CLINICAL ARTICLE
J Korean Neurosurg Soc 41 : 241-245, 2007

Endoscopic Spinal Surgery for Herniated Lumbar Discs

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Objective : So called "minimally invasive procedures" have evolved from chemonucleolysis, automated percutaneous discectomy, arthroscopic microdiscectomy that are mainly working within the confines of intradiscal space to transforaminal endoscopic technique to remove herniated epidural disc materials directly. The purpose of this study is to assess the result of endoscopic spinal surgery and favorable indications in the thoracolumbar spine.

Methods : The records of 71 patients, 73 endoscopic procedures, were retrospectively analysed. Yeung Endoscopic Spine Surgery system with 7 mm working sleeve and 25° viewing angle was used. The mean follow up period was 6 months (range,3-9).

Results : Operated levels were from T12-L1 disc down to L5-L6 or S1 disc. Of 71 cases, 2 patients underwent transforaminal endoscopic surgery twice due to recurrence after initial operation. MacNab's criteria was used to assess the outcome. Favorable outcome, excellent or good, was seen in 78% (57 procedures) of the patients. Among 11 fair outcomes, only 1 procedure was followed by secondary open procedure, laminectomy with discectomy. Two of 5 poor outcomes were operated again by same procedure which resulted in fair outcomes. One patient with aggravated cauda equina syndrome remained poor and a lumbar fusion procedure was performed in other patient with poor outcome. There were 2 postoperative discitis that were treated with conservative care in one and anterior lumbar interbody fusion in the other.

Conclusion : Evolving technology of mechanical, visual instrument enables minimal invasive procedure possible and effective. The transforaminal endoscopic spinal surgery can reach as high as T12-L1 disc level. The rate of favorable outcome is mid-range among reported endoscopic lumbar surgery series. Authors believe that the outcome will be better as cases accumulate and will be able to reach the rate of standard open microsurgery.

KEY WORDS : Endoscopic · Transforaminal · Herniated discs · Indications · Outcome.

Introduction

To obtain same or better operative goal as open surgical procedure, minimally invasive percutaneous approaches have been developed over decades while giving minimal paraspinal tissue damage. Previously, the routes through which percutaneous minimally invasive procedure were performed were focused on mainly posterolateral route by Kambin[6,8,9].

With endoscopic technical development and introduction, the ideas to attack confined disc for internal decompression have been changed to attack epidural target directly and the entry points have been moved more laterally to be able to get transforaminal access[2,11,12,17]. For L5-S1 herniation, interlaminar transligamental introduction of endoscope can be applied. We report clinical result of endoscopic surgery including favorable indications in the thoracolumbar spine and learning curve of technique.

Materials and Methods

The records of 73 procedures (71 cases) either by transforaminal or interlaminar endoscopic approach were retrospectively analysed. The procedures were performed since June, 2005 when Yeung Endoscopic Spine Surgery system with 7mm working sleeve and 25° viewing angle was avaliable. All 73 procedures were performed during 7 months period by one of authors. The patients selection criteria was same as standard open microsurgery for herniated lumbar disc.

