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Outcome of lumbar lateral recess stenosis with percutaneous endoscopic transforaminal decompression in patients 65 years of age or older and in younger patients

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Abstract

Lateral recess stenosis is a common pathology causing clinical syndromes in the elderly population, and there is some concern regarding the number of comorbidities that can occur when performing surgery for this condition in the elderly. However, little research has focused on the issues related to older age, and limited data is available to help the clinician counsel elderly patients undergoing percutaneous endoscopic transforaminal decompression. The present study aimed to explore the safety and efficacy of percutaneous endoscopic transforaminal decompression for lumbar degenerative disease in elderly patients with lumbar lateral recess stenosis and to determine whether age and comorbidity affect the outcome and complication rate.

We identified 117 patients in our patient database who underwent percutaneous endoscopic transforaminal decompression for single-level lumbar lateral recess stenosis. Data regarding the Oswestry Disability Index and visual analog scale for back and leg pain were collected preoperatively, postoperatively, and at the last follow-up. Other data, including preoperative comorbidities, operation time, and intraoperative and postoperative complications, were recorded.

The average follow-up period was 29.9 ± 5.5 months, with a mean age of 69.8 ± 5.4 years in elderly patients (group A) and 50.4 ± 6.4 years in younger patients (group B). Group A had a higher percentage of comorbidity than group B (83.9% vs 18.0%, $P < .001$). Both visual analog scale scores for leg pain and Oswestry Disability Index were significantly improved in the 2 groups, and no difference was found between the groups regarding both parameters ($P > .05$). The elderly patients had the same high rate of favorable outcomes as group B ($P > .05$). Moreover, there was no difference in surgical complications, recurrence, and neurologic deficit recovery rate between both groups. No major complications or perioperative deaths occurred in both groups.

The present study demonstrates that percutaneous endoscopic transforaminal decompression for lateral recess stenosis in elderly patients may be a reasonable treatment associated with substantial benefit.

Abbreviations: ODI = Oswestry Disability Index, VAS = visual analog scale.

Keywords: complications, elderly, lateral recess stenosis, minimally invasive spine surgery, percutaneous endoscopic transforaminal decompression, spinal stenosis

1. Introduction

Lumbar spinal stenosis is a common degenerative disorder in the elderly population that can lead to clinical syndromes such as neurogenic claudication or sciatica with or without low back pain. Anatomically, lumbar spinal stenosis is composed of 3 types: central stenosis, foraminal stenosis, and lateral recess stenosis. Lateral recess stenosis is usually caused by the herniation of the intervertebral disc, hyperplasia of the articular process, and hypertrophy of the ligamentum flavum.[1] Although clinical symptoms can be variable, this progressive disease causes chronic pain and functional impairment, resulting in limitations both in mobility and in the ability to perform activities of daily living.[2]

Long-term studies have demonstrated superior outcomes for surgery compared with conservative management.[3,4] However, many studies have emphasized the morbidity associated with surgical treatment of lumbar stenosis in the elderly population.[5–7] Furthermore, patients with greater medical comorbidity and functional disability are significantly less satisfied with the results of surgery for degenerative lumbar spinal stenosis.[8] In clinical decision-making, both patients and clinicians will have to consider the outcomes and risk factors associated with the given treatment.

With the improvement of instruments and techniques, minimally invasive techniques have recently been developed

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for the surgical treatment of lumbar spinal disease.[9,10] Percutaneous endoscopic transforaminal decompression is considered a safe and effective minimally invasive surgery for the treatment of lumbar degenerative disease.[11,12] The advantages of this procedure have been documented, such as the need for minimal skin incision, use of local anesthesia, non-requirement of excessive bone removal, and early return to ordinary life, thereby, reducing the risk of the procedure.[10,11] However, little research has focused on the issues related to older age, and limited data is available for helping the clinician counsel elderly patients undergoing surgery.

This study aimed to provide information about the safety and efficacy of percutaneous endoscopic transforaminal decompression for lumbar degenerative disease in elderly patients with the diagnosis of lumbar lateral recess stenosis. We therefore evaluated outcome measures, including the visual analog scale (VAS) pain scores, Oswestry Disability Index (ODI), and perioperative complications.

