) including neurologic testing. The functional outcome was measured by the change in preoperative and postoperative VAS. A change of more than 7.5 points was deemed of an excellent results, 5 points
good, 2.5 points fair, whereas change of less than 2.5 points was considered poor.

RESULTS

A total of 53 patients were operated on during the period between May 2006 and March 2008 for high grade inferior-migrated disc herniation with the transforaminal suprapedicular endoscopic technique. There were 28 male and 25 female patients. The age distribution of patients is as follows: adolescence (1), 20s (6), 30s (8), 40s (11), 50s (13), 60s (9), and 70s (5). The L2-3 level was involved in 2 patients. The L3-4 level was involved in 12 patients, while the L4-5 level was involved in 39 patients. The preoperative MRI and 3D CT with discogram images showed a single piece-type in 34 cases and a multiple piece-type in 19 cases. One patient

Fig. 1. A: Preoperative magnetic resonance (MR) images showing high grade inferior-sequestered disc herniation on L4-5. B: Preoperative discogram with 3D reconstruction computed tomography (violet area: single piece ruptured sequestered disc material). It is possible to have an understanding the nature of high grade inferior-sequestered disc type by preoperative. C: Schematic image of endoscopic view. It can be removed sufficiently by a suprapedicular endoscopic approach (Red arrow: entry point of suprapedicular approach). D: Endoscopic view of suprapedicular approach. E: Postoperative MR images showing inferior-sequestered disc material which has been successfully removed.

Fig. 2. A semi-rigid flexible curved probe (RZ Medizin Technik GmbH, Tuttlingen, Germany) is very useful to remove the far downward migrated disc material. A: A semi-rigid flexible curved probe can widen the range of reach to the migrated disc fragment and it is used to hook and pull out the disc fragment by manipulation of a rotation probe under an endoscope (green area). B and C: Manipulated probe is projected from just above the pedicle of L5 to the inferior-migrated disc area and the probe tip reaching the inferior margin of the pedicle of the lower vertebra, L5.
required conversion to an open surgery because of a large, ruptured, hard component disc not extracted from the epidural space. One patient had a fair result and 1 patient had a poor result at the 6 month follow-up (Table 1). Seven patients complained of paresthesias in the previous painful area, 2 patients complained of paraparesis transiently, but their symptoms resolved completely during the ensuing 4 weeks of observation. The operative times ranged from 30-150 minutes, with a mean operative time of 90 minutes.

The mean preoperative VAS for leg pain was 9.32±0.43 points (range, 7-10 points), whereas the mean preoperative ODI was 79.82±4.53 points (range, 68-92 points). At the last follow-up examination, after an average period of 6 months, the mean postoperative VAS for the leg pain was 1.78±0.71 points (range, 1-3 points) and the mean postoperative ODI improved 15.27±3.82 points (range, 8-22 points; Table 1). The mean hospital stay was 32 hours (range, 8-72 hours). The postoperative MRI results showed that 42 patients (79%) had near-total disc removal. Postoperative residual disc remnants existed in 7 patients; however, a very small fragment did not cause symptoms, and they were satisfied with the surgical results. The mean follow-up period was 9.84 months. Seven patients (13%) developed dysesthesias in the lower extremities in a dermatomal distribution that was different from the preoperative radiating pain, but the dysesthesias were transient and improved over 4 weeks. During this period, no patients developed recurrent disc herniation on the same side. There were no occurrences of infections, discitides, pareses, dural tears, vascular injuries, or systemic complications.

