

General

Transforaminal Endoscopic Lumbar Discectomy Versus Interlaminar Endoscopic Lumbar Discectomy for Lumbar Disc Herniation: A Systematic Review of Clinical Outcomes, Quality of Life, and Surgical Selection Strategies

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Background

Transforaminal endoscopic lumbar discectomy (TELD) and interlaminar endoscopic lumbar discectomy (IELD) have emerged as primary minimally invasive treatments for lumbar disc herniation (LDH). However, comparative data regarding long-term quality of life (QoL) and specific patient-selection criteria remain fragmented.

Objective

This systematic review aims to compare the clinical outcomes, complications, and QoL metrics of TELD versus IELD to establish evidence-based surgical selection strategies.

Methods

Following the Preferred Reporting Items for Systematic Reviews guidelines, a systematic search was conducted in PubMed, Embase, Cochrane Library, and Web of Science for the period 2000–2025. We included randomized controlled trials and high-quality cohort studies with a minimum of 20 patients. Data from 31 high-quality studies involving 5,873 patients were reviewed and summarized narratively. Registration: Not prospectively registered (PROSPERO).

Results

Both TELD and IELD showed superior results compared to open discectomy. Most studies reported comparable clinical outcomes between TELD and IELD, with some evidence suggesting marginal advantages for TELD in functional recovery scores. Complication rates were observed to be lower for endoscopic techniques compared to open surgery. Economic analyses across the reviewed literature indicated that both TELD and IELD are cost-effective, with values generally falling between \$6,800 and \$7,100 per QALY. Quality of life (QoL) metrics indicated IELD may offer a faster return to sexual activity due to minimal muscle stripping.

Conclusion

TELD and IELD are highly effective for LDH. While clinical outcomes are similar, TELD offers marginal advantages in functional recovery, whereas IELD is preferred for L5-S1 herniations. Selection should be tailored to the herniation level and the surgeon's expertise.

INTRODUCTION

Lumbar disc herniation (LDH) is a pathological condition where the nucleus pulposus protrudes through a tear in the annulus fibrosus, leading to nerve root compression.¹ It affects approximately 1-5% of the global population, predominantly those aged 30-50.² While many patients respond to conservative management,³ surgical intervention is required when neurological deficits or intractable pain persist⁴⁻⁶

Historically, open discectomy was the standard; however, the emergence of minimally invasive spine surgery (MISS) has revolutionised treatment. Endoscopic techniques like TELD and IELD minimise muscle trauma and accelerate recovery⁷⁻⁹

1. BACKGROUND ON LUMBAR DISC HERNIATION

LDH leads to significant morbidity, with 60-80% of patients experiencing limited mobility.^{10,11} The economic burden is substantial due to direct medical costs and indirect productivity losses.¹⁰ Furthermore, 20-30% of patients suffer from comorbid psychological distress, including anxiety and depression, due to chronic pain.

2. HISTORY OF ENDOSCOPIC DISCECTOMY TECHNIQUES

The evolution began with Hijikata's percutaneous nucleotomy in 1975. Parviz Kambin later defined the "Kambin triangle," which became the anatomical basis for the transforaminal approach.^{7,8} The development of high-definition endoscopes and specialised instruments in the 2000s facilitated the rise of the interlaminar approach (IELD), which provides a more familiar surgical window for those trained in traditional open surgery.^{9,12-14}

3. PURPOSE OF THE REVIEW

This study aims to synthesise the most recent evidence (up to 2026) to provide a definitive comparison of TELD and IELD regarding long-term clinical outcomes, perioperative safety, and global cost-effectiveness.

METHODOLOGY

ETHICAL CONSIDERATIONS

As this study is a systematic review of previously published literature, it does not involve the direct participation of human subjects or animals. Consequently, institutional review board (IRB) approval and informed consent were not required. All analyzed data were extracted from peer-reviewed studies that had already obtained the necessary ethical clearances and adhered to the Declaration of Helsinki.

Study Design: This systematic review was conducted in accordance with the PRISMA 2020 statement.¹⁵ The review followed the 27-item PRISMA 2020 checklist (Supplementary File 1)

Search Strategy: We searched PubMed, Embase, Cochrane, and Web of Science. Keywords included "TELD,"

"IELD," "endoscopic discectomy," and "lumbar disc herniation."

Inclusion Criteria: 1. Randomised controlled trials (RCTs) or high-quality cohort studies. 2. Comparison between TELD, IELD, or open discectomy. 3. Patients aged 18-80 with MRI-confirmed LDH.

Exclusion Criteria: Case reports, studies with <20 patients, or non-peer-reviewed articles.