2. Patients and methods

The electronic medical records of all consecutive patients with lumbar lateral recess stenosis, who underwent transforaminal endoscopic surgery from October 2014 to September 2016, were retrospectively reviewed. All the patients underwent dynamic X-ray scattering, magnetic resonance imaging, and computed tomography before the operation to define the pathological type and diseased region. The patients were divided into 2 groups as follows: those 65 years of age or older (group A) and younger patients (group B). The inclusion criteria were as follows:

1. unilateral radicular pain or intermittent claudication as the main symptom;
2. imaging showing lumbar lateral recess stenosis in a single level or only 1 responsible level requiring treatment;
3. at least 3 months of conservative treatment before surgery; and
4. postoperative follow-up of more than 2 years.

The exclusion criteria were as follows:

1. prominent back pain (> 30/100 on the VAS);
2. imaging showing degenerative spondylolisthesis more than Meyerding Grade I or unstable vertebra or scoliosis more than 20 degrees;
3. prior surgery in the same segment; and
4. cauda equina syndrome. The study was approved by the ethics committee.

Postoperative follow-up was performed by regular outpatient care and by phone. Patient functions were evaluated using the VAS score for low back pain and leg pain, ODI, and the modified MacNab criteria before and after surgery, which were recorded as primary outcome. The data, including preoperative comorbidities, operation time, and intraoperative and postoperative complications, were recorded too.

All percutaneous endoscopic transforaminal decompression procedures were performed under local anesthesia (0.5% lidocaine) with the patient in a prone position on a radiographic table. The index level was identified under G-arm fluoroscopy and labeled. The skin entry point was generally 10 to 14 cm from the midline; the distance could also be premeasured on magnetic resonance imaging or computed tomography preoperatively. After infiltration of the entry point and the trajectory to facet with 10 mL of 0.5% lidocaine, a 2-mm Kirschner wire was inserted via a posterolateral approach. The Kirschner wire was attached on the tip of superior articular process (Fig. 1). In the lateral view, the Kirschner wire tip should point to the posterior rim of the upper endplate of the distal vertebra while the tip of the Kirschner wire in the anteroposterior view should point to the medial pedicular line. A stab incision was made on the skin to pass sequential serial dilators ending with a reamer which was used to enlarge the foramen by removing the ventral aspect of the superior articular process. An anteroposterior fluoroscopic view was used to verify that the tip of the reamer was not past the medial border of the pedicle. A 7.0-mm beveled working cannula was then placed outside of the foramina over the sequential dilators. After an endoscope was inserted through the cannula, the endoscopic power drill or reamer was used to remove the superior part of the facet joint, allowing the remaining hypertrophied ligamentum flavum contributing to the stenosis to be visualized and then removed using the biting forceps and holmium laser. A radiofrequency bipolar coagulator was used to coagulate bleeding vessels. When decompression was visually confirmed, the endoscope was removed.

The statistical analysis was performed using GraphPad Prism 6 (GraphPad Software, San Diego, CA) and Microsoft Excel (Microsoft, Redmond, WA). The data are reported as the mean ± standard deviation. Statistical analysis was first performed using paired t-tests and confirmed by nonparametric Wilcoxon signed-rank tests to assess the significance between preoperative and postoperative ODI values and VAS scores for low back pain and leg pain. For patients with multiple postoperative sets of outcome scores, the last set of outcome scores, that is, the longest duration of follow-up, was used. Significant differences between groups were determined using independent samples *t*-tests and Fisher exact test to evaluate the independence of categorical variables. Significance was set at $P < .05$.

3. Results

One hundred fifty-six patients who underwent transforaminal endoscopic surgery for single-level lumbar lateral recess stenosis within the study period were reviewed. Among these patients, 117 had a follow-up evaluation of ≥ 2 years. Reasons for loss to follow-up included loss of contact in 37 patients and death from other diseases in 2 patients whose families were contacted, and according to them, these deaths were due to natural causes and not a result of the procedure. The overall demographic characteristics of all patients and patients with follow-ups are similar. There were 56 patients in group A and 61 patients in group B. The demographic information for these patients is presented in Table 1.

