



TRANSFORAMINAL ENDOSCOPIC REMOVAL OF RECURRENT LUMBAR DISC EXTRUSION AFTER PRIOR MICRODISCECTOMY: A CASE SERIES ANALYSIS AND LITERATURE REVIEW

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Objective. To evaluate the clinical efficacy of transforaminal endoscopic discectomy (TESSYS) for recurrent lumbar disc herniation initially removed by microdiscectomy.

Material and Methods. A retrospective observational case series study ($n = 24$) was performed. In 2024–2025, patients with recurrent disc herniation at L4–L5 ($n = 14$) or L5–S1 ($n = 10$) level underwent transforaminal endoscopic removal of the herniation (TESSYS). Recurrence was defined as repeated detection of herniated material at the same level and side with recurrence of radicular symptoms after a period of clinical improvement of 1 month or more. Outcomes were assessed using VAS (back and leg pain), ODI and MRC before surgery, at discharge, and after 3 and 12 months. Achievement of MCID for ODI, length of hospital stay, and complications were analyzed.

Results. The average age of patients was 48.3 ± 11.0 years, and length of hospital stay was 1.46 ± 0.66 days. Statistically significant improvement in VAS and ODI was observed at all follow-up stages ($p < 0.001$). By 12 months the VAS score for back pain decreased from 6.21 ± 1.50 to 0.75 ± 0.85 , and for leg pain — from 6.92 ± 1.06 to 0.38 ± 1.06 . The ODI score decreased from $58.50 \pm 14.08\%$ to $4.54 \pm 7.56\%$ by 12 months; MCID was achieved in 100% of patients. Muscle strength (MRC) increased from 4.00 ± 1.29 to 4.71 ± 0.69 by 12 months. No intraoperative complications (nerve root injury, dural tear, infection) were observed. In two patients (8.3%), transient paresthesia/dysesthesia was identified and resolved conservatively within 2 weeks; in one patient (4.2%), a recurrence at 10 months required decompression and stabilization surgery.

Conclusion. In the presented series, TESSYS demonstrated high clinical efficacy and safety for recurrent disc herniation; however, this interpretation is limited by the small sample size and the lack of own control group.

Key Words: transforaminal endoscopic discectomy; TESSYS; recurrent disc herniation; microdiscectomy.

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Lumbar intervertebral disc herniation is a common cause of lower extremity pain and one of the most frequent forms of degenerative spinal pathology [1, 2]. The management strategy for lumbar disc herniation varies and is determined by the size and location of the herniation relative to neural structures, spinal canal characteristics, segment stability, the duration and severity of pain, as well as the surgeon's personal priorities and capabilities.

Lumbar microdiscectomy is considered the gold standard for the treatment of lumbar disc herniation, achieving favorable outcomes in 90–92% of cases

[3]. At the same time, recurrent disc herniation remains one of the most widely discussed issues following microdiscectomy, often requiring reoperation. The recurrence rate ranges from 5% to 26%, with the cumulative risk of reoperation reaching 25% at 10 years [4].

In recent years, percutaneous endoscopic procedures for lumbar discectomy have become increasingly popular [5]. The efficacy and safety of endoscopic techniques, particularly the transforaminal endoscopic approach (TESSYS), have been confirmed by a number of clinical studies [6, 7]. The TESSYS technique accesses the herniation through a natu-

ral anatomical window known as Kambin's triangle, thereby minimizing tissue trauma and blood loss while accelerating postoperative recovery [8, 9]. The recurrence rate after TESSYS ranges from 3.6% to 10.0% [10].

Although some patients with recurrent intervertebral disc herniation may improve with conservative therapy, the majority ultimately require repeat surgery [11]. Regardless of the chosen technique, revision surgery is more complex due to cicatricial adhesions and is associated with an increased risk of iatrogenic injury to neuro-osseous and ligamentous structures [12]. Open and endoscopic inter-

laminar approaches in revision surgeries are typically performed through the previously operated interlaminar window and, therefore, inevitably involve dissection within the zone of epidural fibrosis and cicatricial adhesions. This increases the technical complexity of mobilizing the dural sac and nerve root, limits the visualization of anatomical landmarks, and risks a higher rate of intraoperative complications, primarily dural tears with liquorrhea, iatrogenic nerve root injury, and severe epidural bleeding/hematoma [13].

