

# Microendoscopic lumbar discectomy: Technique and results of 188 cases

Arvind G Kulkarni, Anupreet Bassi, Abhilash Dhruv

## ABSTRACT

**Background:** Discectomy performed open or with an operating microscope remains the standard surgical management. Tubular retractor system is being increasingly used. Potential benefits include less muscle and local damage, better cosmesis, decreased pain and operative time and faster recovery after surgery. We have evaluated the outcome of micro endoscopic discectomy (MED) utilizing tubular retractors in terms of safety and efficacy of the technique.

**Materials and Methods:** 188 consecutive patients who underwent surgery for herniated disc using the tubular retractors between April 2007 and April 2012 are reported. All patients had a preoperative MRI (Magnetic Resonance Imaging) and were operated by a single surgeon with the METRx system (Medtronic, Sofamor-Danek, Memphis, TN) using 18 and 16 mm ports. All patients were mobilized as soon as pain subsided and discharged within 24-48 hours post surgery. The results were evaluated by using VAS (Visual Analog Scale 0-5) for back and leg pain and ODI (Oswestry Disability Index). Patients were followed up at intervals of 1 week, 6 weeks, 3 months, 6 months, 12 months and 2 years.

**Results:** The mean age of patients was 46 years (range 16-78 years) and the sex ratio was 1.5 males to 1 female. The mean followup was 22 months (range 8-69 months). The mean VAS scale for leg pain improved from 4.14 to 0.76 ( $P < 0.05$ ) and the mean VAS scale for back pain improved from 4.1 to 0.9 ( $P < 0.05$ ). The mean ODI changed from 59.5 to 22.6 ( $P < 0.05$ ). The mean operative time per level was about 50 minutes (range 20-90 minutes). Dural punctures occurred in 11 (5%) cases. Average blood loss was 30 ml (range 10-500 ml). A wrong level was identified and later corrected in a case of revision discectomy. Four patients with residual disc-herniation had revision MED and three patients with recurrent disc herniation later underwent fusion. One patient had wound infection which needed a debridement.

**Conclusion:** MED for herniated discs effectively achieves the goals of surgery with minimal access. The advantages of the procedure are cosmesis, early postoperative recovery and minimal postoperative morbidity.

**Key words:** Herniated nucleus pulposus (HNP), micro endoscopic discectomy, minimal invasive spine surgery

## INTRODUCTION

Discectomy first reported by Mixter and Barr<sup>1</sup> (1934) has changed the management of lumbar disc herniations. Kambin and Savitz<sup>2</sup> (1973) introduced the concept of endoscopic lumbar discectomy. Caspar<sup>3</sup> (1977), Yasargil<sup>4</sup> (1977) and Williams<sup>5</sup> (1978) added refinements in approach

with the use of microsurgical technique. Foley and Smith<sup>6</sup> (1997) introduced an operative endoscope with the tubular system terming it “Endoscopic Discectomy”. As an alternative to the endoscope, Foley *et al.* (2003) modified the tubular retractors to include a microscope, which is termed “Micro Endoscopic Discectomy” (MED). The term is used interchangeably for describing the discectomy procedure utilizing tubular retractors either with an endoscope or a microscope.<sup>7</sup> Recent prospective randomized control trials (RCTs) have found a benefit of surgery for patients when conservative therapies fail.<sup>8-11</sup> Discectomy performed open or with an operating microscope remains the standard surgical management.<sup>12-14</sup> Tubular retractor system<sup>15-17</sup> is being increasingly used now. The potential benefits of to this technique include less muscle and local damage, better cosmesis,<sup>18-20</sup> decreased pain and operative time and faster recovery after surgery.<sup>21,22</sup> On the other hand, open surgery includes extensive retraction and dissection of paraspinal muscles, longer operative time, longer incisions and bone resection.<sup>23,24</sup> Many surgeons have been reluctant to use these techniques due to significant learning curve.

