Retrospective Review

Awake, Transforaminal Endoscopic Lumbar Spine Surgery in Octogenarians: Case Series

Albert E. Telfeian, MD, PhD[1], Rahul Sastry, MD[1], Adetokunbo Oyelese, MD, PhD[1], Jared Fridley, MD[1], Joaquin Q. Camara-Quintana, MD [1], Tianyi Niu, MD[1], Prakash Sampath, MD[1], Kai-Uwe Lewandrowski, MD[2], Kyle Mueller, MD[1], and Ziya L. Gokaslan, MD[1]

From: [1]Department of Neurosurgery, Rhode Island Hospital, The Warren Alpert Medical School of Brown University, Providence, RI; [2]Center for Advanced Spine Care of Southern Arizona, Tucson, AZ

Address Correspondence:
Albert E. Telfeian, MD, PhD
Department of Neurosurgery
Rhode Island Hospital
593 Eddy Street
Providence, RI 02903
E-mail: ATelfeian@Lifespan.org

Disclaimer: There was no external funding in the preparation of this manuscript.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 09-01-2021
Revised manuscript received: 11-08-2021
Accepted for publication: 11-17-2021

Free full manuscript: www.painphysicianjournal.com

Background: Optimal approaches for treating surgical spine pathology in very geriatric patients, such as those over the age of 80, remain unclear.

Objective: To describe outcomes of awake, transforaminal endoscopic surgical treatment for patients 80 years old and older presenting with lumbar radiculopathy.

Study Design: Retrospective case review.

Methods: The records of 52 consecutive patients who underwent awake transforaminal lumbar endoscopic decompression surgery performed by a single surgeon at a single institution between 2014 and 2019 were retrospectively reviewed. All included patients were followed for at least one year after surgery.

Results: Transforaminal surgeries performed were discectomies (21), foraminotomies (7), redo foraminotomies post-laminectomy (5), fusion explorations (13), facet cyst resections (3), spondylolisthesis decompressions (2), and a decompression for metastatic disease (1). Seven patients (13.5%) required repeat surgery at the treated level during the one-year follow-up. For the remaining 45 patients, at one-year follow-up, preoperative visual analog scale (VAS) for leg pain and Oswestry disability index (ODI) improved from 6.9 (± 1.4) and 40.5% (± 11.5) to 1.8 (± 1.4) and 12.0% (± 10.8), respectively. The only complication of the procedure was a single durotomy (2%).

Limitations: Single-center, retrospective case review with a relatively small number of cases with diverse clinical pathology. A multi-center case study with a larger number of patients with a more homogeneous case pathology would be more revealing.

Conclusions: Endoscopic spine surgery offers octogenarians a safe and effective option for the treatment of lumbar degenerative spine disease and may represent a valuable treatment strategy in a growing patient population.

Key words: Endoscopic discectomy, transforaminal, TESSYS, radiculopathy, octogenarian

Pain Physician 2022: 25:E255-E262

The number of American adults aged 65 or greater is projected to double to approximately 98 million by the year 2060 (1). Given the largely progressive nature of degenerative spine pathologies, it is expected that the overall aging of the population will also result in a commensurate increase in demand and health care utilization related to spinal pathologies (2). Accordingly, contemporary health care systems have already seen an increase in the overall utilization of spine surgery over the last 2 decades; however, the specific distribution of surgical procedures, which range from minimally to maximally invasive, has also varied substantially and

cannot only be explained by the increased demand of an aging population (3-5). Optimal approaches to very geriatric patients, such as those over the age of 80, remain unclear. It is well established that, even at ages 80 and older, spine-related pathologies are a major source of disability and that surgical management of these pathologies can be both efficacious and cost-effective (6-8). In general, surgical procedures and in spine surgery specifically, octogenarians are known to be at significantly higher risk of complications, which, especially in patients with comorbid frailty, is associated with an increased risk of perioperative mortality (9-11). Furthermore, surgery in the geriatric is also associated with medium- to long-term neurocognitive and functional decline (12-13). It stands to reason that factors such as the utilization of general anesthesia, the invasiveness of surgery, and the discharge of an geriatric patient to home and not to a nursing facility may have a large impact both on the natural history of spine-related disability and overall long-term health. Within this context, endoscopic spine surgery, in which a minimally invasive approach is undertaken without general anesthesia, is an attractive option in this particular patient population. As such, the aim of this clinical investigation was to evaluate the efficacy of and complications associated with endoscopic spine surgery in an octogenarian population.

