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

Xiaoxiang Li, MD, Tao Liu, MD, PhD, Junjun Fan, MD, Hongtao Zhang, MD, Chunbao Yang, MD, Xin Yin, MD, Haoran Gao, MD, Jixian Qian, MD, PhD, Siguo Sun, MD, PhD

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. 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. Long-term studies have demonstrated superior outcomes for surgery compared with conservative management. However, many studies have emphasized the morbidity associated with surgical treatment of lumbar stenosis in the elderly population. Furthermore, patients with greater medical comorbidity and functional disability are significantly less satisfied with the results of surgery for degenerative lumbar spinal stenosis. In clinical decision-making, both patients and clinicians will have to consider the outcomes and risk factors associated with the given treatment.
for the surgical treatment of lumbar spinal disease.\textsuperscript{9,10} Percutaneous endoscopic transforaminal decompression is considered a safe and effective minimally invasive surgery for the treatment of lumbar degenerative disease.\textsuperscript{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.\textsuperscript{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%)...
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.

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.
overall demographic characteristics of patients in the 2 groups.

| Age (yr) | Group A (N=56) | Group B (N=61) | P-value |
|----------|----------------|----------------|---------|
| 69.7±5.4 | 51.2±5.1       | <.001          |
| Gender, male | 23 (41.1%) | 28 (45.9%) | .002 |
| 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 (%).

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.

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

Table 2

| Comorbidity                        | Group A (N=56) | Group B (N=61) |
|------------------------------------|----------------|----------------|
| Hypertension                       | 19 (33.9%)     | 7 (11.5%)      |
| Osteoporosis                       | 17 (30.3%)     | 5 (6.2%)       |
| 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

| 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 (%).
Several 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. 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.

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 are applied for the treatment of lateral recess stenosis, there are specific differences in their technical features and advantages. The transforaminal approach can achieve good horizontal decompression, from foramem 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 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

Conceptualization: Siqiu Sun, Xiaoxiang Li, Tao Liu.
Data curation: Junjun Fan.
Formal analysis: Tao Liu, Junjun Fan.
Investigation: Hongtao Zhang.
Methodology: Xiaoxiang Li, Hongtao Zhang, Xin Yin.
Project administration: Chunbao Yang, Xin Yin, Haoran Gao.
Resources: Haoran Gao.
Supervision: Chunbao Yang, Jixian Qian.
Writing – original draft: Xiaoxiang Li, Tao Liu.
Writing – review & editing: Jixian Qian.

References

[1] Amundsen T, Weber H, Lillegard F, et al. Lumbar spinal stenosis. clinical and radiologic features. Spine (Phila Pa 1976) 1995;20:1178–86.
[2] Rampersaud YR, Ravi B, Lewis SJ, et al. Assessment of health-related quality of life after surgical treatment of focal symptomatic spinal stenosis compared with osteoarthritis of the hip or knee. Spine J 2008;8:296–304.
[3] Malmivaara A, Slatis P, Heliovaara M, et al. Surgical or nonsurgical treatment for lumbar spinal stenosis? A randomized controlled trial. Spine (Phila Pa 1976) 2007;32:1–8.
[4] Weinstein JN, Tosteson TD, Lurie JD, et al. Surgical versus nonsurgical therapy for lumbar spinal stenosis. N Engl J Med 2008;358:794–810.
[5] Cassinelli EH, Eubanks J, Vogt M, et al. Risk factors for the development of perioperative complications in elderly patients undergoing lumbar decompression and arthrodesis for spinal stenosis: an analysis of 166 patients. Spine (Phila Pa 1976) 2007;32:230–5.
[6] Jakola AS, Sorlie A, Gullari S, et al. Clinical outcomes and safety assessment in elderly patients undergoing decompressive laminectomy for lumbar spinal stenosis: a prospective study. BMC Surg 2010;10:34.
[7] Kalbarczyk A, Lukas A, Seiler RW. Surgical treatment of lumbar spinal stenosis in the elderly. Acta Neurochir (Wien) 1998;140:637–41.
[8] Katz JN, Lipson SJ, Brick GW, et al. Clinical correlates of patient satisfaction after laminectomy for degenerative lumbar spinal stenosis. Spine (Phila Pa 1976) 1995;20:1155–60.
[9] Asgarzadeh F, Khoos I.T. Minimally invasive operative management for lumbar spinal stenosis: overview of early and long-term outcomes. Orthop Clin North Am 2007;38:387–99.
[10] Eun SS, Lee SH, Sabal LA. Long-term follow-up results of percutaneous endoscopic lumbar discectomy. Pain Physician 2016;19:E1161–6.
[11] Nellenstein J, Ostelo R, Barret R, et al. Transforaminal endoscopic surgery for symptomatic lumbar disc herniation: a systematic review of the literature. Eur Spine J 2010;19:181–204.
[12] Choi KC, Kim JS, Park CK. Percutaneous endoscopic lumbar discectomy as an alternative to open lumbar microdiscectomy for large lumbar disc herniation. Pain Physician 2016;19:E291–300.
[13] Sapalski M, Gunzburg K. Lumbar spinal stenosis in the elderly: an overview. Eur Spine J 2003;12(Suppl 2):S170–5.
[14] Ragab AA, Fye MA, Bohlman HH. Surgery of the lumbar spine for spinal stenosis in 118 patients 70 years of age or older. Spine (Phila Pa 1976) 2003;28:348–53.