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In India, Ranjan *et al.*,<sup>25</sup> Jayaswal *et al.*,<sup>26</sup> and Jhala *et al.*,<sup>27</sup> have reported the use of METRx tubular system for discectomy with an endoscope. Kaushal *et al.*<sup>28</sup> have reported results of the Destandau endoscopic technique. We report our experience using the METRx tubular retractor system with a microscope. To the best of our knowledge this is the first study from India where a combination of METRx system and microscope has been used in a large series [Figure 1a].

## MATERIALS AND METHODS

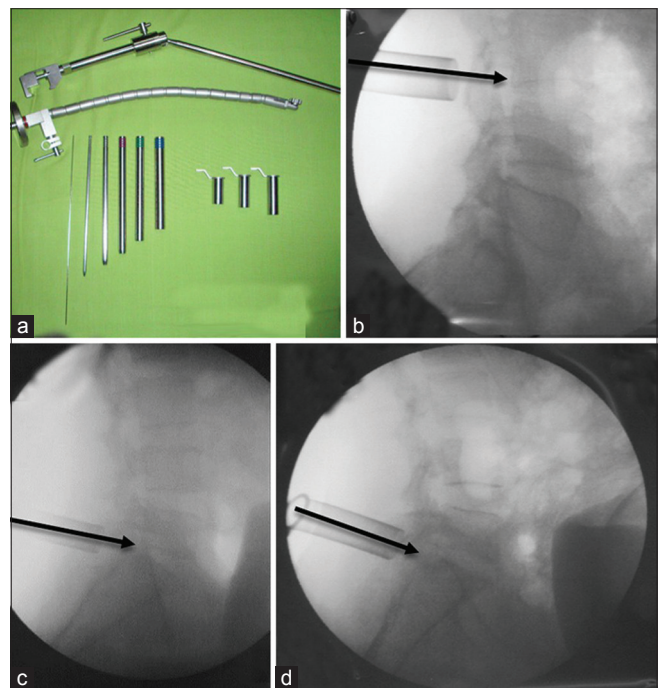
188 consecutive patients who underwent surgery for herniated disc using the tubular retractor were prospectively evaluated between April 2007 and April 2012. Patients with at least 6 weeks of conservative treatment with positive nerve root tension signs, radicular pain and correlating MRI findings were included. Exclusions were patients with large central disc herniations, chronic discogenic pain, discitis, previous instrumentation, multilevel fusions or presence of instability. There was no control group. All patients had preoperative standing x-rays and MRI and were operated by a single surgeon with the METRx™ system (Medtronic Sofamor-Danek, Memphis, TN, USA) using the 18 and 16 mm ports.

