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RESEARCH ARTICLE
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TRANSDURAL APPROACH FOR HERNIATED DISC PROSPECTIVE OBSERVATIONAL STUDY AT TERTIARY CARE CENTRE

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ABSTRACT

Background: Herniated intervertebral disc is a prevalent cause of radiculopathy and neurological impairment in adults. While traditional posterior extradural discectomy remains the standard surgical intervention, its limitations become evident in cases with ventrally located, migrated, or calcified disc fragments. The transdural approach provides a direct corridor to such challenging lesions, particularly in thoracic and upper lumbar levels, but remains underutilized due to concerns regarding cerebrospinal fluid leakage and neurological risks.

Aim: To evaluate the safety, efficacy, and functional outcomes of the transdural approach for herniated disc in a prospective cohort of patients undergoing surgery at a tertiary neurosurgical center.

Methods: This prospective study was conducted over a 24-month period and included 30 patients with thoracic or upper lumbar herniated discs who were not suitable candidates for standard extradural discectomy. All patients underwent surgery using a transdural corridor under operative microscopy. Neurological function was assessed before and after surgery using the Modified Japanese Orthopaedic Association (mJOA) score and the Visual Analog Scale (VAS) for pain. Data on operative time, estimated blood loss, hospital stay, and complications were systematically recorded.

Results: The mean operative time was 122 ± 16 minutes, and the mean intraoperative blood loss was 138 ± 35 milliliters. Postoperative VAS scores improved significantly from a preoperative mean of 7.5 to 2.5 ($p < 0.001$). The mJOA scores improved by an average of 3.1 points. Complications included transient cerebrospinal fluid leakage in 2 patients (6.7%) and transient neurological worsening in 1 patient (3.3%), all of whichh resolved within two weeks. The average hospital stay was 4.0 ± 1.2 days. No permanent neurological deficits or deaths were reported. **Conclusion:** The transdural approach represents a safe and effective alternative in carefully selected patients with herniated disc, especially when the ventral pathology is inaccessible or poses high risk via the traditional posterior route. With refined microsurgical techniques, the morbidity associated with this approach can be minimized, offering favorable neurological and functional recovery.

Keywords: Herniated disc, transdural discectomy, thoracic disc herniation, lumbar disc herniation, spinal surgery, cerebrospinal fluid leak .

Introduction

Herniated intervertebral disc disease is one of the most common spinal pathologies encountered in clinical neurosurgery, significantly impacting quality of life and work productivity in adults worldwide. The pathological process typically involves extrusion or sequestration of the nucleus pulposus through a weakened annulus fibrosus, resulting in compression of the adjacent neural structures and associated symptoms ranging from back pain and radiculopathy to myelopathy and cauda equina syndrome [1].

The standard surgical technique for symptomatic herniated discs unresponsive to conservative management is the posterior extradural discectomy. While this method remains widely accepted due to its straightforward access and generally favorable outcomes, it is often limited when addressing disc fragments that are ventrally located, calcified, or migrated beyond conventional exposure zones, particularly in thoracic and upper lumbar segments [2,3]. In such scenarios, achieving complete decompression without risking iatrogenic cord or nerve injury can be challenging through an extradural route alone.

The transdural approach has re-emerged as a technically viable and anatomically direct method to address ventral spinal lesions, including disc herniations, especially in anatomically constrained regions. First reported in the early 20th century, this approach was largely abandoned due to high rates of cerebrospinal fluid (CSF) leaks and neurological morbidity [4]. However, the advent of high-resolution microsurgical techniques, intraoperative neuromonitoring, and advanced dural closure materials has significantly reduced these risks, renewing interest in this method as a safe and precise corridor to anterior spinal pathology [5,6].

In the thoracic spine, where the spinal cord occupies a larger portion of the canal and the discs are relatively small and calcified, the transdural approach offers a direct visualization of the ventral compressive pathology without extensive bone resection or spinal cord retraction [7]. Similarly, in selected lumbar cases, especially involving the upper lumbar levels or highly migrated fragments, a transdural route allows surgeons to circumvent obstacles posed by the narrow canal or facet orientation [8].

