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Interlaminar Endoscopic Lumbar Discectomy (IELD) - A Comprehensive Case Report with Literature Review

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Abstract

Background: Inter laminar endoscopic lumbar Discectomy (IELD) — also known as percutaneous endo scopic inter laminar Discectomy (PEID) — is a minimally invasive surgical technique for treating lumbar disc herniation (LDH), particularly effective at the L5–S1 level where transformational approaches face anatomical constraints. This comprehensive case report presents representative clinical scenarios, surgical technique, outcomes, and an expanded literature review.

Methods: A composite case report was constructed from published clinical data including patient demographics, imaging findings, surgical technique, and follow-up outcomes, supplemented by systematic reviews and meta-analyses.

Results: IELD demonstrates favorable outcomes with leg pain reduction from mean NRS 6.2±1.9 to 1.1±1.5, back pain from 3.1±2.3 to 1.1±1.3, and Mac Nab good-to-excellent rates of 88.9%–91.7% at final follow-up. Meta - analyses of over 2,000 patients confirm comparable clinical outcomes to transformational approaches, with shorter operative time and reduced fluoroscopy exposure at L5-S1. Complications are minimal and typically transient.

Conclusion: IELD is a safe, effective, and minimally invasive option for LDH, especially at L5–S1 and in

cases of migrated or calcified discs, with rapid recovery and high patient satisfaction. Current evidence supports its role as an established alternative to micro Discectomy.

Keywords: IELD, PEID, LDH.

Introduction

Lumbar disc herniation (LDH) remains one of the most common causes of lower back pain and radiculopathy worldwide. While open Discectomy has historically been the gold standard, minimally invasive techniques have revolutionized spine surgery. Percutaneous endoscopic lumbar discectomy (PELD) encompasses two primary approaches: transformational (TELD/ PETD) and inter laminar (IELD/PEID). The inter laminar approach is particularly advantageous for:

- L5–S1 level herniations where the high iliac crest or narrow foramen limits transformational access
- Intracanalicular and migrated disc fragments (especially posterior epidural migration)
- Calcified disc herniations
- Recurrent disc herniations after prior open surgery
- Concomitant lumbar spinal stenos is requiring decompression
- Axillary-type disc herniations

Ruetten et al. first reported encouraging results with IELD in 331 patients, achieving 95% favorable outcomes with only 2.4% recurrence. Choi et al. further refined the technique using serial dilators through the ligamentum flavum, reporting 91% favorable outcomes and 1.4% recurrence.

A landmark randomized controlled trial by Ruetten et al. demonstrated that favorable clinical outcomes (no pain or occasional pain) were achieved in 96% of patients after either endoscopic surgery (TELD or IELD) or standard micro Discectomy, with equivalent recurrence rates of 6.2%.

Case Presentations

Case 1: Primary L5–S1 Disc Herniation (Classic IELD)

Patient: 40-year-old female

Presentation: Medically intractable right leg and back pain for 6 months. Antalgic gait, restless with pain (NRS 8/10). Oswestry Disability Index (ODI) 32/50. Failed conservative management including epidural injections and neurolysis.

Imaging: MRI revealed a protruded LDH at L5–S1 level.

Procedure: IELD performed under general anesthesia. The endoscope was introduced through the interlaminar window, ligamentum Flavum was split under direct visualization, and the herniated disc was removed.

Outcome: Pain almost completely resolved immediately postoperatively (NRS 2/10). Ambulated normally on the day of surgery. Postoperative MRI confirmed complete removal of herniated disc with decompressed nerve root. Discharged next day; returned to normal life at 2 weeks.

Case 2: L4–5 Disc Herniation with Concomitant Spinal Stenos is (Modified Trephine Laminotomy)

Patient: 57-year-old male

Presentation: Neuro genic claudication for 3 months. Right leg pain and numbness after walking 1,000 meters.

Imaging: MRI demonstrated L4/5-disc herniation with concomitant lumbar spinal stenos is and nerve root redundancy sign.

Procedure: IELD with trephine laminotomy to enlarge the inter laminar space. The ligamentum Flavum and hypertrophic superior articular process were partially removed. The nerve root was decompressed, followed by Discectomy.

Outcome: Postoperative MRI showed complete decompression with disappearance of the redundancy sign. CT confirmed approximately one-third of the lower articular process was removed while preserving most of the articular surface. Recovered well at 1 month; no claudication. Pain-free at 2-year follow-up.

Case 3: Posterior Epidural Migrated Disc Fragment (Rare Presentation)

Patient: 54-year-old male

Presentation: Low back pain radiating to the left lower leg for 3 months.

Imaging: MRI revealed LDH at L4/5 with migration to the dorsal side of the spinal cord — an extremely rare presentation that can mimic intraspinal tumors. Enhanced MRI confirmed the finding.

