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Clinical Article

Efficacy of Unilateral Laminectomy for Bilateral Decompression in Elderly Lumbar Spinal Stenosis

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Objective : The aim of our study is to evaluate the effectiveness of unilateral hemilaminectomy for bilateral decompression in elderly patients with degenerative spinal stenosis. For this purpose, we studied the co-morbid condition and clinical outcome of patients who underwent decompressive surgery using the unilateral approach technique.

Methods : Thirty-four patients over 65years of age who underwent unilateral partial laminectomy for bilateral decompression from January 2000 to October 2003 were analyzed. These patients were studied for preoperative co-morbid condition and physical status according to the American Society of Anesthesiologists(ASA) classification, postoperative morphometrical change, and clinical outcomes, including visual analogue scale(VAS) score. The mean follow-up was 23months (range 6 - 48months).

Results : A patient's physical status was recorded as class I, II, or III by ASA classification, which correlated to 41.2%, 44.1%, and 14.7% of patients, respectively. The cross-sectional area of the pre- and postoperative dural sac at the level of the stenosis was $52.5 \pm 19.9 mm^2$ and $110.6 \pm 18.2 mm^2$, respectively. The outcome was excellent in 8.8%, good in 58.8%, fair in 23.6%, and poor in 8.8% of the patients. The VAS was changed postoperatively to 3.1 ± 1.2. There was no operation-related transfusion yet there was no evidence of postoperative instability at the follow-up examination.

Conclusion : Unilateral laminectomy for bilateral decompression, in spite of the limited exposure, can result in satisfactory decompression of the lumbar spinal stenosis and tolerable clinical outcome. This approach is thought to be appropriate for elderly patients who have a greater surgical burden.

KEY WORDS : Elderly · Lumbar · Spinal stenosis · Unilateral laminectomy.

Introduction

As the life expectancy of the elderly population increases, and by virtue of advances in modern neuro-imaging, physicians, particularly neurosurgeons, are being increasingly confronted with older patients suffering from disabling lumbar spinal stenosis[12,29].

Surgical treatment of symptomatic lumbar spine stenosis in the elderly is recommended[30]. The controversy however, lies in the method or approach for treating lumbar spinal stenosis in a population of patients with co-morbid conditions that result from the aging process in other systems[25]. A previous study emphasized the morbidity associated with surgical treatment of lumbar stenosis in the elderly population[6]. Elderly patients should be made aware of the increased risk for surgical complications because of their age [4].

The goal of the surgeon managing lumbar spinal stenosis should be to achieve adequate decompression of the neural structures while minimizing surgical damage to the posterior stabilizing structure[21]. Unilateral laminectomy preserves the facet joints and neural arch of the contralateral side, limits postoperative destabilization and protects the nervous structure against posterior scarring[21]. Under speculation that limited surgical extent would be better, due to reduced invasiveness, low postoperative complication rate, and preservation of spinal stability[28], we unilaterally performed a partial laminectomy in an attempt to sufficiently decompress both sides of the stenotic spinal canal. We present here the results of our study of this surgical approach.

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Materials and Methods

Patient assessment

We studied 34 patients (17 males and 17 females) who

underwent a unilateral approach for lumbar spinal stenosis from January 2000 to October 2003 and are still undergoing follow-up examinations. The inclusion criteria were an age over 65years, failure of conservative measures (minimum 6weeks), and the absence of associated pathology such as inflammation or malignancy. The exclusion criteria were pure lateral stenosis, spondylolisthesis with spinal instability, previous back surgery, an age of less than 65years, and the cessation of follow-up examinations.