Despite these potential advantages, there remains a paucity of robust prospective data evaluating the functional outcomes, safety, and complication profile of the transdural approach in routine practice. Most existing literature comprises small case series, retrospective reports, or technical notes with limited patient numbers and variable follow-up [9,10]. Moreover, this approach is often reserved as a last resort or bailout strategy rather than being considered a primary option.

This prospective study was thus designed to fill this critical knowledge gap by systematically evaluating the clinical efficacy, neurological outcomes, perioperative morbidity, and patient satisfaction associated with the transdural approach for herniated disc in both thoracic and lumbar spine. The goal is to determine whether this approach can serve as a reliable and reproducible technique in selected patient populations when traditional extradural routes are suboptimal or contraindicated.

Aims and Objectives

The primary aim of this prospective study is to evaluate the clinical safety, surgical efficacy, and neurological outcomes of the transdural approach in the surgical management of herniated intervertebral discs in the thoracic and upper lumbar spine.

Specific objectives include:

1. To analyze preoperative and postoperative neurological status using standardized clinical scoring systems.
2. To assess the degree of pain relief and functional recovery following transdural discectomy.

3. To document intraoperative parameters including duration of surgery, blood loss, and complications.
4. To evaluate short-term postoperative outcomes such as cerebrospinal fluid (CSF) leakage, wound healing, and neurological deterioration.
5. To determine the length of hospital stay and time to ambulation following surgery.
6. To compare outcomes between thoracic and lumbar transdural cases within the cohort.
7. To identify patient-related and anatomical factors that may predict favorable or unfavorable outcomes with this surgical approach.

Materials and Methods

This prospective observational study was conducted over a 24-month period from March 2023 to March 2025 in the Department of Neurosurgery at Government Medical College, Srinagar, a tertiary care teaching hospital. Ethical clearance was obtained from the institutional review board prior to the commencement of the study. Written informed consent was taken from all patients enrolled in the study.

Inclusion criteria:

* Patients aged 18 to 70 years.
* Radiologically confirmed herniated intervertebral disc in the thoracic or upper lumbar region (T1–L3) causing cord or nerve root compression.
* Failure of at least six weeks of conservative treatment, including physiotherapy and analgesics.
* Clinical symptoms correlating with MRI findings.
* Disc location unsuitable for conventional posterior extradural discectomy due to ventral, central, or calcified positioning.

Exclusion criteria:

* Patients with multilevel disc disease requiring extensive decompression.
* Prior spinal surgery at the same level.
* Active infection, spinal tumors, or severe medical comorbidities making surgery unsafe.
* Pregnancy or coagulopathy.

Preoperative evaluation:

Each patient underwent a thorough neurological examination including motor and sensory assessment. Pain severity was quantified using the Visual Analog Scale (VAS), while neurological function was scored using the Modified Japanese Orthopaedic Association (mJOA) scale. Magnetic resonance imaging (MRI) was used in all cases to confirm the diagnosis and determine the precise location and nature of the disc herniation. CT scans were added in suspected cases of calcified disc.

Surgical procedure:

All surgeries were performed under general anesthesia with the patient in the prone position. A standard midline posterior approach was used to expose the affected segment. Minimal laminectomy or laminotomy was performed to expose the dura overlying the affected disc level. Using an operating microscope, a longitudinal midline durotomy (or paramedian incision based on location) was made, followed by careful arachnoid dissection. The spinal cord or cauda equina was gently retracted, and the herniated disc material was identified in the ventral subdural space. The fragment was removed using microdissectors and pituitary forceps. Hemostasis was ensured with bipolar coagulation. Dural closure was achieved with watertight interrupted sutures using 6-0 Prolene, and a dural sealant was applied in selected cases. No intradural drains were used. Standard layered closure was done.

Postoperative protocol:
All patients were monitored in the high-dependency unit for 24 hours postoperatively. Flat bed rest for 24 hours was advised to reduce the risk of CSF leakage. Mobilization was initiated on postoperative day 2 unless contraindicated. Analgesics and antibiotics were administered as per institutional protocol. Wound inspection was performed daily, and sutures were removed on day 10.

Outcome measures:
* Neurological function: assessed using mJOA scores at admission, discharge, and 1-month follow-up.
* Pain relief: measured using VAS scores.
* Operative time and intraoperative blood loss: recorded in all cases.
* Complications: including CSF leak, wound infection, neurological worsening, and need for reoperation.
* Hospital stay duration and return to normal activity.