• Received : September 27, 2006 • Accepted : February 23, 2007
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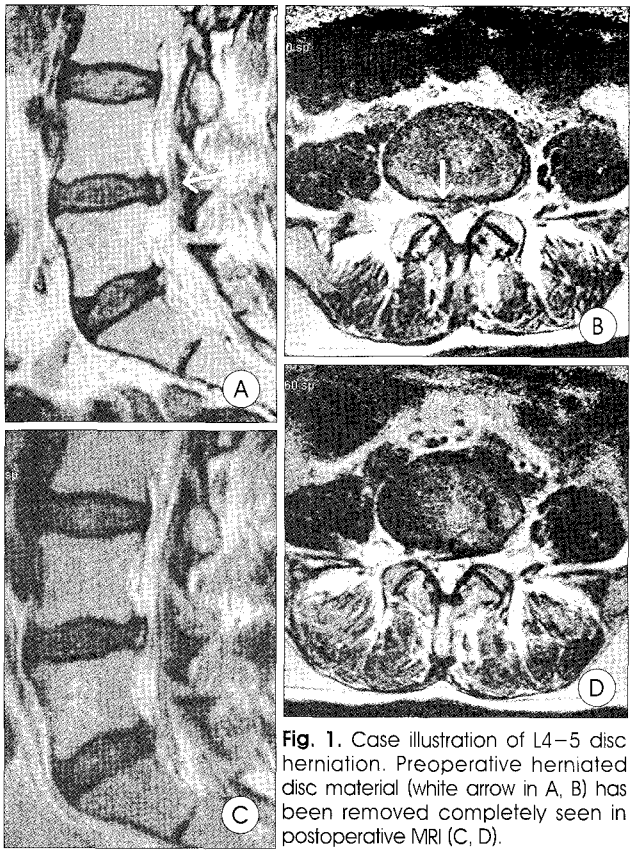

Fig. 1. Case illustration of L4–5 disc herniation. Preoperative herniated disc material (white arrow in A, B) has been removed completely seen in postoperative MRI (C, D).

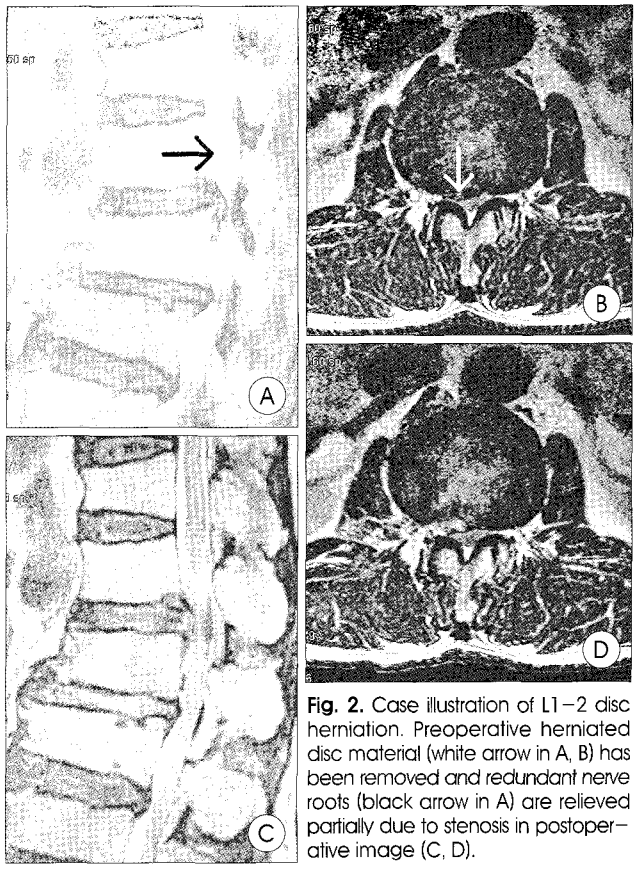

Fig. 2. Case illustration of L1–2 disc herniation. Preoperative herniated disc material (white arrow in A, B) has been removed and redundant nerve roots (black arrow in A) are relieved partially due to stenosis in postoperative image (C, D).

The procedure was performed in prone position under epidural anesthesia. Fluoroscopic monitoring provided guidance about point of entry and trajectory that were presumed and measured by preoperative MRI. Posterolateral route was used in all cases except for L5-S1 herniation that was approached from interlaminar route. Discography with indigo carmine mixed isovist was followed by removal of disc material that was contained or non-contained. Discography was not done for L5-S1. Procedure was completed after confirming adequate decompression of corresponding nerve root or dural sac. Routine postoperative MRI were taken on the next day in each cases to compare effective neural decompression (Fig. 1, 2, 3).