Methods

The protocol for this study was reviewed by the Institutional Review Board of Rhode Island Hospital (Providence, RI). The records of 52 consecutive patients aged 80 or greater who underwent endoscopic lumbar spine surgery for a chief complaint of lumbar radiculopathy between 2014 and 2019 were reviewed. Only patients for whom one year of follow-up was available were included. All procedures were conducted in the prone position with local anesthesia and sedation by a single surgeon (AT) using the Joimax TESSYS endoscopic system (Irvine, California, USA). The procedures were classified on the basis of underlying pathology. All patients were asked to complete the visual analog scales (VAS) for leg pain and the Oswestry Disability Index (ODI) routinely as part of their standard pre- and postoperative evaluation.

Case Examples

Case 1

A 96-year-old male veteran with a prior history of an L4-5 laminectomy who presented with a right foot drop. An MRI demonstrated the previous laminectomy at L4-5, grade 1 spondylolisthesis, and a right-sided juxta-facet cyst compressing the right L5 nerve (Fig. 1). A flexion-extension spine x-ray was performed and revealed no instability. A right lumbar 4-5 transforaminal endoscopic foraminotomy and facet cyst resection were therefore performed (Fig. 1C-D and Fig. 2). The patient had immediate relief of his radicular pain, and his foot drop improved from 0/5 to 4+/5. At one-year follow-up, his VAS and ODI improved from 7 and 40 to 2 and 12, respectively.

Case 2

An 85-year-old man who presented with a left L3-4 radiculopathy and metastatic prostate disease. MRI demonstrated metastatic infiltration and severe left lumbar 3-4 foraminal stenosis (Fig. 3). A left lumbar 3-4 endoscopic foraminotomy and resection of the retropulsed L4 vertebral endplate were performed. The patient was able to ambulate immediately after the procedure and no longer needed the use of his cane. At one-year follow-up, his VAS for leg pain and ODI improved from 5 and 30 to 0 and 6, respectively.

Case 3

The patient is an 81-year-old male who presented with a right lumbar 4-5 radiculopathy after a lateral fusion. MRI demonstrated a right lumbar 4-5 foraminal/far lateral disc herniation (Fig. 4). A right lumbar 4-5 transforaminal endoscopic discectomy was performed. The approach inadvertently violated the dura. The beveled tubular retractor and endoscope were turned away from the dura so the discectomy could be completed. An Integra Duragen patch was placed at the end of the case, and a 3-month postoperative MRI showed resolution of the disc herniation and the area of dura violated (Fig. 4). The patient had no symptoms referrable to the durotomy. At one-year follow-up, his VAS for leg pain and ODI improved from 7 and 42 to 2 and 12, respectively.

Case 4

An 88-year-old female who had undergone a Lumbar 4-Sacral 1 instrumented fusion presented with signs and symptoms of a left L3-4 radiculopathy. MRI demonstrated a left L3-4 foraminal disc herniation and foraminal stenosis (Fig. 5). A left lumbar 3-4 transforaminal discectomy and foraminotomy were performed. Figure 5 demonstrates the blunt-tipped manual side-shaving drill used to perform the foraminotomy and the position of the tubular retractor. At one-year follow-up,