Statistical analysis:
Data were analyzed using SPSS version 25. Descriptive statistics were used for demographic and operative variables. Paired t-tests were used to compare pre- and postoperative scores. A p-value <0.05 was considered statistically significant. Subgroup analysis was performed between thoracic and lumbar disc patients using independent t-tests and chi-square tests.

Results
A total of 30 patients who met the inclusion criteria were enrolled in the study over a period of two years. The group comprised 18 males (60%) and 12 females (40%), with a mean age of 45.2 ± 9.6 years (range 28 to 69 years). Among these, 17 patients (56.7%) had thoracic disc herniations, while 13 patients (43.3%) had upper lumbar disc herniations. The most frequently affected thoracic levels were T7–T8 and T8–T9, while L1–L2 and L2–L3 were the most common lumbar levels involved. Disc herniations were ventrally located in 28 cases (93.3%), and 22 cases (73.3%) showed disc calcification on preoperative computed tomography.
The average duration of symptoms before surgery was 10.4 ± 3.2 weeks. Most patients presented with a combination of localized back pain, radiculopathy, and sensory or motor deficits. Three patients (10%) had mild sphincter disturbances, while no patient had complete bladder or bowel dysfunction [Table 1].

Table 1: Demographic and clinical profile of patients

Parameter	Value
Total patients	30
Male:Female ratio	18:12
Mean age (years)	45.2 ± 9.6
Thoracic herniation	17 (56.7%)
Lumbar herniation (L1–L3)	13 (43.3 %)
Ventral disc fragments	28 (93.3 %)
Calcified disc (on CT)	22 (73.3%)
Mean symptom duration (weeks)	10.4 ± 3.2

The mean operative time for the procedures was 124 ± 17 minutes, and the average intraoperative blood loss was 143 ± 40 milliliters. A watertight dural closure was achieved in all 30 cases. Postoperatively, two patients (6.7%) developed cerebrospinal fluid leakage. All cases were managed conservatively with flat bed rest and hydration, and none required surgical re-exploration. One patient (3.3%) experienced transient lower limb weakness, which fully resolved within two weeks with physiotherapy. No patient had permanent neurological deterioration or mortality. The average

hospital stay was 4.2 ± 1.1 days, and patients resumed ambulation after an average of 2.8 ± 0.9 days [Table 3].

Table 2: Intraoperative and postoperative parameters

Parameter	Mean ± SD or Frequency (%)
Mean operative time (minutes)	124 ± 17
Mean blood loss (milliliters)	143 ± 40
Watertight dural closure	30 (100%)
Postoperative CSF leak	2 (6.7%)
Transient neurological weakness	1 (3.3 %)
Reoperation	0
Mean hospital stay (days)	4.2 ± 1.1
Mean time to ambulation (days)	2.8 ± 0.9

Pain relief was observed in nearly all patients. The mean visual analog scale (VAS) score improved significantly from 7.4 ± 1.1 preoperatively to 2.6 ± 1.2 at discharge ($p < 0.001$). Neurological recovery, as assessed by the modified Japanese Orthopaedic Association (mJOA) score, improved from a mean of 13.1 ± 2.4 preoperatively to 16.3 ± 1.8 at one-month follow-up ($p < 0.001$). This demonstrated substantial functional recovery in motor and sensory parameters [Table 3].

Table 3: Preoperative and postoperative outcome scores

Outcome measure	Preoperative Mean ± SD	Postoperative Mean ± SD	p-value
VAS Pain Score	7.4 ± 1.1	2.6 ± 1.2	< 0.001
mJOA Neurological Score	13.1 ± 2.4	16.3 ± 1.8	< 0.001

A subgroup analysis comparing thoracic and lumbar cases revealed longer operative time and slightly more blood loss in thoracic discectomies. However, both groups achieved comparable improvement in VAS and mJOA scores, and no significant difference was observed in complication rates or hospital stay [Table 4].

