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Clinical outcomes of tubular microdiscectomy with 18mm diameter tubular retractor for lumbar disc herniation. A prospective study over a 2-year period

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ABSTRACT

Introduction: Tubular microdiscectomy is one of the minimally invasive techniques for spine surgery. This prospective study aims to evaluate the clinical outcomes of using a tubular microdiscectomy with an 18 mm dilator for the treatment of lumbar disc herniation over a 2-year period.

Methods: A prospective observational study of 57 patients who had undergone a first-time, single-level lumbar discectomy presented with single-sided radiculopathy with or without backache was done. Perioperative and postoperative results were assessed by documenting operative time, estimated blood loss, length of stay, rate of wound infection, neurological deficits in post-op period, rate of cerebrospinal fluid leak and resumption of work. Pain assessment was done with VAS score at admission, at discharge and in follow up.

Results: A total of 57 patients were included in the study. The average duration of surgery was 64 minutes. The average duration from surgery to discharge was 35.5 hours. The average time for complete resolution of radicular symptoms was 8.5 days. The median time for return to work was 20 days. Two patients experienced cerebrospinal fluid (CSF) leak due to inadvertent durotomy. The mean Visual Analog Scale (VAS) value at admission was 9.5087, which significantly reduced to 1.49 at discharge.

Follow-up assessments at 15 days, 1 month, 3 months and 1 year revealed sustained improvements in clinical outcomes.

Conclusion: Tubular microdiscectomy with an 18 mm dilator demonstrates favourable clinical outcomes for patients having single-level lumbar disc prolapse intervertebral disc causing radiculopathy and low backache, less blood loss intraoperatively, small scar, lesser hospital stay and early return to work.

Keywords
lumbar disc herniation (LDH), sciatica, microdiscectomy, tubular

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INTRODUCTION

Sciatica is a prevalent condition affecting millions of individuals globally, commonly attributed to lumbar disc herniation (LDH) [1]. LDH, characterized by degeneration and swelling of the lumbar intervertebral disc's nucleus pulposus, ranks among the most prevalent musculoskeletal disorders. The surgical treatment of LDH was first documented by Mixter and Barr in 1934 [2]. Later advancements in the field, notably by Caspar [3] and Yaşargil [4] in 1977, introduced

microsurgical techniques to lumbar disc surgery, pioneering the concept of microdiscectomy. This procedure, heralded as the gold standard for open discectomy, boasts superior visibility, reduced invasiveness, and decreased perioperative morbidity [7]. Despite its advantages, traditional microdiscectomy necessitates midline ligament incision and the separation of paraspinous muscle tendons from the spinous process, potentially resulting in postoperative back pain and spinal instability.

In pursuit of minimizing incision size and sparing paraspinal structures, micro endoscopic discectomy emerged as a refinement of microdiscectomy [5]. Employing a small-diameter tubular retractor (18 mm) and sequential dilators, this technique creates a surgical pathway to the lumbar spine between fascicles of the lumbar paraspinous muscles, circumventing the conventional detachment of multifidus muscles from the spine observed in open discectomy and microdiscectomy [6]. An articulated, repositionable arm secures the tubular retractor to the operating table, freeing the surgeon's hands. The tube's diameter accommodates the simultaneous use of 2 or 3 microsurgical instruments, such as a high-speed drill, suction device, and nerve root retractor. Initially coupled with an endoscope for visualization, the tubular retractor later integrated the operating microscope into its setup.

Tubular microdiscectomy (TD) adopts a muscle-space approach, diverging from the traditional subperiosteal muscle dissection, thereby minimizing tissue damage and expediting recovery.

Materials and methods

Study Design: This prospective observational study was conducted at a tertiary care center and teaching institute in Bareilly city, India, spanning from June 1, 2021, to May 31, 2023.

Participants: A total of 57 consecutive patients, aged 18–70 years, with symptomatic lumbar intervertebral disc prolapse unresponsive to conservative management, neurological deficits, or refusal of conservative treatment, were included. The procedures were performed by a single experienced surgeon proficient in tubular microdiscectomy techniques.