Procedure: Successful de compressive surgery per formed via posterior percutaneous endoscopic inter laminar Discectomy.

Outcome: Significant relief from both low back pain and radiating pain. No recurrence during follow-up. Patient expressed high satisfaction with the minimally invasive approach.

Case 4: Recurrent L5–S1 Disc Herniation After Prior Open Discectomy

Patient: 60-year-old male

History: Open Discectomy 10 years prior.

Presentation: Left leg pain for 3 months. VAS 5/10 (trunk), 9/10 (leg). ODI 65%.

Imaging: T2-weighted MRI revealed ruptured disc at L5–S1 on the left para median with downward migration. X-rays showed high iliac crest and large L5 transverse process — factors limiting trans foraminal access.

Procedure: Full endoscopic inter laminar discectomy (FEID) via shoulder approach. Target was the infer olateral corner of the inter laminar window. Large downward herniated disc material was removed.

Outcome: Postoperative MRI showed complete removal with expanded the cal sac. Discharged day after surgery. At 12-month follow-up: VAS 2/10 (trunk and leg), ODI 15%.

Case 5: Recurrent Disc with Prior Fusion Instrumentation

Patient: 53-year-old male

History: L5–S1 discectomy and posterolateral fusion 6 years prior.

Presentation: Left leg pain and weakness for 2 months.

Imaging: X-rays showed posterior decompression and instrumentation at L5–S1. MRI revealed recurrent disc herniation at L5–S1.

Procedure: Inter laminar approach chosen because trans foraminal access was blocked by iliac crest and instrumentation. Scar tissue was carefully dissected. Medial facet was resected (~2 mm) with high-speed drill. After removing scar and soft tissues, the spinal nerve was explored, retracted medially, and the herniated disc was exposed and removed.

Outcome: Recovered well; discharged day after surgery.

Case 6: Highly Down-Migrated L5–S1 Disc (Trephine Laminotomy)

Patient: 48-year-old male

Presentation: Severe left leg pain (VAS 9/10), unable to walk for 2 weeks.

Imaging: MRI showed large down-migrated disc fragment at L5–S1 below the disc space level.

Procedure: IELD with trephine laminotomy. The inter laminar window was enlarged using a trephine to access the down-migrated fragment in the epidural space below the disc level.

Outcome: Complete resolution of leg pain (VAS 1/10) immediately postoperatively. Ambulated same day. MRI confirmed complete decompression at 3-month follow-up.

Urgical Technique

Patient Positioning & Anesthesia

Position: Prone on radiolucent table.

Anesthesia: Local with sedation, epidural, or general anesthesia.

Fluoroscopy: C-arm guidance for trajectory planning

Key Steps

- Skin Incision: ~8–10 mm incision at the target inter laminar level, typically 1–1.5 cm off midline
- Serial Dilatation: Blunt dilators introduced to the inter laminar window under fluoroscopic guidance
- Working Channel Placement: Endoscope with working channel (typically 6 mm outer diameter) docked at the ligamentum Flavum
- Ligamentum Flavum Approach: Split or resect the ligamentum Flavum under direct endoscopic visualization
- Epidural Space Entry: Identify the traversing nerve root and Dural sac
- Decompression (if needed): Partial medial facetectomy or laminotomy using trephine/drill/Kerri son for stenos is
- Discectomy: Gently retract nerve root medially; remove herniated disc with pituitary forceps and radiofrequency probe
- Hemostasis & Closure: Irrigate with saline; close skin with single stitch or adhesive

Technical Pearls

- L5–S1: The wider inter laminar space makes IELD ideal; high iliac crest blocks trans for aminal approach
- Migrated discs: Trephine laminotomy enlarges the window for access to down-migrated fragments
- Stenos is: Remove medial edge of superior articular process and hypertrophic ligamentum Flavum
- Recurrent cases: Scar tissue is the main challenge; maintain meticulous dissection along bony landmarks
- Nerve protection: Use continuous saline irrigation and radiofrequency for hemostas is

Clinical Outcomes (Pooled Data from Literature)

Parameter	Preoperative	Postoperative (Final Follow-up)
Leg Pain NRS/VAS	6.2 ± 1.9	1.1 ± 1.5
Back Pain NRS/VAS	3.1 ± 2.3	1.1 ± 1.3
RMDQ Score	15.0 ± 5.8	2.9 ± 4.1
ODI Score	42–65%	15–20%
MacNab Excellent/Good	—	88.9% – 96%
Mean Operative Time	—	45–75 minutes
Mean Hospital Stay	—	12 hours – 1.6 days
Return to Work	—	~6.8 weeks
Fluoroscopy Frequency (L5-S1)	—	8–12 counts (IELD) vs 18–22 counts (PETD)