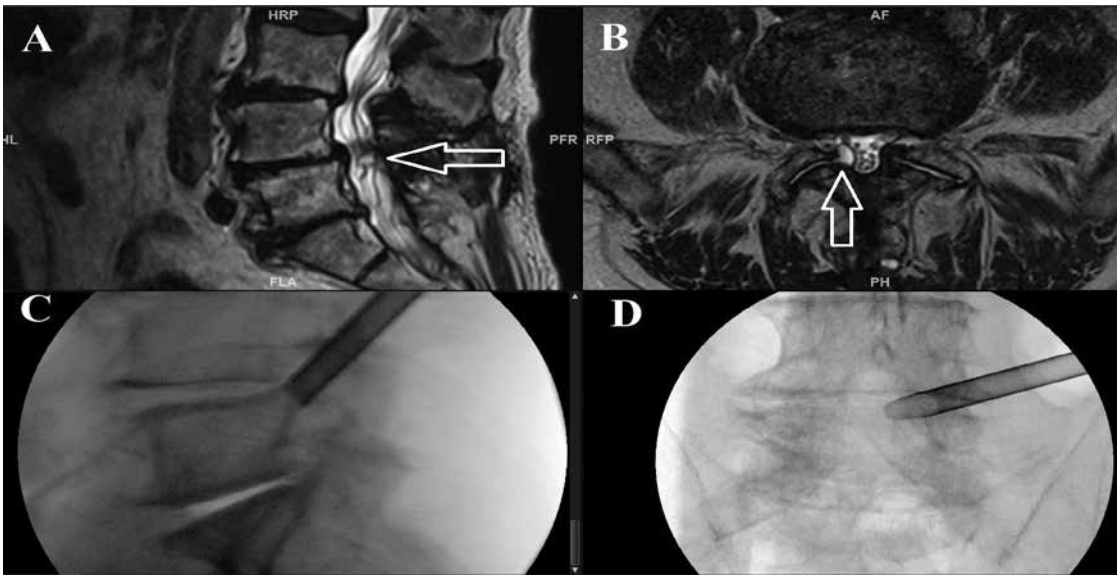

Fig. 1. *Preoperative lumbar MRI demonstrating a right L4-5 facet cyst post-laminectomy and the fluoroscopic images from the surgery.* A. *Sagittal T2-weighted MR image demonstrating the right L4-5 facet cyst (open arrow) compressing the right L5 nerve.* B. *T2-weighted axial MR image demonstrating the right L4-5 facet cyst (open arrow) and the previous laminectomy.* C. *Lateral and B. AP fluoroscopic images the position of the beveled tubular retractor in the right L4-5 foramen.*

Fig. 2. *Endoscopic camera views of a transforaminal endoscopic decompression of a right L4-5 facet cyst post-laminectomy.* A. *Endoscopic camera view of the right L4-5 foramen with a ball probe palpating the medial wall of the right L5 pedicle.* B. *Endoscopic camera view of the Shrill drill performing a foraminotomy at the superior portion of the right L5 pedicle and the ventral portion of the superior articulating process.* C. *Endoscopic camera view of the endoscopic grasper removing the facet cyst.*

her VAS for leg pain and ODI improved from 6 and 32 to 2 and 6, respectively.

Results

Fifty-two patients aged 80 years and older underwent transforaminal endoscopic surgery for treatment of radiculopathy in the 5-year period evaluated. Transforaminal surgeries performed were discectomies (21), foraminotomies (7), redo foraminotomies post-laminectomy (5), fusion explorations (13), facet cyst resections (3), spondylolisthesis decompressions (2), and a decompression for metastatic disease (1). Levels treated

