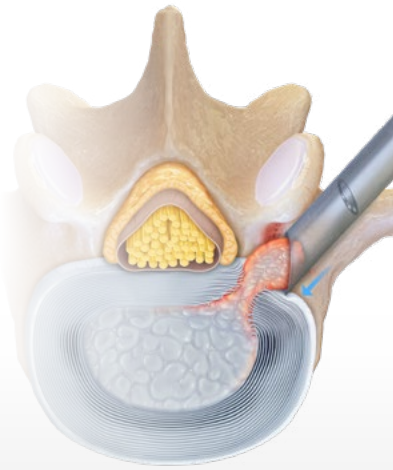
Endoscopic Discectomy and Decompression

Scientific Update



Endoscopic surgery is an ultra-minimally invasive technique for treating a variety of spine pathologies, including disc herniation and stenosis. The transforaminal, or paraspinal, approach provides the ability to treat foraminal stenosis or reach a variety of herniations, including central, foraminal, and far-lateral disc herniations. Meanwhile, the interlaminar approach provides minimally invasive access to central stenosis or to posterior herniations in the lower lumbar spine that may be difficult to reach through a transforaminal approach. These endoscopic techniques result in less tissue and muscle disruption, resulting in less postoperative pain.[1-3] Additionally, patients have experienced faster recovery times and a quicker return to activity than with traditional open procedures.[4,5]

INTERLAMINAR APPROACH

A new full-endoscopic technique for the interlaminar operation of lumbar disc herniations using 6 mm endoscopes: prospective 2-year results of 331 patients.

S Ruetten, M Komp, G Godolias

- Examined the technical possibility of full-endoscopic interlaminar access to reach the spinal canal
- 331 patients were followed for 2 years post-op
- 82% reported no longer having leg pain, while 13% had only occasional pain
- Traumatization of both the access pathway and the spinal canal was reduced compared to conventional procedures

> **Takeaway:** This study found that the full endoscopic interlaminar approach for lumbar disc herniations is a viable alternative to open or microscopic approaches, with a low 2-year recurrence rate (2.4%), no documented complications in 331 patients, and less approach trauma.

Minim Invasive Neurosurg. 2006;49(2):80-87. doi:10.1055/s-2006-932172

Endoscopic and microscopic interlaminar discectomy for the treatment of far-migrated lumbar disc herniation: a retrospective study with a 24-month follow-up.

Fei Yang, Liangjuan Ren, Qingqing Ye, Jianhua Qi, Kai Xu, Rigao Chen, Xiaohong Fan

- Retrospective study of 53 consecutive patients with symptomatic far-migrated lumbar disc herniations treated with interlaminar endoscopic discectomy or interlaminar microscopic discectomy (endoscopic = 33 patients, MIS = 20 patients)
- Patients reported 78.95% excellent or good pain ratings at 2-year postoperative follow-up after microscopic lumbar discectomy
- Patients reported 90.32% excellent or good pain ratings at 2-year postoperative follow-up after endoscopic interlaminar discectomy for a lumbar herniated disc

> **Takeaway:** As compared to the microscopic interlaminar approach, interlaminar endoscopic lumbar discectomy for far-migrated lumbar disc herniations had a higher rate of excellent results (90.32% vs 78.95%) and resulted in better Visual Analog Scale (VAS) scores for lower back pain, lower 24-month Oswestry Disability Index (ODI) scores, and statistically similar complication rates.

J Pain Res. 2021;14:1593-1600. doi:10.2147/JPR.S302717

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Efficacy and safety of full-endoscopic decompression via interlaminar approach for central or lateral recess spinal stenosis of the lumbar spine: a meta-analysis.