Compared with open or endoscopic interlaminar approaches, TESSYS potentially allows for partial or complete avoidance of the scarred area due to a different approach trajectory, while minimizing the impact on osseoligamentous structures that ensure spinal stability. However, the number of studies evaluating the efficacy of TESSYS for recurrent lumbar disc herniation remains limited. Therefore, the present study performed a retrospective analysis of the clinical efficacy and safety of TESSYS in patients with recurrent lumbar disc herniation, with a subsequent comparison of outcome measures against literature series of revision microdiscectomy (external historical control).

The aim of the study is to evaluate the clinical efficacy of TESSYS for recurrent lumbar disc herniation initially treated with microdiscectomy.

Material and Methods

A retrospective observational case series study was conducted ($n = 24$) with recurrent lumbar disc herniation following microdiscectomy who underwent transforaminal endoscopic surgery via the TESSYS technique between 2024 and 2025.

The study was conducted in accordance with the principles of the Declaration of Helsinki by the World Medical Association (2013 revision). All patients provided written informed consent to participate in the study and for the publication of their anonymized medical data.

Recurrent disc herniation was defined as the re-emergence of herniated materi-

al at the same level and on the same side, accompanied by the return of radicular symptoms following a period of clinical improvement (of at least one month) after the primary microdiscectomy.

All patients underwent non-contrast MRI of the lumbar spine. The standard protocol included sagittal T1- and T2-weighted, coronal T2-weighted, as well as axial T2- and T1-weighted imaging at the disc level and adjacent segments. The MRI was initially interpreted by a radiologist (study description) and subsequently verified by a spinal surgeon for clinical-radiological correlation.

Inclusion criteria:

- 1) aged ≥ 18 years;
- 2) previous lumbar microdiscectomy at the clinically significant level;
- 3) a period of clinical improvement of at least 1 month following the primary surgery (characterized by complete and sustained resolution of radicular pain);
- 4) recurrent, clinically significant radicular pain (lumboischialgia) concordant with the level of the lesion and refractory to conservative therapy; and
- 5) MRI-confirmed recurrent disc herniation at the index level correlating with clinical symptoms.

Exclusion criteria:

- 1) foraminal herniation, extraforaminal herniation;
- 2) degenerative lumbar deformity;
- 3) spondylolisthesis (Meyerding grade ≥ 1);
- 4) instability at the previously operated level according to flexion-extension radiography (translation > 3 mm, angulation $> 10^\circ$);
- 5) other pathology determining the pain syndrome (central stenosis); and
- 6) infectious and neoplastic involvement of the spine.

The following methods were used in the study:

- 1) neurological examination and general physical examination to objectively assess the patient's condition;
- 2) to quantify pain intensity, the Visual Analogue Scale (VAS, 0–10) was used at baseline, at discharge, and at 3 and 12 months postoperatively;
- 3) the degree of disability was assessed using the Oswestry Disability Index

(ODI; 0–100%) at the same time points; and

4) muscle weakness was assessed using the Medical Research Council (MRC) sum score.

All patients underwent clinical and neurological examinations, including assessments of sensation, muscle strength, and nerve tension signs. Instrumental verification was performed using lumbar spine MRI. Outcomes were assessed at fixed time points: preoperatively, at discharge, and at 3 and 12 months postoperatively.

The primary endpoint was the change from baseline in the Oswestry Disability Index (ODI) score at 12 months. The minimally clinically important difference (MCID) for the ODI was defined as a reduction of at least 30% from the baseline score [14]. Secondary endpoints included back and leg pain severity on the VAS preoperatively, at discharge, and at 3 and 12 months postoperatively; changes in neurological status, with muscle strength assessed using the MRC scale; and the incidence of adverse outcomes/complications by 12 months.

Additionally, a retrospective subanalysis of the available postoperative lumbar spine MRI data was performed. Postoperative MRI was not part of the standard follow-up protocol for all patients; it was performed in a subset of patients based on clinical indications and/or as part of routine control imaging. The analysis was descriptive in nature. Assessments included signs of adequate decompression, residual or recurrent herniated material, persistent nerve root or dural sac compression, and pronounced postoperative changes requiring clinical-radiological correlation. The interpretation was based on the radiologist's report, with subsequent verification by the attending surgeon.