Table 1. American society of anesthesiologists classification of physical status

Class	Definition	Number of patients (%)
I	No systemic disease	14 (41.2)
II	Mild to moderate systemic disease	15 (44.1)
III	Severe systemic disease	5 (14.7)
IV	Severe systemic disease that is life threatening	-
V	Moribund patient with little chancing or survival	-

Table 2. Number of patients with co-existing systemic disease (n=20)

Co-existing systemic disease	Number of patients (%)
Hypertension	11 (32.4)
Diabetes mellitus	6 (17.6)
Respiratory disease	4 (11.8)
Liver cirrhosis	1 (3.0)
Hepatoma	1 (3.0)
Lung cancer	1 (3.0)
Dementia	1 (3.0)

Table 3. Baseline characteristics of the patients

Variable	Number (%)
Patient assessment	
Patients : male/female	34 : 17/17
Mean age (years)	69.1 (range 65 - 85)
Symptom duration (months)	16.0 (range 2 - 70)
F/U duration (months)	23.0 (range 6 - 48)
Hospital days	10.3 (range 8 - 30)
Initial chief complaint	
Low back pain	31 (91.2)
Leg pain	30 (88.2)
Neurogenic claudication	22 (64.7)
Sensory change	8 (23.5)
Motor deficit	4 (11.8)

Table 4. Baseline findings of at imaging tests

Radiologic parameters	Number (%)
Number of stenotic levels	
Single	13 (38.2)
Two	14 (41.2)
Three	6 (17.6)
Four	1 (3.0)
Stenotic level of the lesion	
L2/3	2 (15.4)
L3/4	4 (30.8)
L4/5	7 (53.8)

The clinical parameters reviewed included preoperative American Society of Anesthesiologists(ASA) classification of physical status (Table 1), preoperative co-morbid conditions, clinical manifestations, and length of hospital stay.

Operative procedure

After routine unilateral exposure to the lamina, a partial laminectomy of the cephalad lamina and a portion of the caudal lamina using a Kerrison rongeur or a high-speed drill was performed. The laminectomy was extended cephalad until the region of insertion of the ligamentum flavum was reached followed by a small laminectomy on the ipsilateral caudal lamina. This allows removal of the intervening ligamentum flavum and affords a midline hemidecompression. The soft tissue and bony stenotic portions were excised using Kerrison rongeurs or a chisel at the subarticular zone. The procedure was done sequentially until the nerve root at the operative level was observed to exit freely into the foramen. After ipsilateral decompression, the contralateral side was addressed by a tilting microscope. A vital point in the process, to allow access for contralateral decompression, is the adequate resection of the "wishbone" portion of the cephalad and caudal lamina, i.e., the junction of lamina with the spinous process. After decompression, all causative soft tissue and

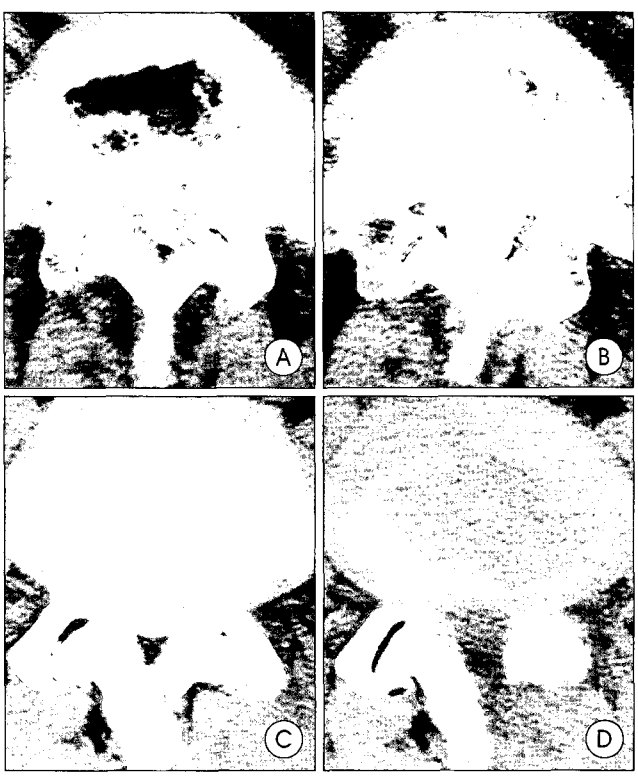

Fig. 1. Preoperative (A, C) and postoperative (B, D) radiologic findings. Markedly widened dural sac (B, D) after decompression.

bony stenotic portions should be resected and adequate decompression of contralateral nerve root confirmed.