### Operative procedure

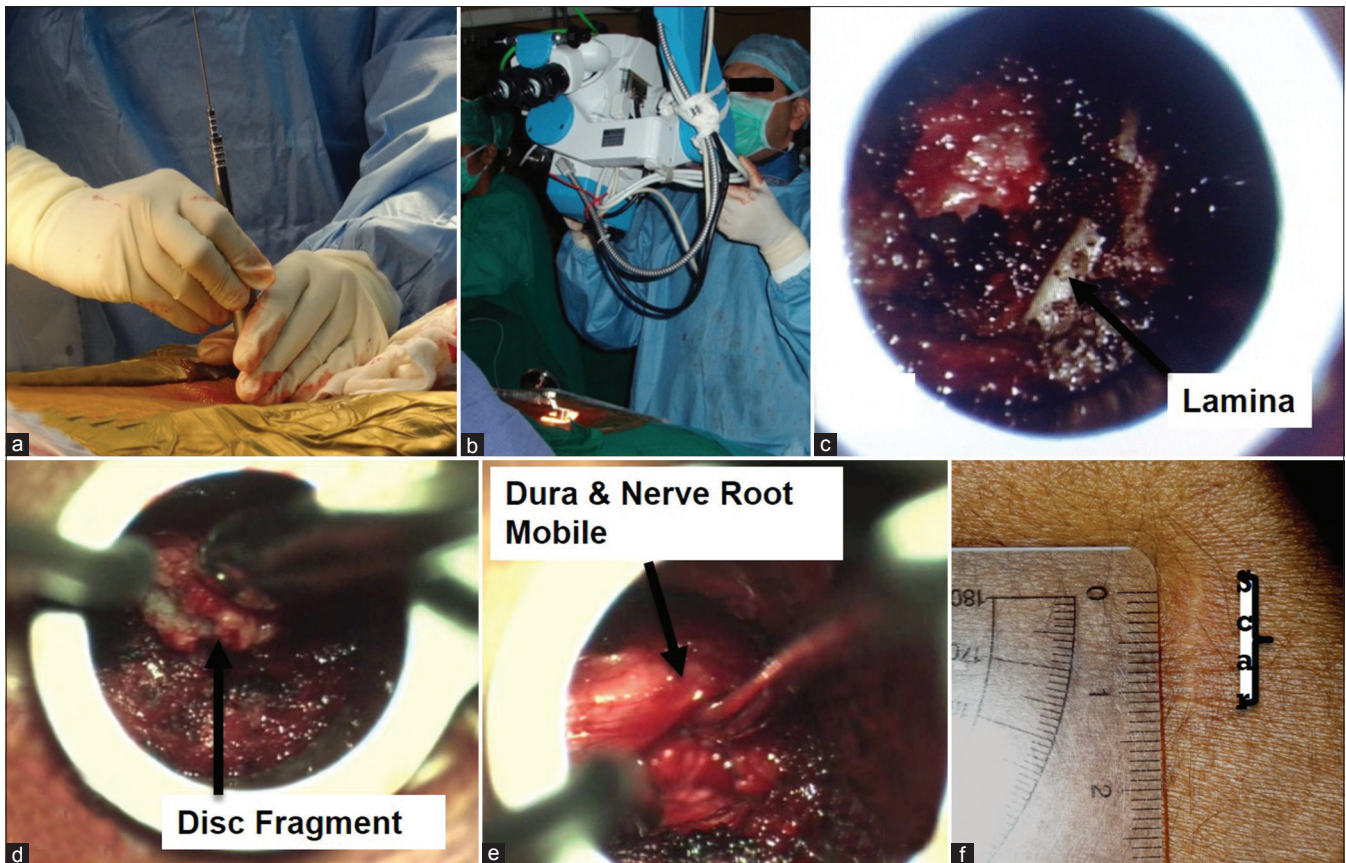
The patient was positioned on a radiolucent table in prone position with bolsters below the chest and the iliac crest keeping the abdomen free, head end raised and pressure points well padded. The surgeon stands on the side of the herniation. Using lateral fluoroscopy imaging on ipsilateral side, a 20 G spinal needle was inserted at the level of the involved disc space. The needle was inserted 1.2 cm lateral to the midline. The needle should be either targeted superiorly, at the disc level or inferiorly, depending upon the anatomy of the herniation or sequestration [Figure 1 b-d]. A 20 mm incision was then made centered over the needle and was deepened till the fascia. The incision was 18 mm if a 16 mm-diameter tube was used. The blunt end of the guide wire was then inserted under fluoroscopic guidance. The sharp end should be avoided as it can cause a dural tear. The target site was the inferior lamina of the superior vertebrae that was the junction of lamina and medial facet. The initial dilator was then inserted over the guide wire and the wire was removed. The initial dilator was used to sweep off the para-spinal muscle mass and palpate the bony landmarks. Sequential dilators were then inserted while confirming the target site under fluoroscopy [Figure 2a]. The marking on the final dilator at the level of skin provides the depth of the tubular retractor. If the marking is between 4 and 5 then a number 5 tubular retractor should be used. The final tubular retractor, which was 18 or 16 mm in diameter, was then docked with the flexible arm as

the final working channel [Figure 2b]. The 18 mm tube was most commonly used in this series. The 16 mm tube was utilized in cases where the disc herniation was small and restricted to the disc space without any migration. In cases of extra-foraminal disc herniations the incision was taken just lateral to the facet joint under fluoroscopic guidance and the tube was docked just lateral to the facet joint directly over the fragment. The operating microscope was then brought into the field [Figure 2b].