Surgical technique

Surgical intervention was performed under general anesthesia without muscle relaxants using the standard TESSYS transforaminal endoscopic technique with a small-diameter (7.0–7.5 mm) working channel. Access was established via a transforaminal window (within Kambin's triangle) under fluoroscop-

ic guidance, with sequential advancement of a guidewire, dilators, and the placement of a working cannula. Limited foraminoplasty was performed when necessary to ensure an adequate trajectory and decompression. Following the introduction of the endoscope, all manipulations were performed under direct endoscopic control, which allowed for safe navigation amid cicatricial-adhesive changes and visual differentiation between scar tissue, nerve root/dural sac elements, and herniated material. Herniated fragments were removed using endoscopic graspers, with the primary objective of relieving nerve root compression and restoring its free flotation. Hemostasis was achieved by targeted coagulation under direct visualization, with minimal traction on the nerve structures. The final stage involved a control revision of the decompression zone to confirm the absence of residual herniation and stable hemostasis, followed by cannula removal and wound closure.

Statistical data analysis

Statistical analysis was performed using GraphPad Prism software, version 9.0 (GraphPad Software Inc., USA). For quantitative variables, the number of observations (N), mean (M), standard deviation (SD), median (Me), lower and upper quartiles (Q1, Q3), and minimum and maximum values were calculated. Both mean $\pm$ SD and median [IQR] were reported to account for data asymmetry and the bounded nature of the clinical scales (VAS, ODI, MRC), especially given the small sample size. For categorical variables, absolute and relative frequencies (n , %) were calculated. The normality of the differences was assessed using the Shapiro–Wilk test. Paired Student's t -test was used for normally distributed differences, whereas the Wilcoxon signed-rank test with Holm's correction was applied for non-normal distributions. Statistical significance was set at $p < 0.05$.

Results

The study included 24 patients with recurrent lumbar disc herniation following microdiscectomy who underwent endoscopic surgery using

the TESSYS technique. 12-month outcome data were available for 24/24 (100%) patients. The mean age was 48.3 ± 11.0 years; Me 48 (IQR 40–52). Males – 15 (62.5%), females – 9 (37.5%). The mean length of hospital stay was 1.46 ± 0.66 days. Levels of lesion: L4–L5 ($n = 14$) и L5–S1 ($n = 10$). Left-sided cases predominated. (L: $n = 16$; R: $n = 8$; L > R).

Dynamics of clinical outcomes

Back pain severity measured by VAS. Baseline: 6.21 ± 1.50 , Me 6.00 (IQR: 5.00–7.25).

At discharge: 1.71 ± 1.08 points; at 3 months: 0.92 ± 0.78 points; at 12 months 0.75 ± 0.85 scores

1. Preoperative vs. discharge: an improvement of 4.50 (95% CI: 3.88–5.08), $p < 0.001$.

2. Preoperative vs. 3 months postoperation: improvement of 5.29 (95% CI: 4.75–5.79), $p < 0.001$.

3. Preoperative vs. 12-month post-surgery: an improvement of 5.46 (95% CI: 4.92–6.00), $p < 0.001$.

Leg pain (VAS). Baseline: 6.92 ± 1.06 , Me 7.00 [6.00; 8.00];

At discharge: 1.21 ± 1.06 ; at 3 months: 0.50 ± 0.78 ; at 12 months: 0.38 ± 1.06 .

1. Preoperative vs. discharge: an improvement of 5.71 (95% CI: 5.29–6.08), $p < 0.001$.

2. Preoperative vs. 3 months postoperation: improvement of 6.42 (95% CI: 5.96–6.88), $p < 0.001$.

3. Preoperative vs. 12-month postoperation: an improvement of 6.54 (95% CI: 6.04–7.00), $p < 0.001$.

Baseline ODI $58.50 \pm 14.08\%$, Me 54.00 [47.50; 74.50]; at discharge: $13.00 \pm 6.91\%$; after 3 months: $4.92 \pm 4.70\%$; after 12 months: $4.54 \pm 7.56\%$.

1. Preoperative vs. discharge: improvement 45.50 pp (95% CI 41.62–49.42), $p < 0.001$.

2. Preoperative vs. 3 months: improvement 53.58 pp (95% CI: 49.50–57.67), $p < 0.001$.

3. Preoperative vs. 12 months: improvement 53.96 pp (95% CI: 49.92–58.08), $p < 0.001$.

At 12 months, 100.0% of patients (24/24) reached the MCID (95% CI: 86.2–100.0%).

The baseline MRC score was 4.00 ± 1.29 , with a median of 4.00 [IQR: 4.00–5.00]. It significantly improved to 4.50 ± 0.93 at discharge, 4.67 ± 0.70 at 3 months, and 4.71 ± 0.69 at 12 months.