Chang-Hyun Lee, Miyoung Choi, Dal Sung Ryu, Il Choi, Chi Heon Kim, Hyeun Sung Kim, Moon-Jun Sohn

- Considered studies concerning full-endoscopic decompression via the interlaminar approach for lumbar spinal stenosis. Changes in ODI and VAS scores for back and leg pain were compared with the minimally clinically important difference (MCID) for each.
- Five studies involving 156 patients at 6- and 12-month follow-ups
- ODI improved by 41.71 (95% CI, 39.80-43.62) after surgery
- VAS leg and back pain scores improved by 5.95 (95% CI, 5.70-6.21) and 4.22 (95% CI, 3.88-4.56), respectively

> **Takeaway:** Successful clinical outcomes can be achieved with full-endoscopic decompression via the interlaminar approach for lumbar central spinal stenosis in patients with defined indications.

[published correction appears in *Spine (Phila Pa 1976)*. 2019;44(4):E258]. *Spine* (Phila Pa 1976). 2018;43(24):1756-1764.

Bilateral spinal decompression of lumbar central stenosis with the full-endoscopic interlaminar versus microsurgical laminotomy technique: a prospective, randomized, controlled study.

Martin Komp, Patrick Hahn, Semih Oezdemir, Athanasios Giannakopoulos, Roderich Heikenfeld, Richard Kasch, Harry Merk, Georgios Godolias, Sebastian Ruetten

- 135 patients treated with full-endoscopic or microsurgical decompression were followed for 2 years post-op
- Postoperatively, 72% of patients no longer had leg pain or the pain was almost completely reduced and 21.2% experienced occasional pain
- Clinical results were the same in both groups, but complications and revisions were significantly reduced in the endoscopic surgery group. There were also measurable advantages in operative time, traumatization, and post-op rehabilitation.

> **Takeaway:** In this prospective randomized controlled clinical trial, as compared to microscopic bilateral laminotomy for lumbar central stenosis, full-endoscopic unilateral laminectomy for bilateral decompression (ULBD) yielded lower rates of complications, fewer revisions, shorter operative times, less need for postoperative medications, shorter hospital stays, and similar long-term outcomes.

Pain Physician. 2015;18(1):61-70.

Surgical treatment for lumbar lateral recess stenosis with the full-endoscopic interlaminar approach versus conventional microsurgical technique: a prospective, randomized, controlled study.

Sebastian Ruetten, Martin Komp, Harry Merk, Georgios Godolias

- 161 patients treated with interlaminar full-endoscopic or microsurgical decompression underwent follow-up for 2 years. VAS, ODI, and the German version of the North American Spine Society (NASS) instrument were used to analyze patient-reported outcomes.
- 74.5% of patients reported no longer having leg pain and 20.5% reported only occasional pain
- Clinical results were equal in both groups, but rates of complications and revisions were significantly reduced in the interlaminar endoscopic group

> **Takeaway:** The clinical results of both groups were equal but endoscopic surgery showed advantages related to operative time, rates of complications and revisions, traumatization, and rehabilitation.

J Neurosurg Spine. 2009;10(5):476-485. doi:10.3171/2008.7.17634

TRANSFORAMINAL APPROACH

Awake, transforaminal endoscopic lumbar spine surgery in octogenarians: case series.

Albert E Telfeian, Rahul Sastry, Adetokunbo Oyelese, Jared Fridley, Joaquin Q Camara-Quintana, Tianyi Niu, Prakash Sampath, Kai-Uwe Lewandrowski, Kyle Mueller, Ziya L Gokaslan

- Retrospectively reviewed 52 consecutive patients who underwent awake transforaminal lumbar endoscopic decompression performed by a single surgeon at a single institution between 2014-2019
- Transforaminal surgeries performed included discectomies (21), foraminotomies (7), post-laminectomy redo foraminotomies (5), fusion explorations (13), facet cyst resections (3), spondylolisthesis decompressions (2), and a decompression for metastatic disease (1)
- 13.5% (7/52) of patients required repeat surgery at the treated level during the 1-year follow-up
  - For the remaining 45 patients, VAS for leg pain improved from 6.9 +/- 1.4 to 1.8 +/- 1.4 and ODI improved from 40.5% +/- 11.5% to 12.0% +/- 10.8%
- The only complication was a single durotomy (2%)

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

Pain Physician. 2022;25(2):E255-E262.

Return to work and recovery time analysis after outpatient endoscopic lumbar transforaminal decompression surgery.