The soft tissue was separated using a long cautery tip till the lamina could be visualized [Figure 2c]. Then, laminotomy was done using a 4 mm high speed burr, till the junction of the inner cortex and ligamentum flavum was encountered. A cleft was created in the ligamentum flavum with a no. 4 Penfield dissector. The flavum was then excised medially and laterally using a no. 2 Kerrison rongeur to get a good visualization of the dural sac and nerve root. It was important to determine preoperatively on the MRI, whether the location of the disc was in the axilla or the shoulder of the nerve root. An inferiorly migrated disc was generally in the axilla of the nerve root. In case of a shoulder disc the nerve root once identified, can be retracted medially using a nerve root retractor. The disc was then identified. The bulge in a contained disc can be well appreciated under the microscope. Then, an annulotomy was done with a no. 15 blade on a bayonet handle in cruciate manner or the annular tear if



**Figure 1:** (a) Image showing flexible docking arm with serial dilators and tubular retractor of different sizes. (b) Intraoperative fluoroscopic image showing superior angulation in superior migrated disc herniation. (c) Intraoperative fluoroscopic image showing angulation in disc herniation with no migration. (d) Intraoperative fluoroscopic image showing inferior angulation in inferior migrated disc herniation



**Figure 2:** (a) Intraoperative image showing serial dilators being introduced. (b) Intraoperative image showing docked tubular retractor with the flexible arm as the final working channel. (c) Intraoperative microscope camera image showing lamina after soft tissue is removed. (d) Intraoperative microscope camera image showing extraction of herniated disc fragment. (e) Intra-operative microscope camera image showing mobile dura and nerve root. (f) Post-operative image showing length of surgery scar after healing

present can be probed with a nerve hook. The disc was then probed using a nerve hook and the herniated fragment was delivered out of the annulus. The fragment was then removed with a disc forceps [Figure 2d]. Multiple attempts were made to seek hidden disc fragments with a nerve hook till adequate nerve root decompression was performed. A pulsatile central dural sac and nerve root that was mobile was considered an adequate decompression surgery [Figure 2e]. The epidural bleeding was controlled using a combination of bipolar cautery, bone wax and Gelfoam®. The thoracolumbar fascia and subcutaneous tissue were closed using 2-0 Vicryl (Ethicon, Johnson and Johnson). The skin was closed using 3-0 Monocryl (Johnson and Johnson Int.).

A single dose of intravenous antibiotic was given on the same night as a standard protocol. Postoperatively, all patients were mobilized as soon as the pain subsides and were discharged within 24-48 hours post-surgery. The patients were allowed to go back to work after 3 weeks. A gradual back-strengthening program was started after 6 weeks.”

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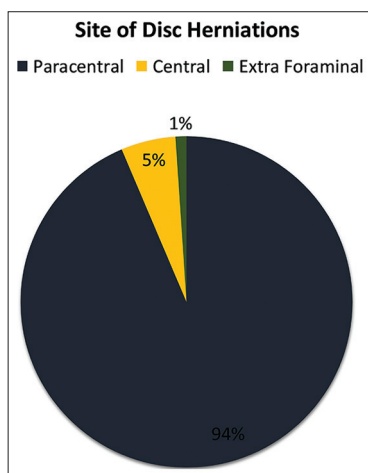
The patients were followed up at intervals of 1 week, 6 weeks, 3 months, 6 months and 12 months and 2 years and were evaluated for technical problems like tube docking issues, complications and overall results by VAS (Visual Analogue Scale) for back and leg pain and ODI questionnaire (Oswestry Disability Index). Paired samples *t*-tests were used for comparisons of continuous variables like VAS and ODI. All statistical analyses were performed using IBM® SPSS® software version 15.0. A probability value of  $P < 0.05$  was considered statistically significant.