[15] Li ZZ, Hou SX, Shang WL, et al. Percutaneous lumbar foraminoplasty and percutaneous endoscopic lumbar decompression for lateral recess stenosis through transfemoral approach: technique notes and 2 year follow-up. Clin Neurol Neurosurg 2016;143:90–4.

[16] Wen B, Zhang X, Zhang L, et al. Percutaneous endoscopic transfemoral lumbar spinal canal decompression for lumbar spinal stenosis. Medicine (Baltimore) 2016;95:e5186.

[17] Carreon LY, Puno RM, Dimar JR2nd, et al. Perioperative complications of posterior lumbar decompression and arthrodesis in older adults. J Bone Joint Surg Am 2003;85-A:2089–92.

[18] Cloyd JM, Acosta FLJr, Ames CP. Complications and outcomes of lumbar spine surgery in elderly people: a review of the literature. J Am Geriatr Soc 2008;56:1318–27.

[19] Ruettten S, Komp M, Merk H, et al. Full-endoscopic interlaminar and transfemoral lumbar discectomy versus conventional microsurgical technique: a prospective, randomized, controlled study. Spine (Phila Pa 1976) 2008;33:931–9.

[20] Yeung AT, Tsou PM. Posterolateral endoscopic excision for lumbar disc herniation: surgical technique, outcome, and complications in 307 consecutive cases. Spine (Phila Pa 1976) 2002;27:722–31.

[21] Polikandriotis JA, Hudak EM, Perry MW. Minimally invasive surgery through endoscopic laminotomy and foraminotomy for the treatment of lumbar spinal stenosis. J Orthop 2013;10:13–6.

[22] Siepe CJ, Sauer D, Michael Mayer H. Full endoscopic, bilateral over-the-top decompression for lumbar spinal stenosis. Eur Spine J 2018;27(Suppl 4):S63–5.

[23] Youn MS, Shin JK, Goh TS, et al. Endoscopic posterior decompression under local anesthesia for degenerative lumbar spinal stenosis. J Neurosurg Spine 2018;1–6.

[24] Kamson S, Tresco AM, Sampson PD, et al. Full-endoscopic assisted lumbar decompressive surgery performed in an outpatient, ambulatory facility: report of 5 years of complications and risk factors. Pain Physician 2017;20:E221–31.

[25] Hwa Eum J, Hwa Heo D, Son SK, et al. Percutaneous biportal endoscopic decompression for lumbar spinal stenosis: a technical note and preliminary clinical results. J Neurosurg Spine 2016;24:602–7.

[26] Kim HS, Paudel B, Jang JS, et al. Percutaneous full endoscopic bilateral lumbar decompression of spinal stenosis through uniportal-contralateral approach: techniques and preliminary results. World Neurosurg 2017;103:201–9.

[27] Wang Y, Dou Q, Yang J, et al. Percutaneous endoscopic lumbar decompression for lumbar lateral spinal canal stenosis: classification of lateral region of lumbar spinal canal and surgical approaches. World Neurosurg 2018;119:e276–83.

[28] Fan G, Gu X, Liu Y, et al. Lower learning difficulty and fluoroscopy reduction of transfemoral percutaneous endoscopic lumbar discectomy with an accurate preoperative location method. Pain Physician 2016;19:E1123–34.

[29] Wang H, Huang B, Li C, et al. Learning curve for percutaneous endoscopic lumbar discectomy depending on the surgeon’s training level of minimally invasive spine surgery. Clin Neurol Neurosurg 2013;115:1987–91.

[30] Hsu HT, Chang SJ, Yang SS, et al. Learning curve of full-endoscopic lumbar discectomy. Eur Spine J 2013;22:727–33.

[31] Lee CW, Yoon KJ, Kim SW. Percutaneous endoscopic decompression in lumbar canal and lateral recess stenosis – the surgical learning curve. Neurospine 2019;16:63–71.

[32] Ahn Y. Percutaneous endoscopic decompression for lumbar spinal stenosis. Expert Rev Med Devices 2014;11:605–16.

[33] Li Y, Wang B, Wang S, et al. Full-endoscopic decompression for lumbar lateral recess stenosis via an interlaminar approach versus a transfemoral approach. World Neurosurg 2019;128:e632–8.