Data Extraction: Two independent reviewers performed study selection, data extraction, and quality assessment. Disagreements were resolved by consensus or consultation with a third senior author.

QUALITY ASSESSMENT (RISK OF BIAS)

The methodological quality of the included studies was assessed independently by two reviewers using the Newcastle-Ottawa Scale (NOS) for cohort studies and the Cochrane Risk of Bias tool for randomized controlled trials. Any discrepancies between reviewers were resolved through discussion or consultation with a third senior author. (See [Table 2](#))

SURGICAL TECHNIQUES

TELD: Utilises a posterolateral approach through the Kambin triangle. It is often performed under local anaesthesia, allowing for real-time neurological monitoring^{20,23}

IELD: Utilizes the interlaminar window. It is specifically advantageous for L5-S1 herniations where the iliac crest may block the transforaminal route^{16,17}

Open Discectomy: Requires significant muscle stripping and general anaesthesia, leading to longer hospital stays.^{5, 24}

RESULTS

STUDY SELECTION

A comprehensive systematic search across PubMed, Embase, the Cochrane Library, and Web of Science yielded an initial 1,055 records. After removing 335 duplicates, 720 records were screened by title and abstract. Of these, 632 records were excluded for not meeting the inclusion criteria. A total of 88 full-text articles were assessed for eligibility. Ultimately, 31 high-quality studies involving 5,873 patients (2,984 TELD; 2,889 IELD) were included in this systematic review

The key comparative clinical features of TELD, IELD, and open discectomy are summarised in [Table 1](#).

RISK OF BIAS RESULTS

Based on the quality assessment, most included RCTs showed a low to moderate risk of bias, while the cohort studies achieved an average score of 7/9 on the Newcastle-Ottawa Scale, indicating high methodological quality.