1. From baseline to discharge: an improvement of 0.50 (95% CI: 0.29–0.75), $p = 0.004$.

2. Preoperative vs. 3 months postoperatively: an improvement of 0.67 (95% CI: 0.38–1.00), $p = 0.004$.

3. Preoperative vs. 12 months: an improvement of 0.71 (95% CI: 0.38–1.04), $p = 0.004$.

No patient experienced intraoperative surgery-related complications, such as nerve root injury, dural tear, or suppuration.

The primary surgical objective was successfully achieved without any adverse events within one year in 21 (87.5%) patients. Transient paresthesia/dysesthesia was observed in 2 (8.3%) patients, which resolved within two weeks postoperatively with conservative therapy. Another patient (4.2%) experienced a recurrence at the L4–L5 level 10 months after the reoperation and underwent decompressive stabilization with a positive outcome.

Intraoperative outcomes (incision length, blood loss, operative time, and radiation exposure time during intraoperative X-ray) are presented in Table. At all follow-up time points, statistically significant improvements with large effect sizes were observed in VAS (back/leg) and ODI scores compared to baseline ($p < 0.001$). For the MRC score, a significant increase in muscle strength was observed by discharge, with the effect sustained at 12 months ($p = 0.004$).

Postoperative MRI was available for 16 (66.7%) of 24 patients. Follow-up imaging was conducted at different times after surgery and analyzed retrospectively as a supplementary radiological parameter. In most of the available observations, signs of adequate decompression of nerve structures were noted without a residual clinically significant compressing substrate. In several cases, postoperative soft tissue and reactive cicatricial changes were visualized, the interpretation of which required correlation with

the clinical picture. In a patient with a subsequent recurrence after 10 months, a follow-up MRI confirmed a recurrent discoradicular conflict. Given the selective nature of postoperative MRI, radiological findings were not used as an independent primary endpoint for evaluating the method's efficacy.

Case study

A 47-year-old male patient was admitted to the neurosurgical department from 18.12.2024 to 20.12.2024, with ICD-10 diagnosis M51.1: degenerative disc disease of the lumbar spine, recurrent L4–L5 disc herniation, acute left-sided L5 radiculopathy, and severe painful and muscular-tonic syndrome; the patient's medical history included a left-sided microsurgical L4–L5 disc sequestrectomy performed on 03.10.2016.

Chief complaints at admission: low back pain (VAS 6/10), bilateral gluteal pain (VAS 6/10), and pain radiating down the posterior aspect of the left thigh and calf (VAS 8/10).

Medical history: In September 2016, the patient was diagnosed with a left-sided sequestered L4–L5 disc herniation accompanied by severe L5 radiculopathy. On 03.10.2016, the patient underwent surgical treatment consisting of a left-sided L4–L5 microdiscectomy, resulting in positive clinical outcomes. In December 2024, the patient experienced progressively worsening pain in the lumbar spine and left lower extremity. Conservative therapy showed no substantial efficacy.

Instrumental diagnostics: MRI, CT of the lumbar spine, and functional radiography were performed. A recurrent left L4–L5 disc herniation with caudal migration into Lee zone 3 was identified; no signs of instability were found (Fig. 1).

Neurological status: No focal neurological deficits were detected (muscle strength 5/5, no sensory deficits, pathological reflexes absent), the gait was antalgic; lumbar spine range of motion was restricted, lumbar lordosis was flattened, Lasegue's sign was positive on the left; the patient ambulated with great difficulty.

Based on the clinical and radiographic findings, the patient was hospitalized for surgical treatment.

Treatment: on 19.12.2024, the patient underwent a video-endoscopic transforaminal L4–L5 disc herniation removal on the left (Fig. 2).

The transforaminal endoscopic approach was selected given the recurrent nature of the L4–L5 herniation and the caudal migration of the fragment (Lee zone 3), as this route provides direct access to the discoradicular conflict without extensive revision of the posterior structures. The absence of instability signs on dynamic radiographs justified performing isolated decompression without stabilization. An additional argument in favor of the transforaminal approach for recurrence was the desire to minimize tissue trauma at the previous surgical site and reduce the extent of dissection.

In the postoperative period, the visual analog scale (VAS) pain scores were 0/10 for leg pain and 2/10 for back pain. The patient was discharged on postoperative day 2 in satisfactory condition. At follow-up examinations at 3 and 12 months, the patient had no complaints.