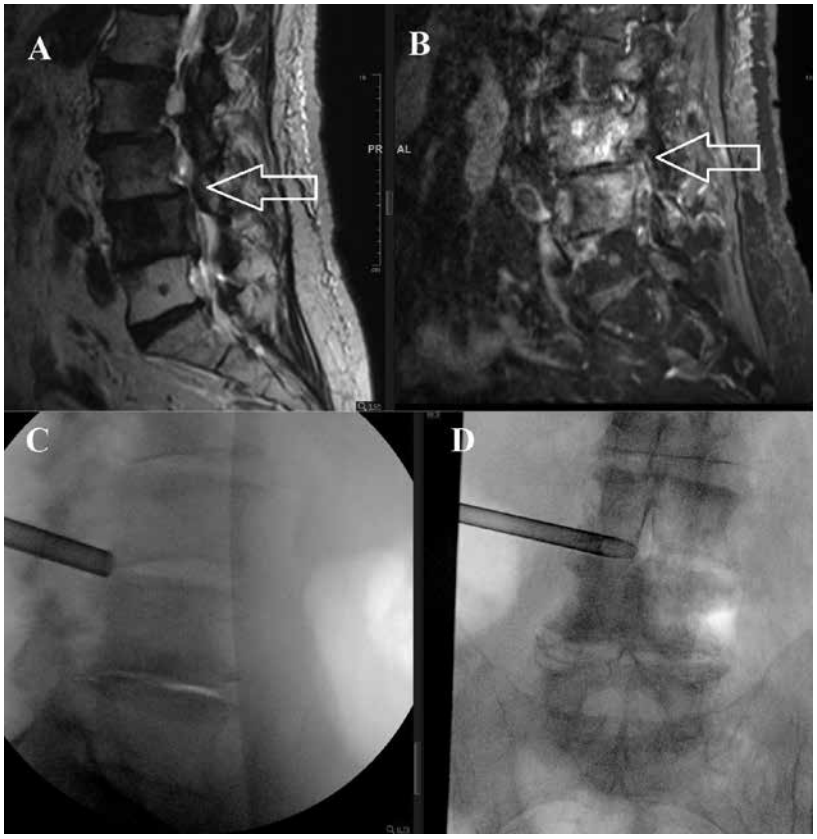

Fig. 3. *Left lumbar 3-4 transforaminal decompression for metastatic prostate disease.* A. *Sagittal T2 weighted MR image demonstrating the left lumbar 3-4 foraminal retrolisthesis and foraminal encroachment.* B. *Sagittal T1-weighted image demonstrating the contrast enhancement of the lumbar 3 and lumbar 4 vertebral bodies.* C. *Lateral fluoroscopic image of the beveled tubular retractor in the foramen.* C. *AP fluoroscopic image of the beveled tubular retractor in the foramen.*

were: L2-3 (4 cases), L3-4 (11 cases), L4-5 (20 cases), L5-S1 (13 cases), and L4-5, L5-S1 (4 cases). Seven patients (13.5%) required repeat surgery at the treated level during the 1-year follow-up (Table 1). Four patients were treated with adjacent segment disease; 2 (50%) of these patients failed within a year. For the remaining 45 patients, at one-year follow-up, preoperative VAS for leg pain and ODI improved from 6.9 (± 1.4) and 40.5% (± 11.5) to 1.8 (± 1.4) and 12.0% (± 10.8). There were no complications in this subset of patients except for a durotomy that occurred in an 81-year-old male. This patient was discharged home on the day of surgery without complaint of headache or other symptoms related to durotomy. There were no infections. All patients went home the day of surgery, and there were no readmissions within a year of surgery.

Failures

Seven patients required repeat surgery in the one-year postoperative period. Two cases were patients with far lateral discs who needed repeat endoscopic procedures. One case was a discectomy above, and one case was a discectomy below a multilevel instrumented fusion; those patients required an extension of the fusion for the discectomy above the fusion and a repeat endoscopic discectomy for the discectomy below the fusion. One case was a fusion exploration for a pedicle screw fusion without interbody fusion. In this case, the patient's symptoms recurred after endoscopic discectomy, and a repeat discectomy and a transforaminal lumbar interbody fusion (TLIF) were performed. One patient had a foraminotomy for a lumbar 4-5 spondylolisthesis, and that patient required a hemilaminectomy at the same site during the one-year follow-up. One patient had a 2 level foraminotomy in the setting of a severe coronal scoliosis. The patient did not improve with endoscopic surgery and was referred for a deformity surgery.

