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Leg pain relief after five surgical techniques for lumbar disc herniation: a systematic review and network meta-analysis of randomized controlled trials

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ADMINISTRATIVE INFORMATION

Support - No funding was received for this study.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 September 2026 and was last updated on 27 September 2026.

INTRODUCTION

Review question / Objective In adult patients with lumbar disc herniation requiring surgery, how do open discectomy (OD), microdiscectomy (MD, including tubular), microendoscopic discectomy (MED), percutaneous endoscopic lumbar discectomy (PELD), and unilateral biportal endoscopy (UBE) compare in terms of leg pain relief?

Rationale Lumbar disc herniation (LDH) is one of the most common causes of low back pain and radicular leg pain, with a symptomatic lifetime prevalence of approximately 1%-3%. When conservative treatment fails, surgery effectively relieves nerve-root compression and leg pain. Open discectomy has long been regarded as the reference standard, but a range of less invasive techniques has since been developed: microdiscectomy (including tubular approaches), microendoscopic discectomy (MED), percutaneous endoscopic lumbar discectomy (PELD and related full-endoscopic variants), and, more recently, unilateral biportal endoscopy (UBE).

Numerous randomized trials and pairwise meta-analyses have compared subsets of these techniques with inconsistent conclusions, and recent network meta-analyses suggest that endoscopic techniques rank favorably. However, no previous network meta-analysis has compared all five techniques within a single network using a pain-specific primary outcome at a standardized follow-up time point, and UBE in particular has not been incorporated as a distinct node.

This systematic review and network meta-analysis therefore aims to compare the five surgical techniques for LDH on leg pain relief (VAS) at the last follow-up standardized to approximately 12 months, to rank the techniques using SUCRA and P-score, and to assess confidence in the evidence using the CINeMA framework.

Condition being studied Lumbar disc herniation (LDH) is the displacement of nucleus pulposus material beyond the normal margins of the intervertebral disc at the lumbar spine, which can compress or irritate the adjacent nerve roots. It most commonly affects the L4-L5 and L5-S1 segments and typically presents with low back pain and unilateral radicular leg pain (sciatica), with or without sensory or motor deficits. The lifetime prevalence of symptomatic LDH is estimated at 1%-3%, with an annual incidence of approximately 0.3-2.7 per 1000 person-years, peaking in the fourth to fifth decades of life. Most patients improve with conservative management; surgery is indicated for those with severe or persistent radicular pain, progressive neurological deficits, or cauda equina syndrome.

METHODS

Search strategy We searched PubMed, the Cochrane Library (CENTRAL), Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang Data, and VIP Database from inception to September 25, 2026, limited to English- and Chinese-language records.

The search combined controlled vocabulary and free-text terms covering three concepts: (1) the condition — "lumbar disc herniation", "disc herniation", "disc prolapse", "sciatica", "radiculopathy"; (2) the interventions — "discectomy", "diskectomy", "microdiscectomy", "microendoscopic discectomy", "percutaneous endoscopic lumbar discectomy", "transforaminal endoscopic discectomy", "interlaminar endoscopic discectomy", "unilateral biportal endoscopy"; and (3) the study design — "randomized controlled trial", "randomised", "random allocation". Terms were adapted to each database's syntax, using Medical Subject Headings (MeSH) where available.

In addition, reference lists of included studies and relevant systematic reviews were screened, and citation tracking of included trials was performed to identify further eligible studies.

Participant or population Adults (18 years and older) with lumbar disc herniation who haven't improved with medication or conservative treatment and need surgery.

Intervention Five surgical techniques for lumbar disc herniation are compared within a common network, with any pairwise combination evaluated in a randomized controlled trial being eligible:

1. Open discectomy (OD): conventional posterior open discectomy via a standard incision, with or without fenestration/laminotomy.
2. Microdiscectomy (MD): discectomy performed under a surgical microscope, including tubular retractor-assisted microdiscectomy.
3. Microendoscopic discectomy (MED): discectomy performed through a 16-18 mm tubular working channel with an endoscope.
4. Percutaneous endoscopic lumbar discectomy (PELD): full-endoscopic discectomy through a small percutaneous working channel; the PELD family is treated as one node, including transforaminal (PTED/PETD/TELD/FELD) and interlaminar (IELD) approaches.
5. Unilateral biportal endoscopy (UBE): discectomy performed through two small portals (one endoscopic viewing portal and one working portal).

Studies comparing at least two of these five techniques were included. Comparisons within the same node (e.g., PTED vs. ILED) were excluded.

Comparator In this network meta-analysis there is no single comparator arm; each of the five surgical techniques listed above serves as both intervention and comparator within the network. Head-to-head randomized comparisons between any two of the five techniques were eligible, and the network estimate for each pair was informed by direct and/or indirect evidence. For presentation purposes, percutaneous endoscopic lumbar discectomy (PELD) was used as the reference treatment, against which the other four techniques were compared.