In addition to routine demographic data from retrospective analysis, main symptom was divided into 3 groups; those who had leg pain, lower back pain and both. Preoperative symptom duration and postoperative admission period were also included in analysis. The level of operation was divided into 2 groups based on L3 vertebral body. Other 2 groups were divided according to the order of operation to assess the learning curve. We used McNab's criteria to assess outcome by interview on follow up visit or telephone survey.

The mean follow up period was 6 months (range,3-9) and Chi-square test was used for statistical comparison.

Results

Among 71 cases, 2 patients underwent transforaminal surgery twice due to recurrence after initial procedure. On the postoperative MRI, they showed adequate neural decompression and their symptoms were relieved. But, on the 3rd and 4th postoperative day, they complained sudden onset of preoperative symptoms and immediate MRI showed new disc materials on the same location where initial decompression, were taken place. Between standard microscopic discectomy and revision endoscopic transforaminal surgery, we chose endoscopic surgery again. Hence, the results of first operation were designated as poor and they finally showed fair outcomes after second procedure.

The mean age was 44.6 years (range 12-74) and 31 procedures were below 40 years and 18 procedures were over 60 years with male preponderance (40 procedures) (Table 1). Among 11 procedures (15.1%) of fair outcomes, only 1 procedure was followed by secondary open procedure, laminectomy with discectomy. Two of 5 poor procedures were followed by same procedures that resulted in fair outcomes. One patient with aggravated cauda equina syndrome remained poor and a lumbar fusion procedure was performed in other patient with poor outcome. There were 2 cases of discitis. One of

Fig. 3. Endoscopic images captured during procedure of Figure 1 case. Extruded disc fragment(*) beyond annulus(**) is being successfully removed in b. The instrument indicates decompressed L5 nerve root over blue, contained disc(***).

Table 1. Age and sex distribution of 73 procedures

	Below 40	40-59	Over 60	Total
Male	21	11	8	40
Female	10	13	10	33
Total	31	24	18	73

Table 2. Statistical analysis between variables and outcome

Outcome	Unfavorable	Favorable	Total	χ^2(p)
Sex				.190(.663)
male	8	32	40	
female	8	25	33	
Age				8.068 (.018*)
below 40	3	28	31	
	(9.7)	(90.3)	(100.0)	
40-59	5	19	24	
	(20.8)	(79.2)	(100.0)	
over 60	8	10	18	
	(44.4)	(55.6)	(100.0)	
Chief complaint				1.514 (.469)
leg pain	6	20	26	
LBP	3	5	8	
leg pain/LBP	7	32	39	
Symptom duration				1.805 (.614)
within 1 week	5	14	19	
1 week-1 month	2	16	18	
1-3 months	4	14	18	
over 3 months	5	13	18	
Operation level				3.012 (.083)
upper lumbar	3	3	6	
lower lumbar	13	54	67	
Group				3.097 (.078)
initial group	11	25	36	
later group	5	32	37	
Total	16	57	73	
	(21.9)	(78.1)	(100.0)	

*p<0.05, LBP : low back pain, (%)

them was treated with conservative care with good outcome and remaining patient with anterior lumbar interbody fusion with poor outcome. Overall outcome was favorable in 57 procedures (78.1%) (excellent in 24 (32.9%), good in 33 (45.2%)), unfavorable in 16 procedures (21.9%) (fair in 11 (15.1%), and poor in 5 (6.8%)). There was a high statistical correlation between age and outcome on the with better outcome in younger patients (*p<0.05) (Table 2).

The chief complaints were combined radicular pain and low back pain in 39, radicular pain only in 26, and low back pain. The distribution of preoperative symptom duration was diverse from less than a week to over 3 months. But, the chief complaint and symptom duration did not show any statistical correlation with outcome. Operated levels were from T12-L1 disc down to L5-L6 or S1 disc. The operation level was divided into 2 groups based on L3 vertebral body, lower lumbar level being 67 (91.7%) and upper lumbar level 6 (8.3%). With regards to the learning curve of technique, division of procedures in operating order (group 1 : initial group 36 procedures, group 2 : later group 37 procedures) did not show any statistical difference in outcome (p=0.078 >0.05), but the percentage of favorable outcome was higher (86.5%) in later group than former group (69.4%) (Table 2).