Surgical technique

Positioning: prone on bolsters with pelvis and thighs flexed

Steps:

- The midline is identified and marked on the patient's back at site of expected pathology (fig. A)
- A 18 G needle is inserted 1.5 cm ipsilateral to the side of the disc herniation (Fig. A).
- The needle is adjusted until lateral fluoroscopy confirms a trajectory that is coaxial (dashed line) with the disc of interest (Fig. B).
- An 18-20 mm vertical incision is made, with the needle mark serving as the midpoint. This incision is limited to the subcutaneous tissue only. ((Fig. C)
- Following the needle trajectory the first tubular dilator is inserted (Fig. D).
- Placement of Tubular Retractor: A small-diameter tubular retractor (18 mm) is positioned over sequential dilators, establishing a surgical pathway to the lumbar spine between the fascicles of the lumbar paraspinous muscles. This approach avoids the conventional detachment of multifidus muscles from the spine.
- The tubular retractor is secured in place by an articulated, repositionable arm affixed to the operating table.
- The diameter of the tube allows for the simultaneous use of 2 or 3 microsurgical instruments, such as a high-speed drill, a suction device, and a nerve root retractor. The operating microscope is then positioned. (Fig. E)
- Residual soft tissue is excised, and haemostasis is achieved using bipolar and/or monopolar cautery.
- The inferior edge of the lamina is identified, and a hemilaminotomy is performed using the high-speed drill. The lamina is excised until the superior insertion of the ligamentum flavum.
- A nerve root retractor is introduced to safeguard the traversing nerve root, retracting it medially.
- Epidural veins are coagulated using bipolar cautery to minimize bleeding.
- Extruded/compressing/offending disc fragments are extracted using a disc forceps.
- Nerve and foramen is assessed using nerve hook, haemostasis achieved and closure in layers.

Figure A.

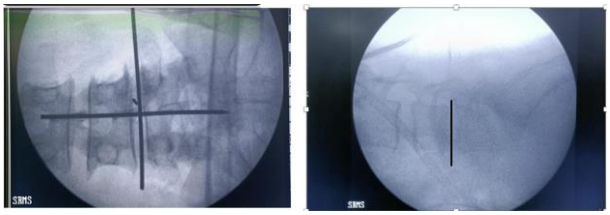


Figure B.

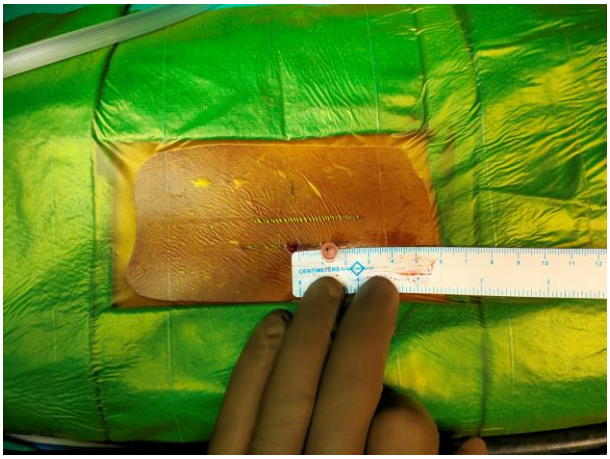


Figure C.

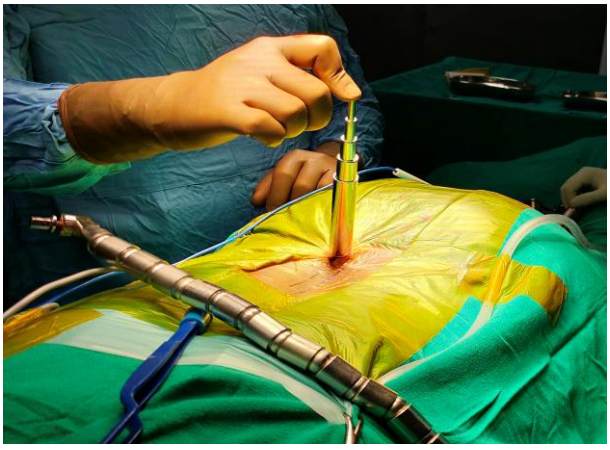


Figure D.