Morphometrical evaluation

Morphometrical evaluation of the preoperative and postoperative CT scans was performed. Computerized planimetric measurement of the cross-sectional area of the dural sac was performed. Measurement of the dural sac area permitted the evaluation of the surgical decompression degree by an image analysis program (OPTIMAS 6.5, Optimas, Inc., Bothell, WA, USA). Scans performed at the facet joint level at each intervertebral space were selected, because this level is most commonly involved in degenerative lumbar spinal stenosis.

Postoperative evaluation and clinical outcome

All patients were followed postoperatively and underwent repeated physical examination for pain, function and neurological damage. Complications after surgery were assessed as infection (deep or superficial), any permanent residual neurological damage, dural tear, other complications or death. Postoperative outcome was evaluated by VAS score and clinical outcome was measured by Ragab's description[25](Table 5). The patients were asked about their symptoms, medications, and limitation of daily activities. The patients were examined at 3, 6, 12, and 24months postoperatively. Possible progression of degenerative spondylolisthesis or evidence of instability were evaluated by history taking, neurologic exam, and roentgenographic study including standard and standing functional views in maximal flexion and extension of the lumbar spine.

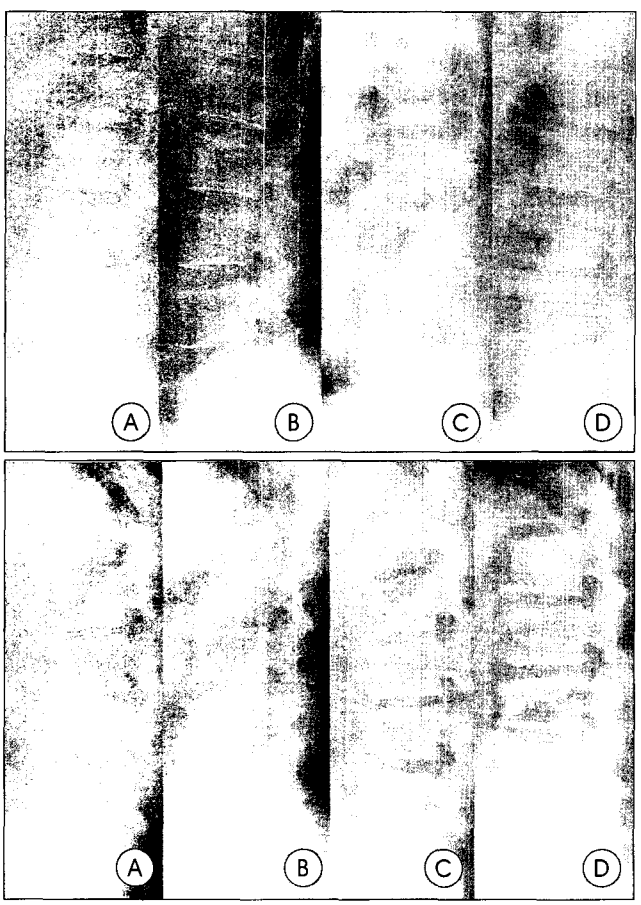

Fig. 2. Preoperative (A, B) and postoperative (C, D) radiologic findings. Upper : The patient with osteoporosis has not definitely postoperative instability at 1 year after surgery. Lower: The patient who had underwent 3-level decompression as L2-3, L3-4 and L4-5 has not definitely surgical instability at 2 years after surgery.

Statistical analysis

Statistical analyses were performed using a commercial software package (SigmaStat version 2.03, SPSS science, Chicago, IL, USA). We used two-sample Student t- test. P values < 0.05 were considered statistically significant.

Results

Patient's assessment

The mean age of patients in the present study was 69.1 years (male: 69.1 ± 7.0, female: 69.1 ± 4.0). Symptom duration averaged 16months (range 2 - 70months) and the mean followup was 23months (range 6 - 48months). Preoperative clinical symptoms and signs were low back pain (91.2%), leg pain (88.2%), neurogenic claudication (64.7%), sensory change (23.5%), and motor weakness (11.8%) (Table 3).