Discussion

Health care demand related to degenerative spine conditions will likely become increasingly prevalent in geriatric patients in the coming decades. Although operative risks are influenced by a variety of physiologic

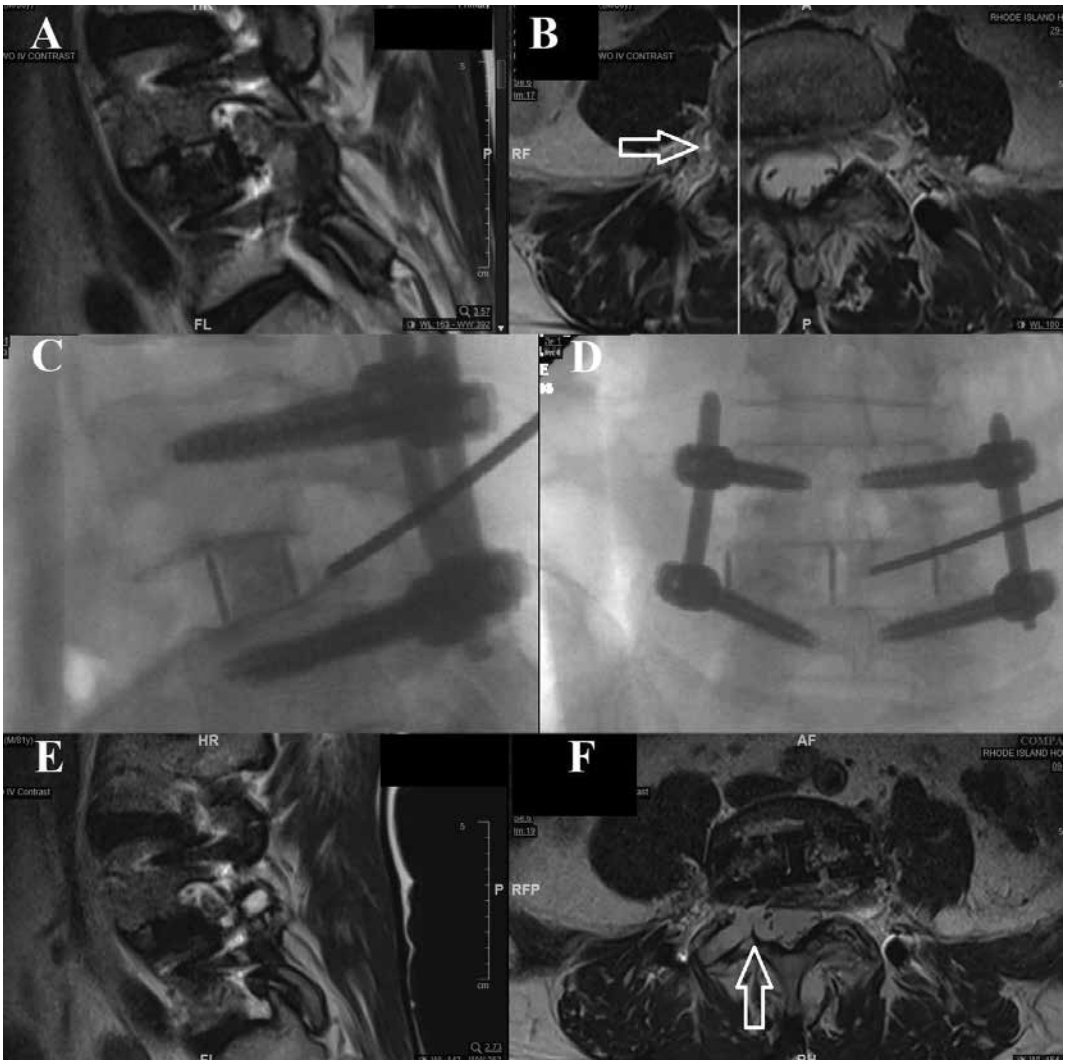

Fig. 4. *Transforaminal decompression of a right lumbar 4-5 foraminal/far lateral disc herniation after a L4-5 LLIF from the contralateral side.* A. *Sagittal T2-weighted MR image depicting the disc herniation in the right L4-5 foramen.* B. *Axial T2-weighted MR image depicting the disc herniation in the right L4-5 foramen.* C. *Lateral and* D. *AP fluoroscopic images of the initial dilator demonstrating the approach used to access the disc.* E. *Sagittal and* F. *Axial T2-weighted MR images taken 3 months after surgery, demonstrating the resolution of the disc herniation but the violation of the dura.*