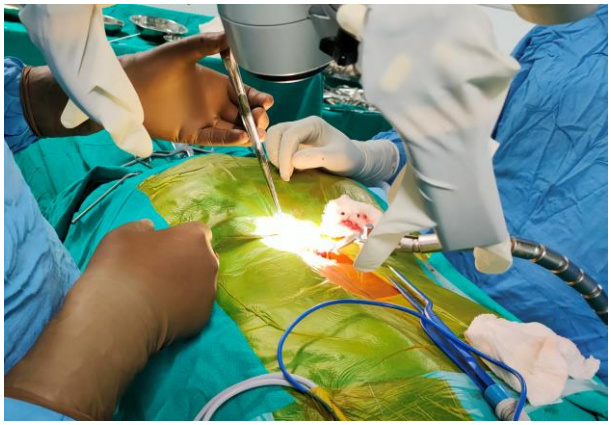


Figure E.

Inclusion Criteria:

- Single-level lumbar disc prolapse /extrusion/ sequestration with unilateral radiculopathy.
- Age between 18 and 70 years.
- Lack of symptom relief after a minimum of 6 weeks of conservative management.

Exclusion Criteria:

- Cauda equina syndrome.
- Spinal instability/spondylolisthesis.
- Failed back surgery syndrome.
- Degenerative lumbar canal stenosis.
- Multi-level disc prolapse.
- Pregnancy.

Data collection

Patient data were recorded in a case record sheet. Preoperative assessments, including comprehensive clinical examinations and radiographic investigations, were conducted, documenting baseline Visual Analogue Scale (VAS) scores for leg and back pain. Intraoperative data, such as incision length, surgical duration, blood loss, specific intraoperative findings, complications, and other relevant details, were also recorded.

Outcome measures

Postoperative complications were categorized into wound complications, surgical site infections, neurological deficits, spinal instability, symptom exacerbation, cerebrospinal fluid (CSF) leakage, discitis, and others. Postoperative pain was evaluated using the VAS scale on the first postoperative day after mobilizing the patient for 50

meters. Diclofenac sodium 75 mg intravenous was administered during surgery and postoperatively at 10:00 p.m., with oral administration advised upon discharge if needed.

Follow-up

Patients were followed up for a minimum of 6 months and a maximum of two years postoperatively, with scheduled visits at 15 days, 1 month, 3 months, 6 months, and 12 months. During follow-up, VAS scores for radicular symptoms were recorded, and any signs of infection or changes in symptoms were documented.

Results

A total of 57 patients were included in study from 1st June 2021 to 31st may 2023 with symptomatic single level lumbar intervertebral disc prolapse.

Of these 57 patients 41(71.9%) were male, 16 (28.07%) were female. Out of 57, 34 cases (59.64%) had involvement at L4-L5 and 23 cases (40.35%) at L5-S1 level. In the study 31(54.38%) patients presented with left-sided radiculopathy and 26 (45.61%) patients with right-sided radiculopathy.

Duration of symptoms ranged from 15 days to 48 months. The average duration of LBA symptoms was 8.8 months and lower limb radiculopathy was 4 months.

The operative time ranged from 32 minutes to 120 minutes and the median duration of surgery was 64 minutes.

The intraoperative blood loss was always less than 10 ml except in two patients in which the blood loss was 50 ml with mean blood loss of 9.92 ml.

Most patients 35 out of 57(61.40%) were discharged within 24 hours of surgery, 2 (3%) after 36 hours, 14(25%) after 48 hours. One patient (2%) was discharged on 5th postoperative day and 5(9%) patients took 72 hours to be discharged. The average duration from surgery to discharge was 35.5 hours, with a median of 24 hours.

Post operative pain was assessed on VAS SCALE on 1st postoperative day by mobilising the patient for 50 metres.

Three patients reported with almost complete resolution of pain after 24 hours of surgery. Eight patients in 2 days after surgery, 3 patients in 3 days, 2 in 4 days, 3 in 5 days, 1 in 10 days, 1 in 12 days, 21 Patients (36.84%) responded with almost complete resolution of radicular pain in 7 days, 12 patients (21.05%) in 15 days, 1 in 28 days and 2 patients in 30 days.