Discussion

A recurrence of a lumbar intervertebral disc herniation is defined as a condition where, following surgical intervention, a patient experiences resolution or significant reduction of leg pain, but after a certain period, a repeated herniation of the nucleus pulposus occurs, leading to compression of the corresponding nerve root or dural sac and a recurrence of pain in the lower back and lower extremity. Diagnosis and treatment of recurrent intervertebral disc herniation

are associated with significant costs and impose a substantial financial burden [15]. Currently, there is no universally accepted definition of lumbar disc herniation recurrence. Several authors suggest that a symptom-free interval of at least 6 months is required to diagnose recurrence after the primary surgery [16]. In other studies, recurrence is defined as the return of a hernia at the same level following a symptom-free interval of more than 1 month after the resolution of preoperative symptoms [17].

Currently, recurrent lumbar disc herniation is predominantly treated by repeat microdiscectomy performed via a conventional surgical approach [18]. Although this approach allows for a more radical removal of herniated material and, if necessary, provides additional stabilization of the spinal segment, it is concurrently associated with higher surgical risk, increased operative time, greater intraoperative blood loss, and higher overall treatment costs [19].

To establish an external literature benchmark, we conducted a narrative review of studies focusing on revision microdiscectomy (repeated microdiscectomy/redisectomy) for recurrent lumbar disc herniation following primary discectomy/microdiscectomy. The data obtained were used to reference-match the results of the current observation series with published rates (external historical control).

Based on the criteria of maximum comparability with our dataset, the optimal matches were the single-center retrospective study of revision microdiscectomy by Mashhadinezhad et al. with a 12-month follow-up [20] and the regis-

Table

Intraoperative parameters

Parameter	Mean (M ± SD)
Incision length, cm	0.7 ± 0.2
Operative time, min	60.7 ± 12.5
Blood loss, ml	17.0 ± 5.8*
Radiation exposure time, sed	23.0 ± 5.5

* Intraoperative blood loss was calculated as the volume of aspirate minus the volume of irrigation fluid administered.

try-based study by Mehren et al. of microscopic revision after discectomy with 12- and 24-month follow-ups [21].

In a retrospective revision microdiscectomy series by Mashhadinezhad et al. ($n = 179$), VAS scores for back pain decreased from 7.18 ± 1.44 to 1.92 ± 0.79 , and leg pain scores dropped from 9.26 ± 0.95 to 1.69 ± 0.63 . Additionally, the Oswestry Disability Index (ODI) improved from 77.89 ± 11.18 to 32.83 ± 20.16 . The frequency of incidental durotomy was 15/179 (8.3%), with the authors reporting no associated severe complications. An overall assessment using the Prolo scale showed that 56% (101/179) of the patients achieved a good/excellent outcome, whereas 44% (78/179) had a satisfactory/poor result [20].

In a study by Mehren et al. [21], patients who underwent microscopic revision showed improvement in ODI scores (from 45.9 to 22.4 at 12 months) and a reduction in pain. Specifically, back pain VAS scores decreased from 43.9 to 27.0, and leg pain VAS scores decreased from 65.5 to 25.0 at 12 months (a 100-point VAS was utilized in this study). In a subanalysis focusing on intraoperative complications, the incidence of dural tears during revision surgery was 9/117 (7.7%). At 12 months, more than 80% of patients in the revision group rated their outcome as acceptable (55.8% were fully satisfied and 25.0% were mostly satisfied). A standardized quantitative assessment of neurological status (e.g., using the MRC scale) was not reported in the reviewed publications; therefore, the literature comparison was limited to ODI/VAS outcomes and complication rates.

An external comparison with reports on revision microdiscectomy confirms a comparable trend of ODI/VAS improvement within the relevant follow-up periods; however, the literature more frequently reports durotomy rates (7.7–8.3%), which may suggest potential advantages of the endoscopic approach in the presence of cicatricial changes, warranting confirmation in comparative studies.

In our cohort, the rate of good and excellent outcomes reached 87.5%, which, combined with favorable ODI/VAS

dynamics, may reflect the potential of the endoscopic approach in the presence of scarring. At the same time, the literature more frequently reports a higher frequency of incidental durotomy during open revision surgeries (7.7–8.3%), which also indirectly suggests the potential advantages of the endoscopic approach; however, this requires confirmation in prospective comparative studies with standardized outcome criteria.