The patients in group A had a mean age of 69.8 ± 5.4 years (range, 65–89) and a mean follow-up period of 29.9 ± 5.5 months (range, 24–47). The patients in group B had a mean age of 51.2 ± 5.1 years (range, 44–64) and a mean follow-up period of 31.3 ± 5.2 months (range, 24–46). The affected lumbar levels included L2–3 (n = 4), L3–4 (n = 11), L4–-5 (n = 26), and L5–S1 (n = 15) in group A compared with L2–3 (n = 2), L3–4 (n = 10), L4–5 (n = 31), and L5–S1 (n = 18) in group B. All patients had leg pain and 29 had low back pain. Neurologic deficits were found in 9 patients (16%) in group A and in 7 patients (11.5%) in group B, and included sensory deficit, motor weakness, or a combination of both. Comorbidities, including hypertension, chronic pulmonary obstructive disease, diabetes mellitus, coronary artery disease, cancer history, peptic ulcer disease, osteoporosis, osteoarthritis, etc (Table 2) were found in 47 patients (83.9%)

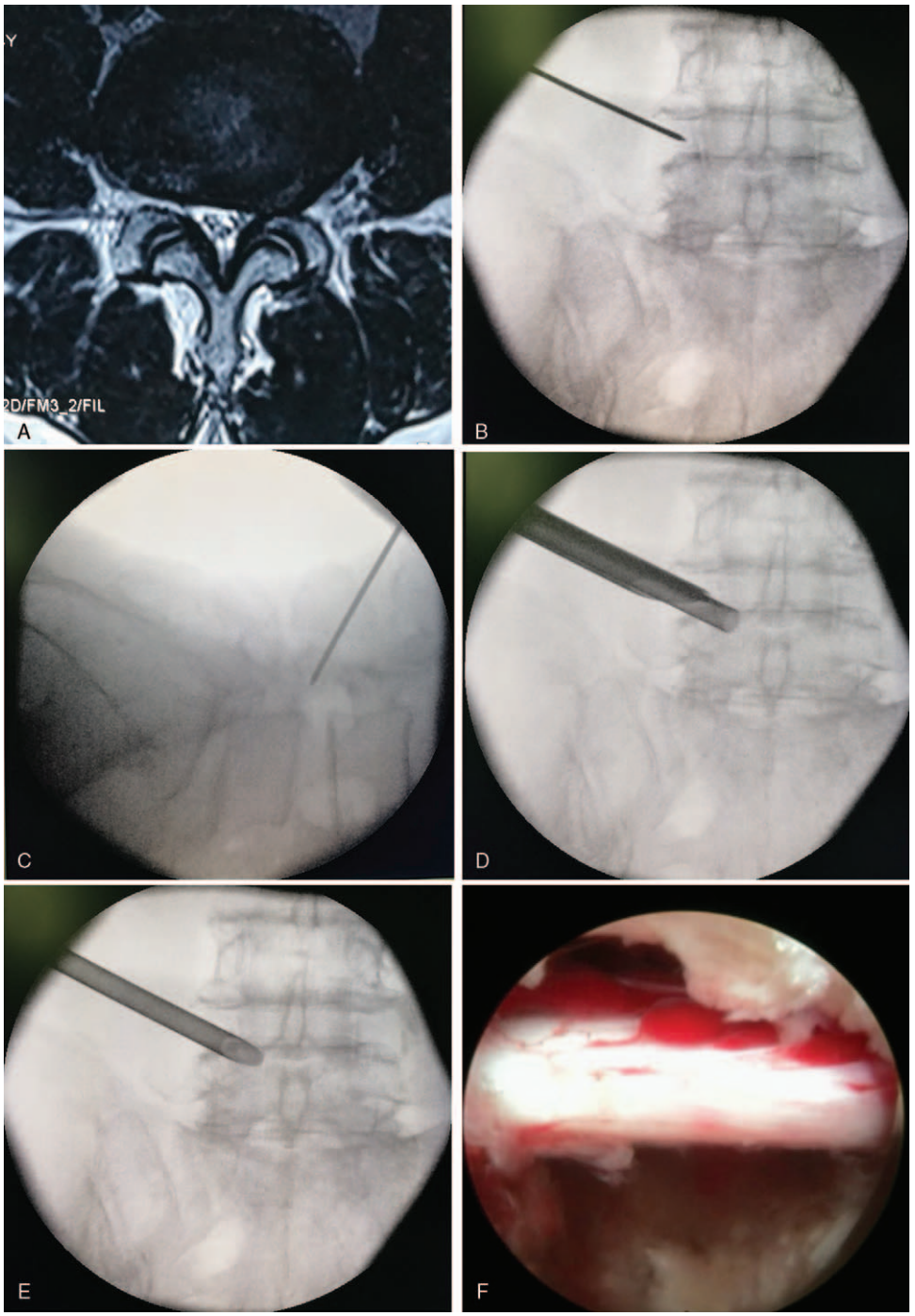

Figure 1. A. Magnetic resonance image showing L4/5 lateral recess stenosis (left). B. The Kirschner wire was attached to the tip of the superior articular process (lateral and anteroposterior view) C. A reamer was used to enlarge the foramen by removing the ventral aspect of the superior articular process. The tip of the reamer was not allowed to get over the medial border of the pedicle, and this was verified via fluoroscopy (anteroposterior view). D. The working cannula was placed though the foramina. E. The dorsal and ventral decompressions were completed around the nerve root. F. Decompression was confirmed.

in group A, while only 11 patients (18.0%) in group B had comorbidities. The comorbidity rate between the 2 groups was significantly different ($P < .001$). The operation time was 81.6 ± 21.3 minutes (range, 44–132) in group A and 79.6 ± 26.4 minutes (range, 41–136) in group B ($P = .650$)