Kai-Uwe Lewandrowski, Nicholas A Ransom, Anthony Yeung

- Retrospective study of 442 patients with symptomatic, contained lumbar herniated disc treated with transforaminal endoscopic surgery
- Mean follow-up of 33.5 months (24-85 months)
- Mean patient age of 40.9 years (30-85 years)
- Excellent and good results were obtained in 83.7% (370/442) of patients
- Patients performing heavy and medium work had lower return to work (RTW) rates than patients who perform light work, at 87.5%, 86%, and 95.8%, respectively
- Mean RTW was 22.27 days for heavy, 13.97 days for medium, and 7.58 days for light work
- Following endoscopic lumbar spine surgery, 83.7% of patients showed significantly improved function and were able to return to work in 10 days or less

> **Takeaway:** RTW and recovery time with narcotic independence following endoscopic transforaminal lumbar decompression for symptomatic contained lumbar disc herniations is on the order of 10 days or less in the vast majority of patients, with an average RTW rate of 92.5%.

J Spine Surg. 2020;6(Suppl 1):S100-S115. doi:10.21037/jss.2019.10.01

Effectiveness and safety of transforaminal spinal endoscopy: analysis of 1000 clinical cases.

Ignazio Tornatore, Attilio Basile, Alessandro Aureli , Alessio Tarantino, Giuseppe Orlando, Rodrigo Buharaja

- The purpose of this retrospective evaluation is to evaluate the safety and efficacy of transforaminal spine endoscopy in a cohort of 1000 patients treated by a single surgeon
- VAS and ODI were recorded postoperatively at 1, 3, 6, and 12 months
- A significant reduction in VAS ($P < .001$) and ODI ($P < .001$) was observed at the final follow-up; 92% of patients reported a high level of satisfaction with their treatment

> **Takeaway:** Transforaminal spine endoscopy results in significant pain and function improvement, with no reported major complications or functional impairments.

Diagnostics (Basel). 2025;15(8):1021. doi:10.3390/diagnostics15081021

OTHER STUDIES

A postoperative phenomenon of percutaneous endoscopic lumbar discectomy: rebound pain.

Chang Zhang, Ziquan Li, Keyi Yu, Yipeng Wang

- Retrospective study of 144 patients treated with single-segment percutaneous endoscopic lumbar discectomy (PELD) from May 2017 to June 2020
- Successful outcomes, according to the modified MacNab criteria, reached 94.4%
- Fifteen patients (10.4%) experienced rebound pain that usually began within 1 month of procedure and lasted for less than 1 month. Symptoms were relieved with conservative treatment.
- One year after undergoing endoscopic discectomy, approximately 94% of patients had significantly improved function and were able to restore motion through exercise

> **Takeaway:** Postoperative rebound pain (radiculitis) can occur in up to 10.4% of PELD procedures without recurrence or instability but normally resolves within a month and does not influence long-term outcomes. Great care must be taken to avoid inadvertent pressure on the dorsal root ganglion with this approach.

Orthop Surg. 2021;13(8):2196-2205. doi:10.1111/os.13088

Endoscopic spine surgery in athletes: case series and review of literature.

Sananthan Sivakanthan, John R Williams, Abdullah H Feroze, Jessica Eaton, Zhun James Pan, Scott Boop, Lynn B McGrath, Kimberly Harmon, Christoph P Hofstetter

- The best evidence available cites a return to play of 81% at 5.2-8.7 months after traditional open and minimally invasive surgery. Endoscopic surgery shows an average 88% return-to-play rate at 3 months.
- Patients who undergo endoscopic lumbar spine surgery may be able to return to sports and other recreational activities in just 6 to 8 weeks
- More than 85% of patients who undergo endoscopic lumbar spine procedures return to athletics

> **Takeaway:** This review study suggests that endscopic spine surgery in athletes may offer both a quicker and higher rate of return to play than traditional minimally invasive approaches, but direct comparison and data volume is lacking.