In recent years, the TESSYS endoscopic technique has been considered an alternative approach for treating recurrent lumbar disc herniation. The TESSYS utilizes a small-diameter working channel (7–7.5 mm), minimizing the need for extensive bone resection and thereby preserving segmental stability. The procedure is performed under direct endoscopic visualization, which facilitates the identification of scar tissue, nerve roots,

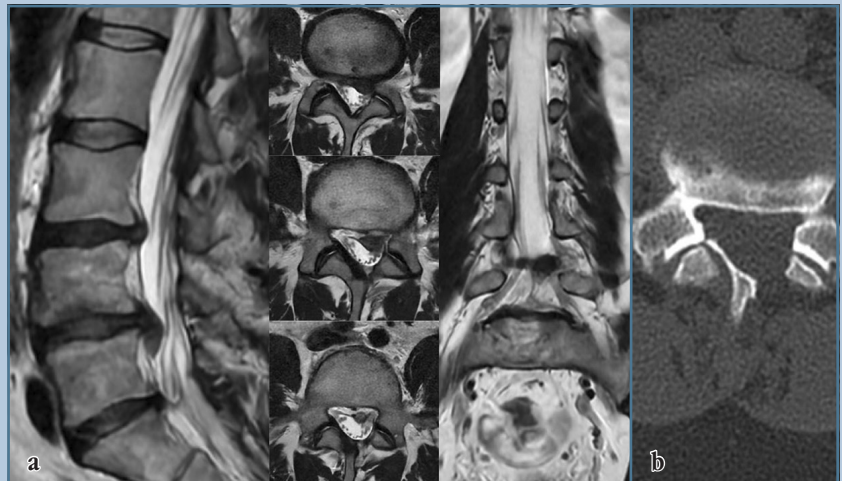


Fig. 1

Preoperative lumbar spine MRI and CT scans of a 47-year-old patient: (a) sagittal, axial, and coronal T2-weighted MRI scans demonstrating a recurrent L4–L5 disc herniation with inferior migration into Lee zone 3; (b) axial CT scan at the L4 level demonstrating a left-sided laminar bone defect



Fig. 2

Postoperative T2-weighted sagittal, axial, and coronal MRI scans. Complete decompression of the neural structures was achieved at L4–L5

vascular structures, fragments of the nucleus pulposus, and other anatomical structures. Hoogland et al. [22] reported on the endoscopic transforaminal treatment of 262 patients with recurrent lumbar disc herniation, achieving a good/excellent outcome rate of 85.70%. The recurrence rate was 4.62%. In a study by Xu et al. [23], 31 patients with recurrent lumbar disc herniation were followed up for two years after TESSYS; the rate of good/excellent outcomes was 83.9%, which is comparable to previously published data, with no further recurrence reported.

When analyzing post-revision MRI scans, it is critical to note that radiological findings do not always correlate directly with the clinical outcome. Postoperative fibrosis, reactive tissue changes, and epidural space alterations can mimic persistent discoradicular conflict or obscure its accurate assessment. Therefore, neuroimaging data should be interpreted in correlation with clinical neurological progression, along-

side intraoperative findings on the extent of compressing hernia fragment removal and the adequacy of neural decompression.

The present study has several limitations. First, the sample size is relatively small ($n = 24$), requiring an expansion of the cohort and a longer follow-up period. Second, the lack of an internal control group of patients undergoing revision microdiscectomy precludes a direct comparison of treatment modalities within a single study. For contextual mapping, literature data served as an external control. This approach inevitably carries a risk of systematic bias, including population heterogeneity (such as varying recurrence criteria and baseline clinical and morphological characteristics) and differences in surgical techniques. Therefore, the results of this literature comparison should be interpreted as a benchmark against published data rather than evidence of superiority of one method over another.

An additional limitation of this study is the lack of a standardized postop-

erative MRI protocol across the entire cohort. Postoperative MRI scans were available for only a subset of patients, which limits the ability to extrapolate these radiological findings to the entire cohort.

Conclusion

This study demonstrates that TESSYS is highly effective for recurrent lumbar disc herniation and may yield superior outcomes compared to microdiscectomy, with a potentially lower complication rate. Compared to microdiscectomy, the TESSYS technique appears to offer several advantages, including a lower incidence or total absence of iatrogenic neurological injury, direct access to the disc extrusion, and an approach unaffected by scar tissue in patients with a history of prior microdiscectomy. These potential advantages warrant validation in comparative studies.

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