No comorbidity-related adverse event occurred in the perioperative period in elderly or younger patients. No major complications or perioperative deaths occurred in both groups. There was no difference between the groups regarding surgery-related mild complication. Mild surgical complications occurred in 8 patients (3 [5.4%] patients in group A; 5 [8.2%] patients in group B, $P = .547$), including dural tears in 3 patients, but no patient underwent revision surgery and there were no residual problems from the tears. Five patients presented with temporary leg numbness but experienced full recovery in 2 weeks.

Table 1

Overall demographic characteristics of patients in the 2 groups.

	Group A (N = 56)	Group B (N = 61)	*P*-value
Age (yr)	69.7 ± 5.4	51.2 ± 5.1	<.001
Gender, male	23 (41.1%, 70.2 ± 5.4*)	28 (45.9%, 51.3 ± 5.8)	.602
Follow-up (mo)	29.9 ± 5.5	31.3 ± 5.2	.067
Preop. VAS (leg)	6.5 ± 1.0	6.3 ± 1.1	.484
Preop. VAS (back)	1.0 ± 1.1	0.8 ± 0.7	.220
ODI	62.4 ± 12.9	60.9 ± 13.2	.288
Comorbidities	47 (83.9%)	11 (18%)	<.001

Values are presented as mean ± SD or as numbers (%).
* Mean age of male patients.
ODI = Oswestry Disability Index, VAS = visual analog scale.

The clinical outcome analysis demonstrated that at the midterm follow-up assessment, both leg pain VAS scores and ODI were significantly improved in the 2 groups (group A: leg pain VAS from 6.5 ± 1.0–1.0 ± 1.1; ODI from 62.4 ± 12.9–15.4 ± 12.1, $P < .001$; group B: leg pain VAS from 6.3 ± 1.1–1.3 ± 1.1; ODI from 60.9 ± 11.3–16.3 ± 9.5, $P < .001$). No significant difference was found between the groups in the change in leg pain VAS or ODI ($P > .05$). There were no significant differences in the improvement of back pain in the 2 groups (group A: from 1.0 ± 1.1–0.9 ± 1.2, $P = .509$; group B: from 0.9 ± 0.8–0.8 ± 0.7, $P = .360$).