Systemic diseases

Physical status of the patients was recorded as class I, II, and III, under the ASA classification, in 41.2%, 44.1% and 14.7% of patients, respectively (Table 1). Co-morbid condition was recorded in 58.6% of all patients, with hypertension (33.3%) being the most common comorbidity. Other coexisting diseases included diabetes mellitus (18.5%), respiratory disease (11.0%), liver cirrhosis (3%), hepatoma (3%), lung cancer (3%), and dementia (3%) (Table 2). There was a high occurrence of osteoporosis in the female patients (64.7%).

Lesion assessment

All patients underwent preoperative CT scan and/or MRI imaging evaluation for the spinal stenosis. The single-level lesion was 38.2% and multi-level lesion was 61.8%. In the patients with a single lesion, 7 had a stenosis at L4/5 (53.8%), 4 at L3/4 (30.8%), and 2 at the L2/3 level (15.4%). In patients with a multi-level lesion, two-level stenosis was the most frequent (66.6%) (Table 4).

Morphometrical assessment

Surgical decompression yielded significant widening of the dural sac as well as the spinal canal (Fig. 1). In the patients who underwent a postoperative imaging study, the preoperative cross-sectional area of the dural sac at the level of the stenosis was $52.5 \pm 19.9 mm^2$ (range 32 to $72 mm^2$), whereas postoperative scans revealed a $110.6 \pm 18.2 mm^2$ (range 92.5 to $130.4 mm^2$) area. There was significant difference between the pre- and post-operative dural sac areas ($p < 0.001$).

Clinical outcome

The initial outcomes of three patients were excellent (8.8%), 20 were good (58.8%), 8 were fair (23.6%), and 3 were poor (8.8%) (Table 5). Twenty-four months after surgery, the outcomes of 2 patients were excellent (11.1%), 11 were good (61.1%), 3 were fair (22.2%), and 1 was poor (5.6%). There was no significant difference between follow-up intervals ($p > 0.05$).

Preoperative scoring of VAS was 7.1 ± 0.9, while 7days after surgery, the VAS score was 4.1 ± 0.8 indicating significant improvement after the operation ($p < 0.001$). Twenty-four months after surgery the mean VAS score was 4.5 ± 0.8. There was no significant difference between follow-up intervals ($p > 0.05$).

The average duration of hospitalization was 10.3days (range 8 to 30days). Regarding operation-related complications, only 2cases of superficial postoperative wound infection were indicated, resulting in a longer hospital stay (20days and 30days) than others. No patients needed an operation-related transfusion. Radiographs demonstrated at follow-up intervals that neither development of degenerative spondylolisthesis nor any evidence of instability was detected in any patient (Fig. 2).

Discussion

Many authors have recommended that surgery for lumbar spinal stenosis should be delayed until the pain becomes so intolerable as to interfere with the patient's daily activities or the appearance of progressive neurologic deterioration signs and symptoms[2,3,11,16,26]. Although controversy still lies in the management of lumbar spinal stenosis, surgical decompression has been proven to be the safe and effective treatment option for patients suffering from the disabling symptoms of spinal st-enosis[10,13,17,27]. However, due to age-related co-existing diseases, healthcare providers as well as patients and their family members are often concerned about surgery in the elderly group[22]. In this respect, applications of less invasive techniques are thought to be very important in the treatment of geriatric spinal stenosis.

Although minimally invasive spine surgery is still met with some skepticism by many neurosurgeons, these less invasive techniques can achieve favorable results with less surgery-related pain, morbidity, and disability[8].

Fenestration with minimal soft tissue dissection and limited bone removal instead of extensive laminectomy to prevent subsequent lumbar instability has become widely accepted for the treatment of spinal stenosis[20,31]. A unilateral approach for bilateral decompression has been modified and performed successfully by many surgeons[1,5,7,19,24]. The unilateral

Table 5. Clinical outcome measurement by Ragab et al[23] classification

	Back pain	Leg pain	Activity	Medications	Initial results (%)	24 months (%)
Excellent	Occasional	None	Normal	None	3 (8.8)	2 (11.1)
Good	Mild	Mild	Normal	NSAIDs	20 (58.8)	11 (61.1)
Fair	Moderate	Moderate	Restricted	NSAIDs	8 (23.6)	4 (22.2)
Poor	Severe	Severe	Restricted	Narcotics	3 (8.8)	1 (5.6)