Study designs to be included Randomized controlled trials (RCTs) only, including parallel-group two-arm and three-arm designs. Studies with quasirandom allocation (e.g., alternation, date of birth, record number), non-randomized, observational, retrospective, and cohort designs were excluded. Conference abstracts without retrievable full text were excluded.

Eligibility criteria Inclusion:
- Adult patients (aged 18 years or older) with lumbar disc herniation requiring surgical treatment.
- Trials reporting leg pain VAS (visual analogue scale) at the last follow-up as mean ± standard deviation, or in a form convertible to mean ± SD (median with interquartile range or range converted using the Wan method; 0-100 scales divided by 10).

Exclusion:

- Trials with no extractable leg pain VAS data (e.g., data presented only in figures without values, control-group SD not reported and not derivable).
- Trials restricted to patients with spinal stenosis, spondylolisthesis, fracture, infection, or tumor.
- Duplicate publications of the same trial (the report with the most complete 12-month data was used).

Information sources Electronic databases: PubMed, the Cochrane Library (CENTRAL), Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang Data, and VIP Database (from inception to September 25, 2026).

Additional sources: reference lists of included trials and relevant systematic reviews, and citation tracking of included trials.

Not searched: grey literature, conference abstracts (excluded unless published in full), trial registries as a standalone source (trial registration records retrieved through the databases were screened for corresponding published reports), and languages other than English and Chinese. Authors of unobtainable full texts were not contacted; trials whose full texts could not be retrieved were documented as excluded.

Main outcome(s) Primary outcome: leg pain intensity measured by visual analogue scale (VAS, 0-10 scale), at the last follow-up standardized to approximately 12 months after surgery.

Timing: for trials with 12-month follow-up, the 12-month value was used; for trials reporting only longer follow-ups (e.g., 24 months), the 12-month data were extracted when available; trials that did not report follow-up duration were assigned to 12 months.

Effect measure: mean difference (MD) with 95% confidence interval for each of the 10 pairwise comparisons, estimated under a random-effects network meta-analysis model.

Standardization: VAS scores reported on 0-100 scales were divided by 10; medians with interquartile ranges or ranges were converted to means and standard deviations using the Wan method.

Additional outcome(s) Secondary outcomes (not included in the network meta-analysis): back pain VAS, Oswestry Disability Index, MacNab excellent/good rate, complication and reoperation rates, operative time, and length of hospital stay.

Data management Records were deduplicated and screened by two independent reviewers (title/abstract, then full text); disagreements resolved by discussion or a third reviewer. Data were extracted independently into a standardized Excel form. Risk of bias was assessed with RoB 2. All screening and extraction records were archived for full traceability.

Quality assessment / Risk of bias analysis Risk of bias of included trials was assessed within the Cochrane Risk of Bias 2 (RoB 2) framework. The multicenter, prospectively registered trial was rated at low risk of bias; the remaining single-center, small-sample trials were rated with some concerns. Assessments informed the within-study bias domain of the CINeMA grading.

Strategy of data synthesis Random-effects frequentist network meta-analysis (Rücker's netmeta framework; τ^2 by restricted maximum likelihood). Effect measure: mean difference with 95% CI; PELD as reference treatment. Heterogeneity: Q test and I^2. Inconsistency: design-by-treatment interaction Q test and node-splitting. Ranking: SUCRA and P-score. Pairwise meta-analyses by DerSimonian-Laird. Sensitivity: 13 pre-specified scenarios. Evidence confidence: CINeMA. Publication bias: comparison-adjusted funnel and Egger test.

Subgroup analysis None. No subgroup analyses were pre-specified. Sources of heterogeneity were explored through 13 pre-specified sensitivity analyses instead.

Sensitivity analysis Twelve pre-specified scenarios: (1) 2-year follow-up studies; (2) 6-month follow-up studies; (3) (2) plus a fusion-control arm; (4) 4-year follow-up (SD imputed 0.5); (5) studies reporting overall pain; (6) excluding the largest trial (Gadjradj 2022); (7) excluding the three-arm trial (Teli 2010); (8) Gadjradj full cohort (n=304); (9) plus 3 Chinese RCTs; (10) excluding two-level trial (Morsy 2026); (11) (9)+(10); (12) plus quasi-randomized trial (Liu G 2026).

Language restriction Yes. Studies published in English or Chinese were eligible.

Country(ies) involved China.

Other relevant information None.

Keywords lumbar disc herniation; discectomy; microdiscectomy; microendoscopic discectomy; percutaneous endoscopic lumbar discectomy;

unilateral biportal endoscopy; network meta-analysis; leg pain.

Contributions of each author

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