During the follow-up period, 7 patients developed recurrence (3 in group A and 4 in group B), and 1 patient in each group underwent revision surgery. The final VAS and ODI after the revision surgery were included. The others received conservative management. Of the 9 patients in group A with neurologic deficit, 7 recovered while residual deficit was present in 2 patients. In group B, 6 in 7 patients with neurologic deficit recovered. Based on the modified MacNab criteria, 42 patients had excellent results, 10 had good results, 2 had fair results, and 2 patients had poor results in group A. A favorable outcome (excellent or good, n = 52) occurred in 93% of the patients (Table 3). While a favorable outcome occurred in 91.8% (56 in 61) in group B. No significant difference in favorable outcome was found between the 2 groups ($P = .547$).

4. Discussion

As the number of elderly persons continues to increase, an associated increase in age-related spine diseases, such as spinal stenosis, is expected, and there is notable interest concerning how to correctly manage the treatment of these patients. Because of high success rates, surgical treatment of the spinal stenosis in the elderly is undertaken.[3,4,7,13] However, a more complex set of issues, such as comorbidity, may adversely affect outcomes.[5,6] Thus, both the risks and benefits of each aspect of a surgical procedure need to be weighed carefully.

Table 2

Distribution of comorbidities.

Comorbidity	Group A (N = 56)	Group B (N = 61)
Hypertension	19 (33.9%)	7 (11.5%)
Osteoporosis	17 (30.3%)	5 (8.2%)
Osteoarthritis	17 (30.3%)	6 (9.8%)
Diabetes mellitus	16 (28.6%)	4 (6.6%)
Peptic ulcer disease	11 (19.6%)	2 (3.3%)
Coronary artery/cardiac disease	7 (12.5%)	2 (3.3%)
Chronic pulmonary obstructive disease	6 (10.7%)	1 (1.6%)
Cerebrovascular disease	6 (10.7%)	0
Cancer history	3 (5.3%)	0
Parkinson disease	2 (3.5%)	0

Values are presented as numbers (%).

Table 3

Distribution of patients with respect to outcome.

Outcome	Group A (N = 56)	Group B (N = 61)
Excellent	42 (75.0%)	47 (77.0%)
Good	10 (17.9%)	9 (14.8%)
Fair	2 (3.5%)	3 (4.9%)
Poor	2 (3.5%)	2 (3.3%)

Values are presented as numbers (%).

There is a concern about the number of comorbidities that can occur when performing surgery on the elderly. However, this study showed a high success rate with few mild complications in the elderly and no difference compared to younger patients. None of the deaths following surgery was as a result of the percutaneous endoscopic transforaminal decompression procedure. Although this was a midterm study, decompression procedures are known to have immediate results and relief of pain, so a follow-up of longer than 2 years is reasonable. A comparison of preoperative and postoperative VAS scores showed that there was a significant decrease in postoperative VAS of leg pain with a mean difference of 5.5 in the elderly group, and a mean improvement of 42 points in the ODI score in this group indicated marked reduction in disability. A favorable outcome occurred in 93% of the elderly patients that underwent the procedure; other studies that evaluated surgical outcome with open decompression surgery in the elderly had findings similar to ours.[6,7,13,14] Moreover, a previous study indicated that decompression procedures have immediate results and relief of pain in a short time.[15,16] The present comparative study showed that elderly patients could also achieve the same satisfactory outcome as younger patients.

However, major complications such as wound infection, urinary retention, gastric ulcer, pneumonia, and stroke and minor complications such as delirium, urinary tract infections, and postoperative dysesthesia may be very common after open decompression surgery in elderly patients.[6,13,17,18] Although the present elderly group had a significantly higher percentage of comorbidities than younger patients, the rate of complications was not significantly higher in the elderly group. In the study, perioperative complications did not appear to adversely affect clinical and health-related quality-of-life outcomes in the follow-up period. These results suggest that age or comorbidity should not be a factor for determining whether percutaneous endoscopic transforaminal decompression is suitable for patients with lumbar lateral recess stenosis.