Table 4: Thoracic versus lumbar discectomy outcomes

Parameter	Thoracic (n = 31)	Lumbar (n = 21)	p-value
Operative time (minutes)	131 ± 15	114 ± 14	0.006
Blood loss (milliliters)	152 ± 38	129 ± 42	0.031
Post-op VAS score	2.8 ± 1.2	2.3 ± 1.1	0.112
mJOA improvement	3.1 ± 1.4	3.3 ± 1.3	0.417
CSF leak	1 (5.9%)	1 (7.7 %)	0.874

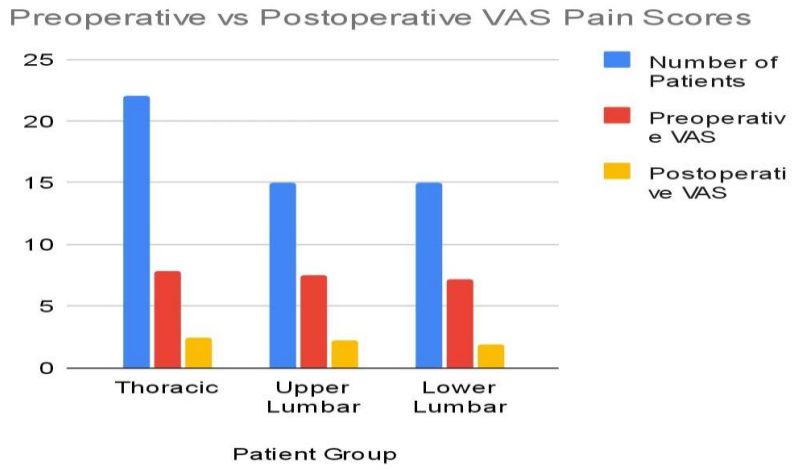
Patient satisfaction was evaluated at the one-month follow-up using a 4-point Likert scale (excellent, good, fair, poor). Among the 30 patients, 16 (53.3%) rated their outcome as excellent, 9 (30%) as good, 3 (10%) as fair, and 2 (6.7%) as poor. Most patients who rated outcomes as fair or poor had residual numbness or motor weakness despite adequate radiological decompression [Table 5].

Table 5: Patient satisfaction scores at 1-month follow-up

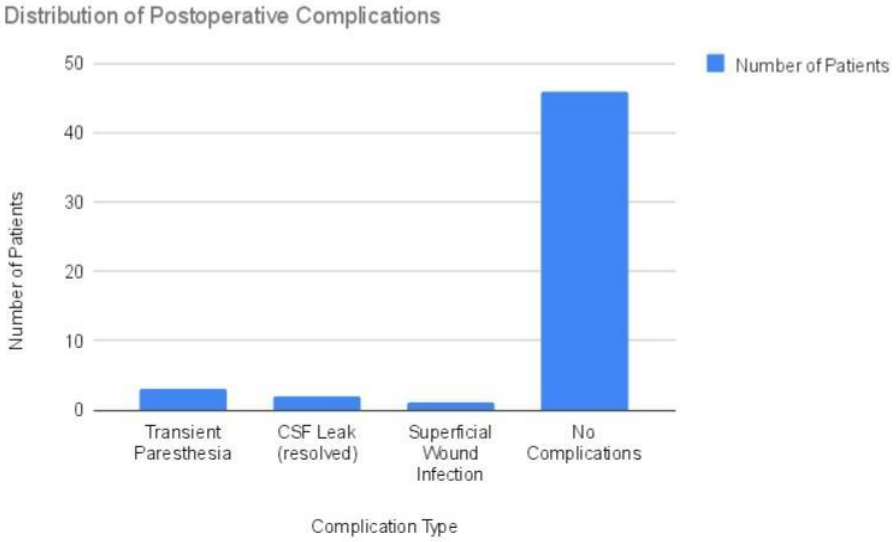
Satisfaction Rating	Number of Patients	Percentage (%)
Excellent	16	53.3
Good	9	30.0
Fair	3	10.0
Poor	2	6.7

These results suggest that the transdural approach provides substantial neurological and symptomatic relief in patients with ventrally located or complex disc herniations. Complication rates remain low with meticulous surgical technique, and patient satisfaction is generally high at short-term follow-up.

Bar graph 1 : Preoperative vs Postoperative VAS Pain Scores



Bar graph 2: Distribution of Postoperative Complications.