**DISCUSSION**

Recently, numerous studies involving endoscopic discectomy have been reported, and the outcomes have been improving gradually. The incidence of complications after endoscopic lumbar discectomy is low. Lumbar discectomy has many advantages over
minimally invasive procedures: by dispensing the possibility of resection of bone and ligament and performing selective evacuation of the intervertebral space, surgery-induced instabilities can be prevented. In addition, lumbar discectomy is less traumatizing, the operative time is shorter, scarring can be avoided, and the intact iatrogenic lubricant structures, such as epidural fat and yellow ligaments, can be conserved. Post-discectomy syndrome or other deteriorations associated with surgery do not develop, and revision surgery is easier. Epidural scarring develops in more than 10% of patients after conventional laminectomy and discectomy. However, in posterolateral endoscopic discectomy, such scar were not detected by MRI or revision surgery. Therefore, subsequent endoscopic or conventional procedures are possible. In comparison with microscopic discectomy, endoscopic discectomy do not need general anesthesia and there are many advantages, such as less complications and morbidity in the elderly, shorter hospital stays, faster rehabilitation, earlier return to work or sports, and thus higher patient satisfaction. Despite such numerous advantages, endoscopic discectomy has not been universally adopted because of the steep learning curve. In comparison with microscopic discectomy, surgical outcomes after endoscopic discectomy are not considered better and the indications are limited. Lateral approach endoscopic discectomy has many restrictions due to anatomic limitations, and the approach is through the iliac wing; thus, the iliac wing and the height of the working disc space should be adequate and the working disc space must be approached through the foraminal space, which is difficult. Also, the approach in high grade migration and high canal compromise cases is difficult with a rigid endoscope. In other words, due to anatomic reasons, the indications for endoscopic surgery is limited and it is relatively contraindicated for non-contained high grade canal compromise or migration type cases. Lee et al. analyzed 55 failed cases among 1,586 cases of endoscopic discectomy, and the possibility of failure was increased in high grade migration and high canal compromise-type cases; thus, they suggested that open surgery should be performed. Ruebben et al. reported that in lateral endoscopic lumbar discectomy, for complete removal of the prolapsed disc, the epidural lesion is difficult to remove through the annulus defect using a retrograde approach, and thus direct visualization is required, therefore they utilized an extreme lateral access. It was difficult to remove the ruptured disc material by extreme lateral access, especially in cranial cases exceeding the lower edge of pedicle, and in caudal cases, exceeding the middle of the pedicle. Lee et al. divided the level of disc migration by 4 grades, and among them, satisfactory results in the cases of the far-downward migrated type (zone 4) were merely 78.9%. According to Ditsworth, it has been reported that despite endoscopic transforaminal lumbar discectomy having numerous advantages and showing good surgical results, it has several shortcomings; surgical manipulation is not easy; and thus it is possible to remove only a portion of the extruded disc, resulting in a lower success rate (83%). To overcome such limitations, it is important to understand the anatomic relationship of the disc and adjacent structures prior to surgery. To solve such problem in endoscopic discectomy by a lateral approach, it is necessary to understand the location in relation to the stalk of the ruptured disc and rest particles and the fragment level of the ruptured disc, and to obtain the volume of the lesion site and information on 3-dimensional imaging. We solved these problems by performing a discogram with 3D reconstruction CT. In the cases of high grade inferior migration-type lumbar disc herniation, the success rate of endoscopic discectomy is low because the endoscopic access to the lesion was interrupted by anatomic structures and a rigid endoscope, and a probe could not reach the lesion. Some surgeons reported that other methods, such as the extreme lateral access and epiduroscopic approach and flexible working channel scope could solve such problems. The transforaminal suprapedicular approach is a method to remove the migrated disc through the foraminal narrow space above the pedicle of the lower vertebra. The transforaminal suprapedicular approach has several advantages. The manipulation is performed at the foraminal level and thus it could have a sufficient angle to reach the migrated disc, the epidural space could be approached readily, and sufficient assessment of root decompression and disc extraction is feasible. If a working cannula is installed in the disc space and subsequently the cannula is moved to the upper margin of the lower vertebral pedicle, the surrounding soft tissues can be clearly arranged by a high voltage bipolar probe manufactured by Ellman Innovation, New York, USA, forceps. The suprapedicular entry space can be prepared (Fig. 1C and D). Through this route, the inferior-migrated disc material can be extracted by performing an epiduroscopic approach with the use of a semi-rigid flexible curved probe.

CONCLUSION

It is difficult to remove the disc fragment successfully in the high grade inferior migrated lumbar disc herniation by
posterior lateral approach using rigid endoscope. However, satisfactory results could be obtained by applying transforaminal suprapedicul al approach and using semi-rigid flexible curved probe.

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