In the past decade, percutaneous endoscopic transforaminal lumbar discectomy has been proven to be a safe and effective procedure in the treatment of lumbar disc herniation.[19,20] This procedure can provide the advantages of a truly minimally invasive procedure and allows the use of local anesthesia. With the development of instruments and minimally invasive techniques, spinal stenosis is considered a new indication for percutaneous endoscopic transforaminal decompression.[21–23] The possible advantages of transforaminal endoscopic surgery have been

severally described, including the small incision, minimal internal tissue damage, and short rehabilitation period.[11,21,23,24] Previous studies seem to suggest that after transforaminal endoscopic surgery, 73.4% to 93.4% of the patients experience a satisfactory outcome.[15,16,25–27] Further, the procedure can be performed under local anesthesia and conscious sedation, thereby, avoiding the risk of general anesthesia, especially for elderly. To the authors' knowledge, the present study is the first reported series of elderly patients with lumbar lateral recess stenosis undergoing surgical decompression using percutaneous endoscopic transforaminal decompression, and our findings suggest that elderly patients with high percentage of comorbidity would not experience increased complications and that similar satisfactory outcomes can be achieved in both elderly and younger patients.

Some previous studies indicate that the percutaneous endoscopic lumbar discectomy technique has a "steep" learning curve, which can be overcome with training and suitable patient selection.[28–30] However, most previous studies were focused on lumbar disc herniation. Only a few studies have focused on the learning curve for percutaneous endoscopic transforaminal decompression in patients with lumbar lateral recess stenosis. The procedure would be more complicated because of the more complex pathogenic mechanism. Recently, Lee et al found that even for the experienced surgeon, percutaneous full endoscopic surgery for spinal stenosis decompression had a steep learning curve, and longer operative times and higher complication rates in the early stage were observed.[31] Nevertheless, the steep learning curve did not affect the postoperative clinical outcomes, which showed favorable clinical outcomes, even in the early stages of the learning curve.

Furthermore, choosing the right patient with lateral recess stenosis is very important for obtaining a good outcome. Although both interlaminar and transforaminal approaches for percutaneous endoscopic decompression are applied for the treatment of lateral recess stenosis, there are specific differences in their technical features and advantages.[32,33] The transforaminal approach can achieve good horizontal decompression, from foramen to intraspinal, while the interlaminar approach is more feasible if decompression is required for central and lateral recess stenoses. The transforaminal approach can be performed under local anesthesia but the interlaminar approach and decompression usually require general or epidural anesthesia, which may increase the risk, especially for elderly patients with comorbidities. However, the high iliac crest may be a barrier for the transforaminal approach in the L5–S1 level in certain cases. Li et al compared endoscopic decompression for lumbar lateral recess stenosis via the interlaminar and transforaminal approach[33] and found that both the interlaminar and transforaminal approaches could obtain satisfactory clinical outcomes. While the interlaminar approach has a shorter operation time and lesser intraoperative radiation exposure, it has a higher anesthetic compared with the transforaminal approach. In our institute, the transforaminal approach is the preferred option for lateral recess stenosis decompression if there is no obvious compression from a central stenosis, not only for the reduced anesthetic risk but also for the lower cost.

The weaknesses of the present study are related to its retrospective design, small patient size, and follow-up duration. First, the present study lacked a control group of conservatively managed patients or patients that underwent open surgery. Furthermore, the present series did not include any perioperative deaths, and our small sample size was insufficiently powered to identify the impact of percutaneous endoscopic transforaminal decompression on fatality rate. Finally, the duration of the follow-up period varied between patients, with a mean of 30.9 months.

5. Conclusions

The present study showed that percutaneous endoscopic transforaminal decompression for lateral recess stenosis was effective for both elderly and younger patients. percutaneous endoscopic transforaminal decompression may be a reasonable treatment associated with substantial benefit for elderly patients who have a high percentage of comorbidity. Patients who were previously not considered eligible for lumbar spinal surgery may be given access to this treatment.

Author contributions

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Supervision: Chunbao Yang, Jixian Qian.
Writing – original draft: Xiaoxiang Li, Tao Liu.
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