The median hours of complete resolution of radicular symptoms were 7 days, with an average of 8.5 days.

All the patients returned to work within 30 days (Fig-3). Most of the patients 27(52%) of 57 returned to work in 16-30 days. 22(42%) patients were able to resume jobs in 15 days. Six percent viz. 3 patients took merely 7 days to return to work. The median time to return to work was 20 days.

Two patients (3.5%) experienced cerebrospinal fluid (CSF) leak due to inadvertent durotomy (Table-1). One patient among this required conversion to open for dural tear repair. Other patient was managed with fat patch only.

We did not observe any discitis, post op wound infection, recurrent herniation of disc at same level in one year follow up

The mean visual analogue scale (VAS) score at admission was 9.5087, which significantly decreased to 1.49 at discharge (Fig.1 and Fig.2).

Patients were followed up at 15 days, 1 month, and 3,6 and 12 months postoperatively and assessed for pain, wound infection and other complications. None of the patients developed any complication in follow up. Sixty five percent patients had VAS SCORE of 1 at 12 months as depicted in Fig.4

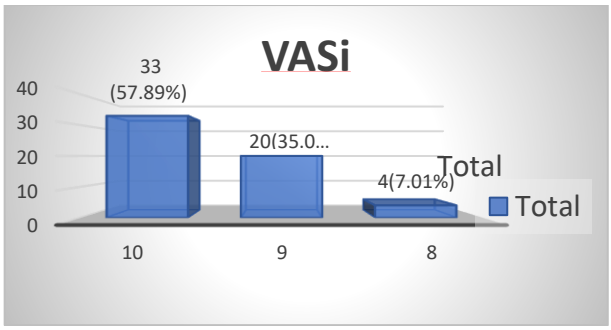
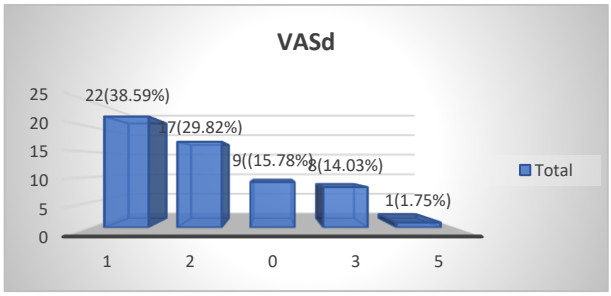


Figure 1. VAS score at admission.

Figure 2. VAS score at discharge.



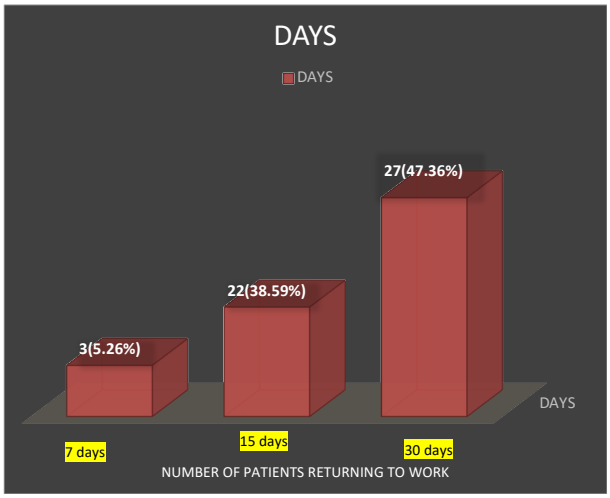


Figure 3. Patients returning to work (Median time- 20 days).

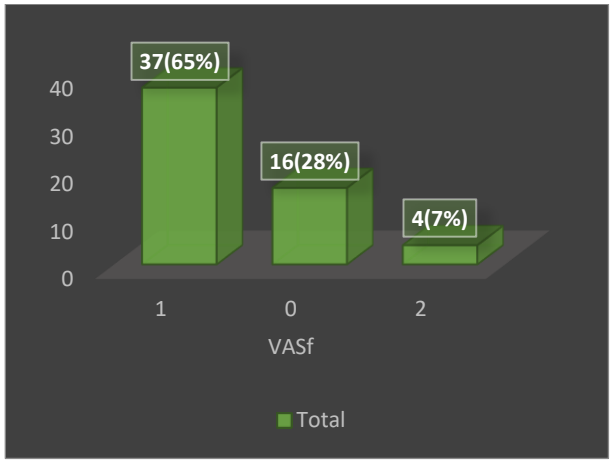


Figure 4. VAS score at 12 month follow up.