World Neurosurg. 2021;145:702-707. doi:10.1016/j.wneu.2020.08.211

Full-endoscopic interlaminar and transforaminal lumbar discectomy versus conventional microsurgical technique: a prospective, randomized, controlled study.

Sebastian Ruetten, Martin Komp, Harry Merk, Georgios Godolias

- 178 patients treated with full-endoscopic or microsurgical discectomy underwent follow-up for 2 years
- Postoperatively, 82% of patients no longer had leg pain and 14% had occasional pain
- Clinical results were the same in both groups
- Minimal blood loss and less tissue disruption with endoscopic techniques as compared to conventional microsurgical techniques
- Transforaminal and interlaminar endoscopic approaches can help relieve nerve compression while minimizing incision size and disruption to surrounding soft tissue and muscle anatomy

> **Takeaway:** In this prospective RCT comparing full-endoscopic discectomy to conventional microsurgical discectomy, 2-year outcomes and recurrence rates were similar but the full-endoscopic group had quicker operative times, experienced fewer complications and less postoperative pain, returned to work quicker, and required less postoperative pain medication.

Spine (Phila Pa 1976). 2008;33(9):931-939. doi:10.1097/BRS.0b013e31816c8af7

Comparison of clinical outcomes following minimally invasive or lumbar endoscopic unilateral laminotomy for bilateral decompression.

Lynn B McGrath, Gabrielle A White-Dzuro, Christoph P Hofstetter

- Retrospective analysis of 95 consecutive patients undergoing either MIS (n = 45) or endoscopic (n = 50) unilateral laminotomies for bilateral decompression to treat lumbar spinal stenosis
- Surgical time for endoscopic technique was significantly longer per level (161.8 +/- 6.8 minutes) than minimally invasive tubular surgery (99.3 +/- 4.6 minutes)
- Hospital stay for MIS patients was an average of 2.4 +/- 0.5 days compared to 0.7 +/- 0.1 days for endoscopic patients
- At 1-year follow-up, endoscopic patients had a significantly lower VAS score for leg pain (1.3 +/- 0.3) compared to MIS patients (3.0 +/- 0.5)
- At 1-year follow-up, endoscopic patients had a significantly lower ODI for back pain (20.7 +/- 3.4) compared to MIS patients (35.9 +/- 4.1)
- Three patients required a return to the OR acutely after surgery: 2 patients from the MIS group for epidural hematoma and 1 patient from the endo group for disc reherniation

> **Takeaway:** Lumbar endoscopic unilateral laminotomy for bilateral decompression is a safe and effective surgical procedure with a favorable complication profile and positive patient outcomes. The endoscopic group had better clinical outcomes and shorter length of hospital stay, fewer complications, and fewer revisions.

J Neurosurg Spine. 2019;30(4):491-499. doi:10.3171/2018.9.SPINE18689

Current techniques of endoscopic decompression in spine surgery.

Yong Ahn

- The main objective of endoscopic spine surgery is to reduce tissue trauma and maintain proper segmental stability and mobility
- Definitive benefits of endoscopic spine surgery over conventional open surgery can be summarized by research:
  - Minimized tissue damage through the use of a small skin incision, reduced need for extensive laminar or facet resection and minimal dural sac retraction, and reduced blood loss
  - Feasibility of outpatient surgery, with the aid of local anesthesia combined with conscious sedation, leading to reduced operative time and shorter length of hospital stay
  - An earlier recovery, potentially obtainable due to less postoperative medication, fewer wound complications, and a quicker return to work
- There are studied limitations and risks to endoscopic spine surgery, including:
  - Rate of perioperative complications such as hematoma, dorsal dural tear, and surgical site infection can be relatively low. However, adverse events such as nerve root injury, tissue damage, and increased radiation exposure are still present.
  - The learning curve is relatively challenging to ensure clinical success without complications. Systematic training in endoscopic techniques are required before performing in a real situation.
  - Standard indications are still widely undetermined and therefore limited. Appropriate patient selection is essential to success. A calcified disc, severe stenosis, cauda equina syndrome, painless weakness, or severe fibrotic tissue adhesion may be contraindications for endoscopic spinal surgery.