## RESULTS

The mean age of patients was 46 years (range 16-78 Years) and the male to female ratio was 1.5:1. The mean followup was 27 months (range 8-69 months). 94% of patients had paracentral disc [Figure 3]. Eight patients (4%) also had associated stenosis. Out of 198 total levels operated,

L4-5 ( $n = 111$ , 56%) and L5-S1 ( $n = 69$ , 35%) were the most commonly involved [Table 1]. A 18 mm tube was used in 160 (85%) patients and 16 mm tube was used in 28 (15%) patients.

The mean operative time per level was about 50 minutes (range 20-90 minutes). Some of the cases done early in the study took a longer time that is up to 90 minutes, however after gaining experience the average time taken for surgery was less than the mean average. The average blood loss was 30 ml (range 10-500 ml). There was only one patient who bled close to 500 ml of blood. This was secondary to unexpected bleeding from the cancellous bony surfaces as a result of osteoporosis as well as disproportionate epidural bleeding. Dural punctures in our study occurred in 11 cases (5%) [Table 2]. The first three cases were managed with fibrin glue injection was used over the tear and the other tears were treated conservatively with masterly inactivity. No delayed cerebrospinal fluid leaks or pseudomeningoceles developed. One wrong level (0.5%) was identified and later corrected in a case of revision



**Figure 3:** Pie chart diagram depicting frequency of disc herniations based on morphology

**Table 1: Levels operated in our study ( $n=198$ )**

L4-L5	111
L5-S1	69
L3-L4	14
L1-L2	2
L2-L3	2

**Table 2: Complications ( $n=188$ )**

Complication	No.	Management
Dural tear	11	Conservative
Residual disc	4	Revision MED
Recurrent disc	3	Fusion
Wrong level surgery	1	Corrected intraoperative
Wound problem	1	Debridement

MED=Micro-endoscopic discectomy

discectomy. There were four patients (2.1%) with residual disc-herniation; all had a successful revision MED. There were three patients (1.5%) with recurrent disc-herniation who later underwent fusion. These occurred at 1 month, 3 months and 4 months after the primary MED. One patient (0.5%) had wound infectious. The patient needed debridement, antibiotics and dressings and recovered without further complications.

The mean VAS scale for leg pain improved significantly from a preoperative value of 4.14 to 0.76 ( $P < 0.05$ ) postoperatively. The mean VAS scale for back pain changed significantly from a preoperative value of 4.1 to 0.9 ( $P < 0.05$ ) postoperatively. The mean ODI changed significantly from 59.5 to 22.6 ( $P < 0.05$ ) till last followup.

## DISCUSSION

Lumbar disc herniations causing significant or new neurological deficit, cauda equina syndrome, or those refractory to conservative treatment are dealt surgically.<sup>3-6</sup> A proper technique should lead to satisfactory outcomes, minimal morbidity and good cosmesis. It should be cost effective, able to adjust to patient factors like obesity, ethnicity, etc., The percutaneous systems such as chemonucleolysis,<sup>29</sup> percutaneous lumbar discectomy (manual<sup>30</sup> and automated<sup>31</sup>), nucleoplasty and percutaneous laser-assisted discectomy<sup>32</sup> cannot deal with disc fragment extrusions and associated bony and ligamentous compression. The results of these procedures have been very variable and speculative ranging from 29% to 92% success rates.<sup>16</sup>