Table 1. VAS

Parameters	Number of patients
Total patients in study Male Female	57 41(71.9%) 16 (28.07%)
Site of PIVD: L4L5 L5S1	 34(59.64%) 23(40.35%)
Average duration of symptoms: LBA Radiculopathy	 8.18 months 4 months
OPERATIVE PARAMETERS Intraoperative time(skin incision to skin closure) Average blood loss Inadvertent durotomy	 64 minutes 9.9 ml 2(3.5%)
Average stay (surgery to discharge - hours)	35.5
Average duration of complete resolution of symptoms(days)	8.5
Average VAS SCORE At admission At discharge	 9.5 1.49
Patients returning to work in 7 days 15 days 30 days	 3(5.26%) 22(38.59%) 27(47.36%)
Discitis	0
Wound infection	0
Recurrent disc herniation at same level in 1 year	0
Segmental instability	0
Converted to open	1
Any other	none

Statistical analysis

Study data were entered in MS Excel and then analysed using SPSS Version 27.0. Data are presented as means and percentages depending on the type of variable.

Discussion

Lumbar disc prolapse causing low back ache and lower limb radiculopathy is the most common spinal pathology affecting all age groups. Patients not responding to conservative management for a minimum of 4-6 weeks, or routine activities of daily living affected are treated surgically [8]. Discectomy performed either through an open approach or by minimally invasive techniques remains the gold standard management. Open microdiscectomy surgery requires muscles dissection and retraction which might induce iatrogenic morbidity of the soft tissues in spite of providing greater direct visualization of anatomic structures and obtaining the optimal angle for disc removal; however, discectomy with tubular retractors which minimizes the tissue injury and ensures that deeper tissues are less exposed to potential pathologic organisms due to restricted surgical field. Minimally invasive tubular lumbar microdiscectomy is a refinement of the standard open microscopic lumbar discectomy technique. Advantages of this minimal invasive technique includes less perioperative pain, early ambulation, shorter hospital stay and early return to work with smaller incision [9].

In study of Art et.al [9]mean day of mobilisation of patients was done on 2nd day post operatively,

while in this study most of the patients were mobilised with in 36 hours.

In study of Nayak et.al [10] The mean surgical incision length in the tubular microdiscectomy group was 2.45±0.41 cm and 22 mm diameter tubular retractor, while in my study we used 1.8cm-2 cm incision only and 18 mm diameter tubular retractor. Ryang et.al[11] reported average blood loss in minimal invasive group 26.2 ml and 63.8 ml in open microdiscectomy group, while in our study average blood loss was 9.92 ml only. Average operative time was 47 mins in study of Art et.al [9]and 82 minutes in study of Ryang et.al[11] , but it was 64 minutes in our study which is comparable to former. In study of Art et.al [9]mean duration of hospital stay was 3.3 days while in our study mean hospital stay was 35.5 hours. In the trial by Brock et al.[12] postoperative analgesic usage was significantly lower in the tubular group, an observation that is supported by our study too.

We had only two patients with intraoperative dural tear causing CSF leak mean of 3.5% which lesser than reported by Sonawane et.al[14] in which mean was 6.5%. and 19.5% in study of Nayak et.al[10]

We did not observe any discitis, post op wound infection, recurrent herniation of disc at same level in one year follow up which were observed in other studies [9,10,13,14].

The study of Clark et.al[13] for lumbar discectomy says that Level I evidence supports equivalently good outcomes for tubular microdiscectomy compared with standard microdiscectomy, my study strengthens the same.

Conclusions

Tubular microdiscectomy gives good outcome in single level lumbar prolapse intervertebral disc causing radiculopathy and low backache, less blood loss intraoperatively, small scar, lesser hospital stay and early return to work. Moreover the other complications like discitis, post-operative wound infection and recurrent herniation are nil as per my study.

Owing to lesser hospital stay and shorter operative time it may be cost effective too.

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