> **Takeaway:** Endoscopic transforaminal lumbar discectomy has been proven through randomized trials and meta-analyses as an alternative surgical option to traditional open surgery. However, the current level of evidence is limited for other techniques, and, therefore, further high-quality research is required to confirm clinical relevance and efficacy.

Ann Transl Med. 2019;7(Suppl 5):S169. doi:10.21037/atm.2019.07.98

An algorithm for selection of full endoscopic approach for symptomatic nerve root decompression.

Patgaonkar P, Goyal V, Patel P, Dhole K, Ravi A, Patel V, Borole P.

- Retrospective single-surgeon study of 396 patients (504 symptomatic motion segments) who underwent transforaminal (TF) or interlaminar (IL) full endoscopic decompression.
- Developed and validated the FAPDIS algorithm, a 6-factor radiologic scoring system—facet angle (F), anterior pathology (A), posterior pathology (P), dorsal migration (D), inferior migration (I), and superior migration (S)—to guide approach selection. Each segment receives both a TF and IL score (maximum score of 12), and the approach with the higher comparative total is recommended; a difference of 0-0.5 defaults to surgeon preference.
- Introduced a key technical principle: Endoscopic access should maintain a minimum 20° angle relative to facet inclination to allow adequate bone resection for decompression while preserving facet stability.
- Provided detailed approach selection rules:
  - Facet orientation: sagittal facets (F1 and F2) favor TF; coronal facets (F3 and F4) favor IL.
  - Posterior pathology: P1 and P2 favor IL; P3 and P4 favor TF.
  - Migration patterns: far calcified dorsal migration and far and very far superior or inferior migration favor IL to prevent inadequate TF decompression and excessive facet removal.
- Interobserver reliability for the algorithm was good to excellent, with ICC 0.873 (TF) and 0.882 (IL); the greatest scoring variability occurred in P3 and P4 posterior pathology assessment.
- Significant clinical improvement was observed at 6 months: VAS decreased from 9 → 1 ($P < .001$) and ODI from 89 → 12 ($P < .001$).

> **Takeaway:** The FAPDIS algorithm provides a structured, reproducible framework for selecting between transforaminal and interlaminar full endoscopic approaches by integrating six surgically relevant radiologic factors. By matching the optimal approach to facet orientation, pathology type, and migration pattern, the algorithm helps minimize inadequate decompression, reduce risks to the exiting/traversing nerve roots, and avoid excessive facet resection. It demonstrated strong interobserver reliability and substantial postoperative improvements, positioning FAPDIS as a practical decision support tool for endoscopic lumbar decompression.

N Am Spine Soc J. 2023;15:100244. doi:10.1016/j.xnsj.2023.100244

INTERLAMINAR VS TRANSFORAMINAL APPROACH

Transforaminal versus interlaminar endoscopic lumbar discectomy for lumbar disc herniation: a systematic review and meta-analysis.

Khanathip Jitpakdee, Yanting Liu, Vit Kotheeranurak, Jin-Sung Kim

- 1948 patients from 18 studies were included, consisting of 1006 (51.6%) treated with transforaminal endoscopic lumbar discectomy (TELD) and 942 (48.4%) treated with interlaminar endoscopic lumbar discectomy (IELD)
- TELD had better improvement of post-op ODI, post-op VAS for back pain, and last follow-up VAS for back pain
- IELD had shorter operative and fluoroscopic time, especially in L5-S1 operations
- Bed rest time was significantly longer following IELD, with no difference in VAS for leg pain, length of hospital stay, or complications

> **Takeaway:** Both interlaminar and transforaminal approaches to endoscopic discectomy were studied with comparable clinical outcomes when it comes to pain measurement levels, patient satisfaction, hospital stay, and complication risk.

Global Spine J. 2023;13(2):575-587. doi:10.1177/21925682221120530

TRANS-SUPERIOR ARTICULAR PROCESS APPROACH

The endoscopic trans-superior articular process approach: a novel minimally invasive surgical corridor to the lateral recess.