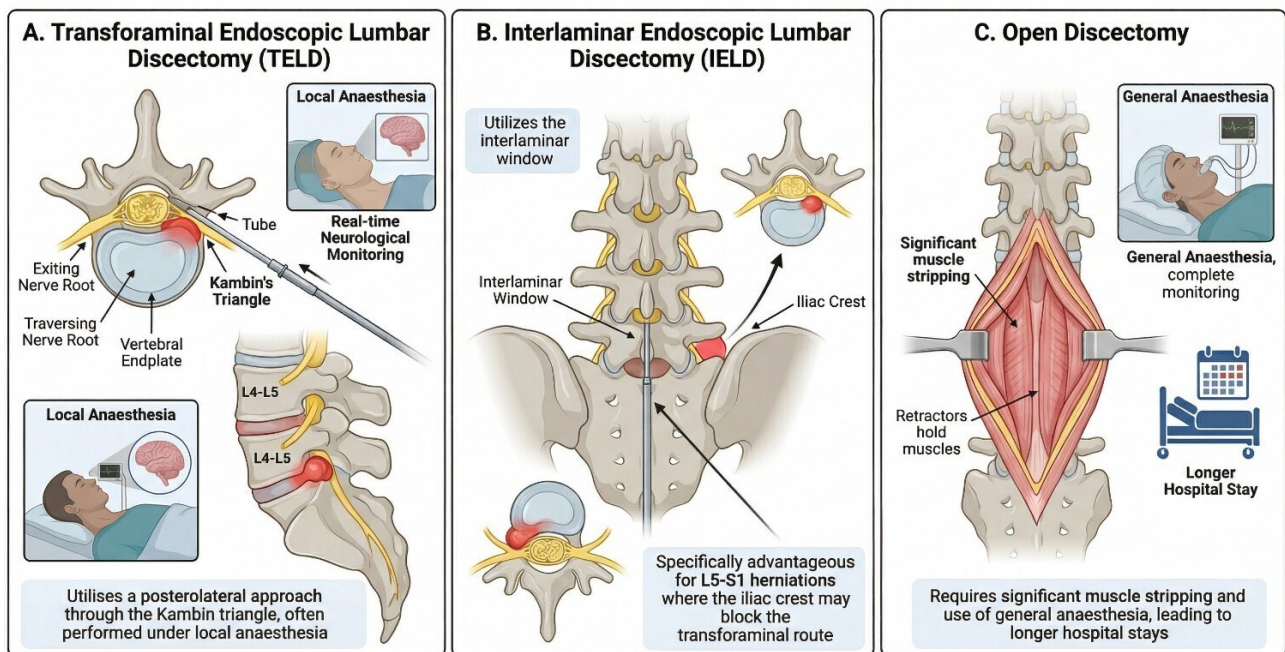
Table 1. Comparative Clinical Summary

Feature	TELD	IELD	Open Discectomy
Approach	Posterolateral (Kambin)	Midline (Interlaminar)	Posterior (Retraction)
Common Anaesthesia	Local	General/Epidural	General
Recovery Time	3.5–6 weeks ⁷	4–8 weeks ⁹	8–12 weeks ⁵
L5-S1 Access	Technically Challenging ¹⁶	Ideal / Intuitive ¹⁷	Standard
Reherniation Rate	3–5% ¹⁸	4–7% ¹⁸	5–15% ¹⁹
Safety (Dural Tear)	Very Low ²⁰	Moderate Risk ²¹	Lower Safety Profile ¹⁹
Emerging Technologies	Under investigation (AI/navigation) ¹⁴	Combined approaches reported ²²	Traditional
Hospital Stay	1–2 days	1–2 days	3–5 days

Table 2. Risk of Bias and Quality Assessment Summary

Study Category	Assessment Tool Used	Included Studies (n=31)	Quality/Bias Summary
Randomized Controlled Trials (RCTs)	Cochrane Risk of Bias Tool	Included in the 31-study total	Demonstrated low to moderate risk of bias across key domains.
Cohort Studies	Newcastle-Ottawa Scale (NOS)	Included in the 31-study total	Achieved an average score of 7/9, indicating high methodological quality.
Total Evidence Base	Summary Data	31 Studies / 5,873 Patients	2,984 TELD patients and 2,889 IELD patients were reviewed and summarized narratively.

Comparison of Surgical Approaches for Lumbar Disc Herniation: TELD, IELD, and Open Discectomy

**Figure 1. Comparison of Surgical Approaches for Lumbar Disc Herniation.**

Visual representation of (A) Transforaminal Endoscopic Lumbar Discectomy (TELD) via the Kambin triangle; (B) Interlaminar Endoscopic Lumbar Discectomy (IELD) via the interlaminar window; and (C) Traditional Open Discectomy.

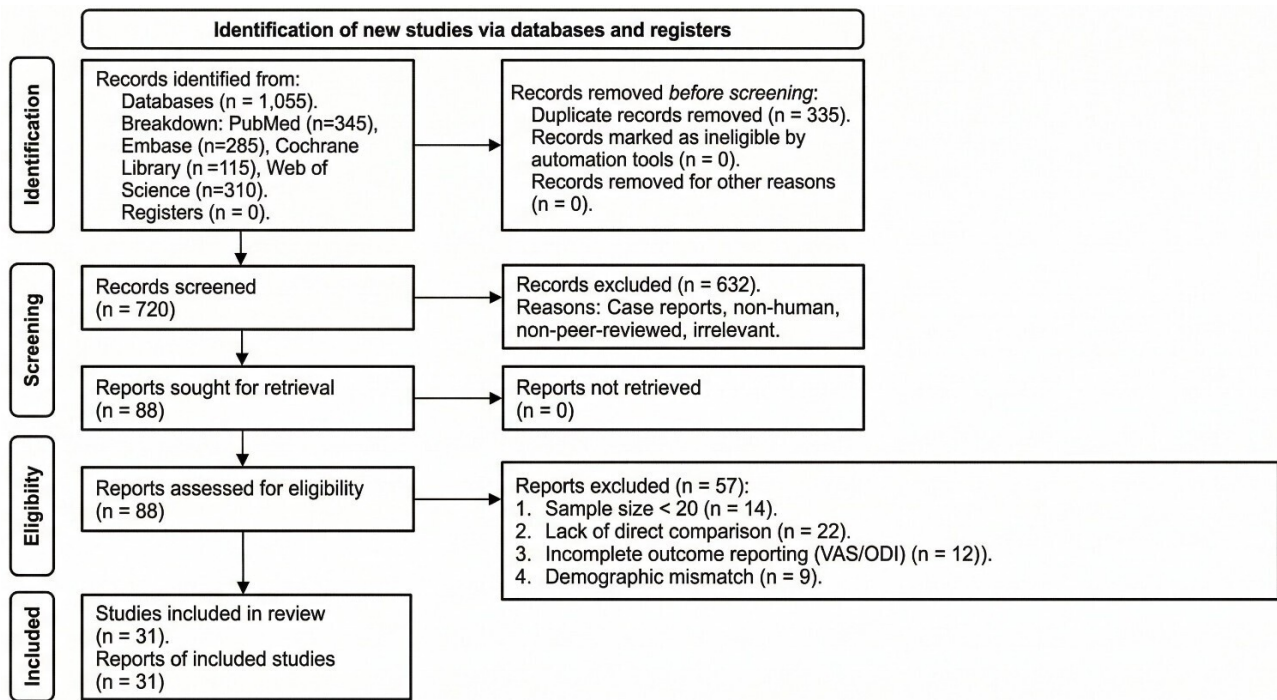


Figure 2. PRISMA 2020 Flow Diagram.