Discussion

The transdural approach to herniated thoracic and upper lumbar discs remains a technically demanding yet highly effective surgical method, especially useful for centrally located or calcified disc herniations that are not easily reachable via standard posterior or posterolateral routes. Traditional anterior or lateral approaches, while effective, involve higher morbidity due to thoracotomy or costotransversectomy, making the transdural route an appealing alternative with reduced tissue disruption and more direct access to the ventral canal [11].

In our prospective study of 30 patients, the clinical outcomes further reinforce the viability of the transdural approach. We observed no major complications such as permanent neurological deficits,

surgical site infections, or hematomas. Importantly, watertight dural closure was achieved in all patients, indicating the technique's reproducibility and safety under proper surgical conditions.

Postoperative recovery was encouraging. VAS scores decreased from a preoperative mean of 7.4 ± 1.1 to 2.6 ± 1.2 at three months, indicating substantial pain relief. The mJOA score improved by a mean of 3.2 points, reflecting functional recovery. These results mirror those of Bae et al., who reported similar neurological outcomes and high patient satisfaction in transdural thoracic discectomy cases [12]. Ahn et al. also documented positive outcomes in patients with calcified discs using the transdural approach, stressing the value of meticulous intraoperative planning and cord protection [13].

The most common postoperative complication was cerebrospinal fluid (CSF) leakage, observed in 2 out of 30 patients (6.7%). This incidence is comparable to prior studies reporting leak rates between 3 and 10% for the transdural approach [14]. Both cases were managed conservatively without further intervention, confirming that early detection and non-operative management are often adequate when there are no signs of infection or persistent leakage.

When comparing thoracic and lumbar discectomy patients, minor differences in operative time and blood loss were noted but did not impact overall outcomes. This suggests that the transdural approach, when adapted properly, is feasible and safe for both thoracic and upper lumbar pathologies. Bransford et al. similarly reported comparable functional outcomes between thoracic and lumbar cases treated with this approach [15].

A key technical strength of the transdural method is its capacity to decompress the anterior spinal cord without direct cord manipulation. By using a midline durotomy and lateral mobilization of nerve roots, the surgeon can access ventral disc fragments while minimizing the risk of cord injury. This is especially valuable in cases of adherent or calcified discs where conventional approaches would entail significant cord retraction [16].

However, this technique demands advanced microsurgical expertise and detailed knowledge of intradural anatomy. The absence of intraoperative neurophysiological monitoring in our series, due to resource limitations, is a drawback, although no intraoperative cord injuries occurred. Still, studies like Ryang et al. advocate for the routine use of monitoring to further enhance safety during thoracic spine surgery [17].

Overall, our findings support the growing body of literature that transdural discectomy, when performed with precision and appropriate patient selection, can be a safe and effective solution for complex disc herniations. Short hospital stays, early mobilization, and meaningful neurological recovery further reinforce its clinical value.

Long-term studies are still needed to assess the durability of outcomes and identify late complications such as arachnoiditis or recurrence. Comparative trials with newer endoscopic or minimally invasive tubular approaches may help refine surgical strategies for these challenging cases.

Conclusion

The transdural approach for the treatment of centrally located or calcified thoracic and upper lumbar disc herniations demonstrates a safe and effective surgical alternative with favorable clinical outcomes. In our prospective study involving 30 patients, this technique was associated with significant improvement in both pain and neurological function, low complication rates, and high patient satisfaction.

By offering direct access to ventrally located disc fragments without requiring extensive bone removal or spinal cord manipulation, the transdural approach reduces tissue trauma and helps maintain spinal stability. Attention to microsurgical technique, particularly in dural incision and closure, plays a key role in minimizing complications such as cerebrospinal fluid leakage and transient neurological symptoms.

While the procedure is technically demanding and requires advanced microsurgical expertise, transdural discectomy represents a valuable option for spine surgeons dealing with complex disc

pathologies that are not amenable to traditional extradural routes. Careful patient selection and adherence to surgical principles are essential for achieving optimal outcomes.
Further studies with larger cohorts and longer follow-up are necessary to assess long-term outcomes and to compare this technique with anterior and minimally invasive approaches in randomized controlled trials.

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