Complications

Complication	Incidence	Notes
Dural tear/CSF leak	1%–3%	Usually small; often managed without repair
Transient dysesthesia	3%–9%	Typically resolves within 3–6 months

Recurrent herniation	1.4%–6.2%	May be treated with repeat IELD or open surgery
Nerve root injury	Rare	Avoided with direct visualization
Infection	Very rare	Continuous saline irrigation reduces risk
Incomplete decompression	2%–5%	May require revision

A systematic review noted a higher incidence of dural injury with IELD compared to TELD (P = 0.04), attributed to the proximity to the dural sac. However, overall complication rates remain low, and muscle injury biomarkers (creatine phosphokinase) show no significant difference between IELD and TELD — both are significantly lower than open discectomy.

Discussion

Advantages of Ield

- Minimally invasive: 8–10 mm incision; preserves para spinal muscles
- Direct trajectory: Straight-line access to central and para central herniations
- L5–S1 optimization: Overcomes iliac crest and foraminal anatomy limitations
- Versatility: Treats migrated discs, calcified herniations, stenos is, and recurrent cases
- Rapid recovery: Same-day or next-day discharge; early return to work
- Visual clarity: Continuous saline irrigation provides excellent endoscopic visualization
- Reduced radiation: Significantly fewer fluoroscopy counts compared to PETD at L5-S1

Indications & Contraindications

Indications

L5–S1 LDH (especially high iliac crest)

- Central/para central herniations
- Migrated disc fragments (upward/downward)
- Calcified disc herniations
- Recurrent LDH after prior surgery
- LDH with grade 1–2 lumbar spinal stenos is
- Axillary-type disc herniations

Contraindications

- Cauda equina syndrome (relative — may need urgent open decompression)
- Severe central canal stenosis (grade 3)
- Segmental instability/spondylolisthesis
- Active infection
- Prior extensive laminectomy with absent inter laminar anatomy

Comparison with TELD and Micro discectomy

- A recent meta-analysis (2026) comparing IELD and TELD across 17 studies (2,066 patients) found:
- IELD: Shorter operative time, significantly lower radiation exposure
- TELD: Tended to result in reduced postoperative back pain (better preservation of anatomical structures)
- No significant differences: Complication rates, recurrence rates, ODI, VAS leg pain, or MacNab excellent/good rates

Another systematic review of 31 studies (5,873 patients) confirmed comparable clinical outcomes between TELD and IELD, with both approaches offering shorter recovery time (4–8 weeks) compared to open discectomy (8–12 weeks).

A 2026 systematic review and meta-analysis of 13 RCTs (1,059 patients) focused specifically on L5/S1 LDH found:

- PEID associated with shorter operative time (MD = -17.07 min, 95% CI -26.05 to -8.09)

- PEID associated with fewer fluoroscopy counts (MD = -8.94 counts, 95% CI -11.40 to -6.48)
- No difference in VAS leg pain, ODI, MacNab excellent/good rates, or complications

A 2025 meta-analysis of 8 studies (784 patients) with L5-S1 LDH similarly found PEID superior in operative time and fluoroscopy duration, with comparable clinical outcomes.

A comprehensive systematic review and meta-analysis (2025) comparing full-endoscopic discectomy with microdiscectomy found no significant differences in postoperative pain, disability index, complication rate, or recurrence rate, with endoscopic surgery offering shorter operation time and hospital stay.

Learning Curve

The learning curve for IELD is estimated at 30–50 cases, with proficiency typically achieved after 40–60 procedures. Key factors influencing the learning curve include:

- Familiarity with endoscopic anatomy and two-dimensional visualization
- Mastery of instrumentation through a narrow working channel
- Understanding of the ligamentum Flavum anatomy and safe entry techniques
- Experience with hemostas is in a fluid-filled environment

Surgeon volume and institutional experience significantly influence operative time and fluoroscopy use, contributing to the high heterogeneity observed in meta-analyses.

Conclusion

Inter laminar endoscopic lumbar Discectomy represents a mature, evidence-based minimally invasive technique for the treatment of lumbar disc herniation. It is particularly valuable at the L5–S1 level, for migrated or calcified discs, and in revision scenarios. With proper patient selection, meticulous technique, and adequate training, IELD achieves clinical outcomes comparable to open micro discectomy while offering the benefits of reduced tissue trauma, shorter hospitalization, and faster recovery. Current meta-analytic evidence supports its safety and efficacy, with over 5,000 patients analyzed across multiple systematic reviews. As endoscopic technology, robotics, and AI continue to evolve, IELD is poised to remain a cornerstone of modern minimally invasive spine surgery.

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