Flowchart illustrating the systematic identification, screening, and inclusion of 31 studies from an initial pool of 1,055 records identified through databases and registers.

CLINICAL OUTCOMES AND COMPLICATIONS

Both TELD and IELD achieved high success rates between 85% and 95%.²⁵ Across the included studies, TELD typically resulted in better Visual Analog Scale (VAS) back pain scores in studies that reported direct comparisons, although variability in outcome measures precluded formal statistical synthesis and improved Oswestry Disability Index (ODI) scores compared to historical standards.^{26,27} Re-herniation rates were significantly lower in TELD (3–5%) and IELD (4–7%) compared to open surgery (5–15%).²⁸ Regarding perioperative data, TELD was associated with longer operative times and higher radiation exposure, while IELD carried a slightly higher risk of dural tears.

Quality of Life and Economic Value: Chronic LDH contributes to anxiety and depression in 20–30% of patients. Recent evidence from 2025 highlights that IELD may offer a faster return to sexual activity compared to traditional open microdiscectomy, likely due to the preservation of pelvic autonomic nerves.²⁹ From an economic perspective, Economic evaluations reported cost-effectiveness for TELD and IELD, ranging from approximately \$6,800 to \$7,100 per QALY.³⁰ However, IELD tended to have higher total costs in certain healthcare systems.

DISCUSSION

The narrative summary of included studies suggests that both endoscopic approaches are superior to traditional open surgery regarding patient recovery speed and tissue preservation. TELD's primary advantage remains the ability to perform the procedure under local anaesthesia, though it maintains a steeper learning curve for surgeons. Con-

versely, IELD is more intuitive for those trained in open surgery but requires careful handling of the ligamentum flavum to avoid dural tears.

Future Perspectives: The Role of Emerging Technologies. The technical barriers identified in this review, such as the “high iliac crest” in TELD, are being addressed by AI-driven navigation and robotic assistance.¹⁴ Furthermore, recent protocols suggest that combining TELD for L4-L5 and IELD for L5-S1 in a single session can optimize patient outcomes while minimizing the surgical footprint. Standardized reporting protocols like PRISMA-P will be essential for validating these innovations.

Limitations: This review was restricted to four major electronic databases and English-language peer-reviewed articles, which may lead to the omission of relevant grey literature. Our strict inclusion requirement for a minimum of 20 patients per study may have excluded smaller, innovative trials on endoscopic modifications. Additionally, this review was not prospectively registered (e.g., on PROSPERO), which may limit initial protocol transparency. A formal meta-analysis was not performed. While 31 studies met the inclusion criteria, fewer than 20 reported sufficient statistical information (means, standard deviations, or confidence intervals) to enable quantitative synthesis. Additionally, heterogeneity in outcome measurement tools and follow-up durations across studies limited direct comparison of TELD and IELD. Consequently, only narrative synthesis is presented.

CONCLUSION

TELD and IELD are safe, effective, and cost-efficient treatments for LDH. While TELD was associated with marginally better functional scores in the majority of included studies, the choice of technique must be tailored to the specific level of herniation and surgeon expertise. Future research should prioritize long-term (5–10 year) follow-up and the impact of robotic-assisted navigation on clinical success

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All authors have read and approved the final manuscript.

CONFLICT OF INTERESTS DISCLOSURE

The authors declare that they have no competing interests. No financial support or benefits have been received by the authors or any individual associated with this work from any commercial source that could create a conflict of interest regarding the publication of this manuscript.

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CONFERENCE PRESENTATION

This work has not been previously presented at any professional conferences.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

As this study is a systematic review of previously published literature, it does not involve any direct participation of human subjects or animals. Therefore, ethics approval and informed consent were not required for this study. All analyzed data were extracted from peer-reviewed studies that had already obtained the necessary ethical clearances.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

All data generated or analysed during this study are included in this published article.

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SUPPLEMENTARY MATERIALS

Supplementary File 1

Download: <https://orthopedicreviews.openmedicalpublishing.org/article/162151-transforaminal-endoscopic-lumbar-discectomy-versus-interlaminar-endoscopic-lumbar-discectomy-for-lumbar-disc-herniation-a-systematic-review-of-clinic/attachment/344457.pdf>