factors and comorbid medical conditions, advanced age and the invasiveness of surgical intervention are both certainly associated with perioperative morbidity and mortality. As such, there is a significant potential for minimally invasive decompressive surgery, when indicated, for the management of spinal pathologies in this patient population. Endoscopic lumbar transforaminal decompression, which allows for decompression of foraminal pathology with minimal soft tissue disruption and anesthetic requirements, clearly fits this paradigm. In this series of 52 consecutive patients over the age of 80 treated via an awake endoscopic transforaminal approach, we report clinically and statistically significant reductions in both ODI and VAS with a 13.5% reoperation rate and one major complication (durotomy). One hundred percent of patients were discharged home on the day of their initial procedure, and none were readmitted. There were no infections over the course of follow-up. The results are largely comparable to results observed in a similar series of ge-

riatric patients undergoing endoscopic transforaminal decompression despite the fact that this patient cohort had substantially more heterogeneous indications for surgical intervention (14).

A total of 13.5% of patients in this series required reoperation after endoscopic decompression. Rates of reoperation after endoscopic transforaminal decompression vary in the literature from 4 to 15% and are broadly comparable with rates of reoperation after open microdiscectomy (15-19). In large, population-based studies, rates of reoperation for geriatric patients have been notably higher than those for younger patients (20). In this series, 3 patients underwent repeat endoscopic decompression 3-5 months after index surgery. Two other patients were referred for open posterior decompression with or without fusion. The remaining 2 patients ultimately underwent revisions of pre-existing fusions. Notably, a high proportion of cases in this patient population were revisions of prior open decompressions (5 patients, 10%) or fusions (13 patients, 25%). Complications or sequelae of prior lumbar open decompression and/or fusion surgery are increasingly common indications for endoscopic lumbar decompression; however, it is unclear if these indications make up 25% or more of all endoscopic lumbar procedures, as they did in this series (17,21-23). Treatment failure in this population commonly necessitates more invasive surgical intervention, such as an extension of prior fusion, which in turn must be conducted under general anesthesia and implies a greater surgical risk to the patient. As such, attempted endoscopic decompression, even if unsuccessful, may be a reasonable first step in the treatment of these patients.

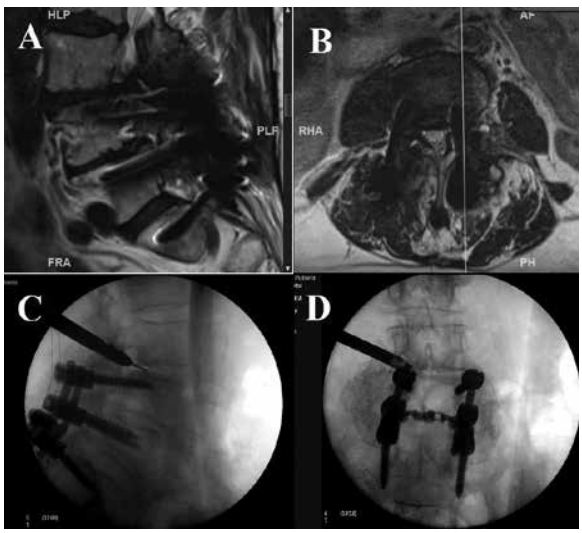

Fig. 5. *Transforaminal decompression of a left lumbar 3-4 foraminal disc herniation above a L4-S1 instrumented fusion.* A. *Sagittal T2-weighted MR image depicting the disc herniation in the left L3-4 foramen.* B. *Axial T2- weighted MR image depicting the foraminal stenosis and disc herniation in the left L3-4 foramen.* C. *Lateral fluoroscopic image of the blunt-tipped manual shaver drill during the foraminotomy.* D. *AP fluoroscopic image of the beveled tubular retractor and ball-tipped probe in the foramen.*

There was one durotomy (2%) among 52 cases in this series. This patient was managed successfully with the placement of a Duragen onlay and had no subsequent symptoms or infection afterward. Both age and invasiveness are known risk factors for durotomy in all spine surgery (24-25). Rates of durotomy after open lumbar surgery in all patients have been reported between 2 and 15% (10,19,26-27). In endoscopic approaches, the rate of durotomy is much lower and varies in the literature from 0 to 2% (19,28). Our experience with this procedure in the octogenarian population suggests that it can be conducted safely without the substantial added risk of durotomy in older patients.