Saqib Hasan, Brie White-Dzuro, Jason K Barber, Ralf Wagner, Christoph P Hofstetter

- The study purpose was to describe the trans-superior articular process (SAP) technique and report mean 24-month follow-up data
- The clinical case series included 40 patients with unilateral symptomatic lateral recess stenosis. Operative data, VAS for the back and leg, and ODI data were retrospectively collected.
- Patients reported significantly lower VAS for back pain (decrease of 2.87 points) and ipsilateral leg pain (decrease 5.42 points) ($P < .001$). 90% of patients met the MCID for VAS leg pain. ODI scores significantly improved, evidenced by an average decrease of 34.5 points ($P < .001$), and 88% of patients achieved MCID.

> **Takeaway:** A novel endoscopic trans-SAP approach for lumbar foraminal and lateral recess pathology decompression is an effective technique. The technique utilizes bony landmarks for safe identification of neural structures, and no postoperative neurologic deficits or complications were observed.

Oper Neurosurg. 2020;19(1):E1-E10. doi:10.1093/ons/opaa054

LATERAL SUPERIOR ARTICULAR PROCESS APPROACH

Full-endoscopic lumbar discectomy via lateral superior articular process approach for treating far lateral lumbar disc herniation: a retrospective study and technical note.

Lu Lin, Zhen-Yong Ke, Lei Chu, Yun Cheng, Guo-Sheng Zhao, Dian Zhong, Xin Cai, Xiao-Lin Chen

- The purpose of this retrospective clinical study was to evaluate the safety and efficacy of the lateral superior articular process (LSAP) full-endoscopic lumbar discectomy approach and full-endoscopic transforaminal discectomy (FETD) approach to treat far lateral lumbar disk herniation. A technical description of the two techniques is detailed.
- Thirty-two patients with far lateral lumbar disk herniation with mean 11.16 ± 2.54 months follow-up were reviewed (n = 12, LSAP; n = 20, FETD). Data collected include operative time, blood loss, length of hospital stay, complications, VAS, and ODI.
- A significant decrease in operative time minutes (54.17 ± 17.17, LSAP; 71.50 ± 25.39, FETD; $P = .045$), and days spent in hospital (4.25 ± 1.42, LSAP; 6.50 ± 2.69, FETD; $P = .005$) were observed. VAS and ODI significantly decreased in both groups at all postoperative time points.

> **Takeaway:** Full-endoscopic lumbar discectomy via LSAP and FETD are effective techniques for treating far lateral lumbar disc herniation, evidenced by low complication rates and decreased postoperative pain. Advantages of the LSAP approach include decreased operative time and length of hospital stay.

Int Orthop. 2023;47(11):2843-2850. doi:10.1007/s00264-023-05937-0

FAR LATERAL TRANSFORAMINAL DISCECTOMY

Magnetic resonance imaging predictors of surgical difficulty in transforaminal endoscopic lumbar discectomy for far-lateral disc herniation under local anesthesia.

Yong Ahn, Sungsoo Bae, Dae-Jean Jo, Byung-Rhae Yoo

- The purpose of this study was to examine the factors influencing surgical difficulty and transforaminal endoscopic lumbar discectomy (TELD) for far lateral disc herniation performed under local anesthesia
- Seventy-five patients were retrospectively reviewed to collect MRI and intraoperative data, including operative time, access pain during the transforaminal approach, and procedural pain during endoscopic decompression. Postoperative length of hospital stay and postoperative procedures were recorded.
- Patients with narrower foraminal windows tended to have prolonged operative time (P = .0017) and hospital stay (P = .003). Additionally, these patients (grade 2 or 3 narrowing) resulted in longer operative time of 21.77 minutes (P = .005).
- Patients with extraforaminal disc herniations were more likely to experience access pain compared to patients with foraminal disc herniations (P = .003).

Takeaway: Evaluation of foraminal narrowing and herniation zone with preoperative MRI can predict surgical difficulty and outcomes for patients undergoing TELD for far lateral lumbar disc herniations.

Biomedicines. 2025;13(4):778. doi:10.3390/biomedicines13040778

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