Discussion

Standard open microdiscectomy has been challenged by various minimally invasive procedures, especially by percutaneous approaches. The percutaneous route was mainly from posterolateral point that was extensively tried by Kambin and others[6,8,9,13] to recently introduced percutaneous transforaminal approach[7]. The introduction of endoscopes to minimally invasive procedure with fine instrumental evolution attracted surgeons to attack intervertebral disc under the direct vision rather than blind. Hence, the point

of attack has been moved more laterally and transforaminal access was able to show non-contained herniated disc as well as contained herniation[2,11,12,17].

We used posterolateral transforaminal route for 59 procedures. L4-5 level was 42, L3-4 6, L5-6 (S1) 5, L2-3 3, L1-2 2 and T12-L1 1 procedure, respectively. In 5 procedures, lumbarization of S1 vertebra provided relatively unhindered trajectory to L5-S1 disc level and enabled transforaminal route possible. The reported endoscopic surgery studies show the upper level to L2-3 disc level[13,16]. Usually, transforaminal approach for upper lumbar disc level is limited because kidney lies close to spine, but preoperative measurement of trajectory and intraoperative precise 3-D topographic orientation can make it possible together with 25 degree angled view of endoscope. But, direct intraspinal endoscopic view may not be possible by steeper angle of trajectory which is more vertical than lower lumbar level in spite of 25 degree angled view of endoscope. We tried to approach endoscopically up to T12-L1 level by tracing the lower margin of 12th rib without any thoracoabdominal injury with fair outcome. Further experience and evolution of endoscopic equipment will be required to make the application of endoscopic surgery to upper lumbar level safer and more effective.

For the percutaneous approach to L5-S1, translaminal or transiliac, interlaminar routes were studied[4,14,19]. But, the interlaminar approach through wide space can overcome obstacles from other routes minimizing invasiveness. It provides exposure of either shoulder or axial region of corresponding root according to preoperative assessment of the position of extruded disc and nerve root[10]. We performed 14 procedures by interlaminar route and majority of patients (13 cases, 93%) showed favorable outcome.

When operation level was divided into 2 groups based on L3 vertebral body to compare outcome, because difficulty in approach is anticipated as the level goes cranially, there was no statistical difference ($p=0.083>0.05$) between upper and lower level. The lower lumbar level was predominant (67 cases, 91.7%) and upper lumbar level was involved only 6 cases (8.3%). The lower lumbar level showed better results without statistical support probably due to limited number of cases. However, the outcome of upper lumbar level may improve with meticulous technique and development of instrument. The transforaminal approach can be extended to thoracic area in this regard.

As with others, the beginner of certain technique has his own learning curve and skillfulness is dependent on endeavor and instinct. So, serial division of procedures and analysis may provide the learning curve of endoscopic technique as in this report. Even though there was no statistical difference in outcome ($p=0.078>0.05$) between initial half of procedures and later half, the percentage of favorable outcome was higher in (86.5%) later group than initial group (69.4%). The result will be better as cases accumulate and there is no strict criteria between beginner and expert.

The overall favorable outcome was 78.1% and it is mid-range among reported endoscopic lumbar surgery series (65-95%)[1-3,5,10,15-18]. But, it will be better as cases accumulate and refinement of technique and instrument will be needed to reach or surpass the rate of standard open microsurgery. The age is another important factor in treatment of spinal disease considering the fact that degenerative process of disc and spine, and soft tissue being part of aging process. Facet and ligamental hypertrophy with or without micro instability make intervertebral foramen and lateral recess shallow and narrow. Thus, the transforaminal route may be partly blocked by hypertrophied foraminal ligament and/or facet.

Conclusion

Endoscopic discectomy is a minimally invasive method aiming early functional recovery but the rate of favorable outcome is still lower than open discectomy. To reach to the rate of favorable outcome of standard open microsurgery, optimal selection of patients, technical and instrumental evolutions will be required.

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