Although this is a retrospective series, these results do reflect the outcomes of a patient cohort who were

Table 1. *Patients who underwent reoperation after endoscopic transforaminal decompression*

Age	Sex	Side & Level treated	Pre-operative diagnosis	Post-operative outcome
80	F	L L3-4	Herniated disc above L4-S1 fusion	Required TLIF, extending fusion, 5 months post-op
81	M	R L5-S1	Herniated disc below L3-5 fusion	Required repeat endoscopic procedure 3 months post-op
81	M	R L4-5	Grade I spondylolisthesis with foraminal stenosis	Required hemilaminectomy 4 months post-op
82	M	L L4-5	Far lateral disc herniation	Required repeat endoscopic discectomy 4 months post-op
82	M	L L3-4	L3-S1 fusion with pedicle screws and herniated disc	Required TLIF at 4 months
85	F	R L4-5	Far lateral disc herniation	Required repeat endoscopic discectomy 5 months post-op
87	F	R L4-5, L5-S1	Foraminal stenosis, severe coronal scoliosis	Referred for deformity correction immediately post-op

operated on by a single surgeon with a fixed operative technique at a single institution and therefore eliminate many significant sources of confounding. A minimum follow-up period of one year is likely sufficient to identify many cases of early treatment failure. Patients who were lost to follow-up were excluded from the analysis altogether. This study is necessarily limited by its retrospective nature, and there is likely selection bias in patients who are both referred for and who ultimately consent to surgical intervention. Furthermore, this study does not attempt to make comparisons between operative and non-operative interventions. Further analysis, either in the form of prospective trials or larger, multi-institutional retrospective cohorts with longer-term follow up will be necessary to further assess the risks and benefits of this intervention in a geriatric population. Future analyses could also seek to assess the cost-effectiveness of endoscopic transforaminal decompression, particularly as a first offered intervention in redo lumbar surgery.

Conclusion

Endoscopic spine surgery offers octogenarians a safe and effective option for the treatment of lumbar degenerative disc disease and may represent a valuable treatment strategy in a growing patient population.