NSAIDs; non steroidal anti-inflammatory drugs

Table 6. Distribution of Clinical outcomes relevant to ASA classification

	No	Excellent	Good	Fair	Poor	Postoperative complication
ASA I	14	14.2%	57.1%	21.4%	7.1%	-
II	15	6.7%	60%	26.7%	6.7%	6.7%
III	5	-	60%	20%	20%	20%
Total	34	8.8%	58.8%	23.6%	8.8%	5.9%

ASA; American society of anesthesiologists

Table 7. Comparison of results with previous series

Procedure	No	Excellent	Good	Fair	Poor	Postoperative complication
Present study	34	8.8%	58.8%	23.6%	8.8%	5.9%
Fenestration[19]	50	32%	28%	32%	8%	*
Laminectomy[3]	200	18.5%	49.5%	19.5%	12.5%	43.5%
Laminectomy with fusion[24]	45	40%	51.1%	2%	5.9%	20.3%

* not described in the study

approach can preserve the facet joints as well as the neural arch of the contralateral side to limit postoperative destabilization and protect the nervous structures against posterior scarring[21]. The unilateral lam-inectomy also preserves the ligamentous structures that funct-ion as a mechanical strut in the movement of the lumbar spine, thereby allowing improved postoperative muscle reatt-achment and function[14,18,32].

In this study, only patients with an ASA physical status of I, II, and III underwent surgery. Very high risk patients, classified as ASA IV and V were denied surgery and excluded from this study. In our study, 58.8% of patients had one or more systemic diseases, graded class II or III in the ASA of physical status. A previous study reported that, for geriatric patients rated as a physical status of I-II, surgical treatment of lumbar spinal stenosis is a safe and effective option, however the suitability of ASA III patients requires further investigation[25]. In this study, on the clinical outcomes of ASA I, II, and III class, excellent or good results were 71.3%, 66.7% and 60%, respectively (Table 6). The clinical outcomes of ASA III class were less satisfied. However, the clinical outcome resulted from small cases, so further study is needed.

Compared with the traditional procedures for spinal stenosis, patients were slightly less satisfied with the surgical result than total laminectomy with fusion (Table 7). We thought our results may be resulting from the only aged patient and the chronic co-morbidity of a systemic problem. A previous study demonstrated that the majority of patients, who underwent total laminectomy, respond well to laminectomy, but complication (22%) and late deterioration (10%) rates are not insignificant. In addition, radiological instability is common after decompression for degenerative lumbar spinal stenosis however, this correlates poorly with clinical outcome[9]. The laminectomy with fusion for an osteoporotic patient carries the risk of operation-related problems as screw loosening, which may lead to the loss of correction and nonunion. Its rate ranged from 0.6 to 11% of the cases[23]. Most elderly patients, especially women, have osteoporosis and the prevalence increases with age. Osteoporosis is one of the most important parameters influencing the stability of the spine[23] postoperatively. There was no evidence of postoperative spinal instability in patients with osteoporosis in this study. In addition, a previous study demonstrated that appropriate surgical treatment for lumbar spinal stenosis may contribute to the prevention of physical inactivity-induced osteoporosis in elderly patients with neuro-genic intermittent claudication caused by degenerative lumbar disease[15]. Although surgically related complications were focused on in geriatric patients, the patients had no significant complications other than superficial wound infection in this study. In the present study, multi-levels of stenosis were 61.8% and the approach is a useful technique for multi-levels of lumbar stenosis. Postoperatively, no secondary stabilization procedure was necessary for patients. Undoubtedly, long-term follow-up is needed to confirm these results because every decompressive procedure bears the risk of secondary instability, which may require further stabilization.

Conclusion

This unilateral approach for bilateral decompression has the advantages of postoperative instability prevention by preserving the contralateral facet joint and neural arch and substantial widening of the spinal canal. In addition, unilateral laminectomy for lumbar spinal stenosis is a less invasive technique and leads to favorable results in elderly patients with co-morbid conditions. We feel that this technique may be appropriate for elderly patients with moderate symptoms of lumbar spinal stenosis.

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