References

1. Mather M, Jacobsen LA, Pollard KM. Aging in the United States. *Popul Ref Bur*. Published online 2015.
2. Waldrop R, Cheng J, Devin C, McGirt M, Fehlings M, Berven S. The Burden of spinal disorders in the elderly. *Neurosurgery* 2015; 77:S46-S50.
3. Yoshihara H, Yoneoka D. National trends in the surgical treatment for lumbar degenerative disc disease: United States, 2000 to 2009. *Spine J* 2015; 15:265-271.
4. Deyo RA, Mirza SK, Martin BI, Kreuter W, Goodman DC, Jarvik JG. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. *JAMA* 2010; 303:1259-1265.
5. Grotle M, Småstuen MC, Fjeld O, et al. Lumbar spine surgery across 15 years: trends, complications and reoperations in a longitudinal observational study from Norway. *BMJ Open* 2019; 9:e028743.
6. Wang MY, Widi G, Levi AD. The safety profile of lumbar spinal surgery in elderly patients 85 years and older. *Neurosurg Focus* 2015; 39:E3.
7. Adogwa O, Carr RK, Kudyba K, et al. Revision lumbar surgery in elderly patients with symptomatic pseudarthrosis, adjacent-segment disease, or same-level recurrent stenosis. Part 1. Two-year outcomes and clinical efficacy: clinical article. *J Neurosurg Spine* 2013; 18:139-146.
8. McGirt MJ, Parker SL, Hilibrand A, et al. Lumbar surgery in the elderly provides significant health benefit in the US health care system: patient-reported outcomes in 4370 patients from the N2 QOD registry. *Neurosurgery* 2015; 77:S125-S135.
9. Hamel MB, Henderson WG, Khuri SF, Daley J. Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. *J Am Geriatr Soc* 2005; 53:424-429.
10. Kobayashi K, Imagama S, Ando K, et al. Complications associated with spine surgery in patients aged 80 years or older: Japan Association of Spine Surgeons with Ambition (JASA) multicenter study. *Glob Spine J* 2017; 7:636-641.
11. Shah R, Attwood K, Arya S, et al. Association of frailty with failure to rescue after low-risk and high-risk inpatient surgery. *JAMA Surg* 2018; 153:e180214.
12. Schulte PJ, Roberts RO, Knopman DS, et al. Association between exposure to anaesthesia and surgery and long-term cognitive trajectories in older adults: report from the Mayo Clinic Study of Aging. *Br J Anaesth*. 2018; 121:398-405.
13. Zhang LM, Hornor MA, Robinson T, Rosenthal RA, Ko CY, Russell MM. Evaluation of postoperative functional health status decline among older adults. *JAMA Surg* 2020; 155:950-958.
14. Jasper GP, Francisco GM, Telfeian AE. A retrospective evaluation of the clinical success of transforaminal endoscopic discectomy with foraminotomy in geriatric patients. *Pain Physician* 2013; 16:225-229.
15. Kim CH, Chung CK, Park CS, Choi B, Kim MJ, Park BJ. Reoperation rate after surgery for lumbar herniated intervertebral disc disease: nationwide cohort study. *Spine* 2013; 38:581-590.
16. Choi KC, Lee JH, Kim JS, et al. Unsuccessful percutaneous endoscopic lumbar discectomy: a single-center experience of 10,228 cases. *Neurosurgery* 2015; 76:372-381.
17. Hoogland T, van den Brekel-Dijkstra K, Schubert M, Miklitz B. Endoscopic transforaminal discectomy for recurrent lumbar disc herniation: a prospective, cohort evaluation of 262 consecutive cases. *Spine* 2008; 33:973-978.
18. Kosztowski TA, Choi D, Fridley J, et al. Lumbar disc reherniation after transforaminal lumbar endoscopic discectomy. *Ann Transl Med* 2018; 6:106.
19. Barber SM, Nakhla J, Konakondla S, et al. Outcomes of endoscopic discectomy compared with open microdiscectomy and tubular microdiscectomy for lumbar disc herniations: a meta-analysis. *J Neurosurg Spine* 2019; 31:802-815.
20. Kim CH, Chung CK, Choi Y, et al. The selection of open or percutaneous endoscopic lumbar discectomy according to an age cut-off point: nationwide cohort study. *Spine* 2015; 40:E1063-1070.
21. Telfeian AE. Transforaminal endoscopic surgery for adjacent segment disease after lumbar fusion. *World Neurosurg* 2017; 97:231-235.
22. Telfeian AE, Moldovan K, Shaaya E, et al. Awake, endoscopic revision surgery for lumbar pseudarthrosis after transforaminal lumbar interbody fusion: technical notes. *World Neurosurg* 2020; 136:117-121.
23. Syed S, Telfeian AE, Houle P, et al. Four complications associated with lateral and oblique fusion treatable with

endoscopic spine surgery: technical note and case series. *Pain Physician* 2020; 23:E665-E671.

24. Baker GA, Cizik AM, Bransford RJ, et al. Risk factors for unintended durotomy during spine surgery: a multivariate analysis. *Spine J* 2012; 12:121-126.
25. Takahashi Y, Sato T, Hyodo H, et al. Incidental durotomy during lumbar spine surgery: risk factors and anatomic locations: clinical article. *J Neurosurg Spine* 2013; 18:165-169.
26. Rosen DS, O'Toole JE, Eichholz KM, et al. Minimally invasive lumbar spinal decompression in the elderly: outcomes of 50 patients aged 75 years and older. *Neurosurgery* 2007; 60:503-510.
27. Yolcu YU, Helal A, Alexander AY, et al. Minimally invasive versus open surgery for degenerative spine disorders for elderly patients: experiences from a single institution. *World Neurosurg* 2021; 146:e1262-e1269.
28. Telfeian AE, Shen J, Ali R, Oyelese A, Fridley J, Gokaslan ZL. Incidence and implications of incidental durotomy in transforaminal endoscopic spine surgery: case series. *World Neurosurg* 2020; 134:e951-e955.