Open discectomy (OD) and microdiscectomy remain the current standard of surgical treatment.<sup>12-14</sup> Several recent prospective RCTs have compared OD to tubular retractor-based MED<sup>33-36</sup> and success rates have been found to be similar. Our results are comparable to results of MED by Wu *et al.*,<sup>37</sup> in which the mean VAS scale changes were significant and ODI changed from 48% to 23%. In our series, there was one wound infection at a rate of 0.5%, discitis rate of 0% and a durotomy rate of 5%. These rates compared favorably with those reported by Ebling *et al.*,<sup>38</sup> (3.3%, 0.8% and 3.9%, respectively), Caspar *et al.*,<sup>39</sup> (0.7, 0.7 and 6.7% respectively), Williams *et al.*,<sup>14</sup> (0, 0 and 0% respectively) and Pappas *et al.*,<sup>40</sup> (7.2, 0.5 and 1%, respectively). Our re-operation rate was 4.2% while the reoperation rate in MED series by Wu *et al.*<sup>37</sup> was 2.4%. A higher rate in our case could be attributed to two peaks in the learning curve: One at the beginning with the use of the 18 mm tube and the other at the beginning with the 16 mm tube. The complications occurred during the initial cases of using the respective tubes. As the

authors performed more cases, gaining experience the learning curve was negotiated and in subsequent cases, the complication rates were negligible. The aforementioned authors<sup>14,38-40</sup> reported reoperation rates in OD ranging from 3% to 14%. In our series there were 11 cases (5%) of dural tears. The fibrin glue injection was used over the dorsal tear. Due to inherent quality of technique there is no dead space to encourage the collection of CSF as the paraspinal muscles, thoracolumbar fascia, subcutaneous soft tissues, and skin fall into place causing a tamponade-effect once the tube is retracted. There were three cases of recurrent disc herniations. The patients chose a fusion procedure over a revision discectomy and underwent a successful fusion.<sup>41</sup>

The advantages of MED over OD include small incision, better cosmesis, early ambulation, less postoperative pain, less blood loss, short hospital stay, less analgesics, short time to return to work and thus less cost of treatment.<sup>20,42,44</sup> In our study skin incision was 1.8-2 cm in length initially which after shrinkage [Figure 2f] (which accompanies healing), became shorter leading to better cosmesis. If one would compare microdiscectomy and MED, it is but natural that if both the procedures have the same overall outcome, then the procedure with lesser tissue invasion, lesser length of incision, lesser use of postoperative analgesics with an early return to work becomes the procedure of choice.<sup>13</sup> This was the conclusion drawn by Katayama *et al.*,<sup>13</sup> while comparing microdiscectomy against macrodiscectomy.

Minimal tissue damage has been proven by studies comparing measurements of pre-operative and postoperative cross-sectional area (by MRI or CT) of paraspinal muscles, intraoperative EMG, serum biochemical markers (CRP, CPKMM and IL) and histological evidence, which show MED causes less local damage than microdiscectomy and OD.<sup>19,45-47</sup> It was found to be more effective in obese patients and in extraforaminal HNP's. These patients need more soft tissue dissection in OD for visualization thereby improving outcomes and decreasing complications.

Another measure of success of this technique is reflected by the patient's ability to return early to the previous job. Bookwalter *et al.*<sup>44</sup> reported that 40% of their patients returned to work in fewer than 5 weeks proving its cost-effectiveness. Caspar *et al.*<sup>39</sup> reported a mean return-to-work time of 18.6 weeks and Foley and Smith<sup>15</sup> reported a mean return-to-work time of 17.6 days. Our protocol is to allow patients to resume work after 2 weeks following surgery.

Majority of patients in the two most recently published RCTs comparing OD and MED expressed a preference for MED.<sup>48,49</sup> METRx™ can be used with both a microscope and an endoscope. The microscope system allows both

hands free and therefore two separate instruments can be used simultaneously as dissection is performed with clear visualization of structures under a microscope.<sup>41</sup> This is the advantage of this system over Destandau system, wherein the surgeon has to hold the tube while performing the procedure with one hand only. While with an endoscope, there is problem of fogging of the camera secondary to cautery smoke as well as contamination by blood in the field, which requires repeated withdrawal and cleaning of the camera lens. The limitations of MED include a learning curve, specialized equipment and specific training. A study on lumbar MED by a single surgeon states that approximately 30 cases are required to overcome the learning curve and before the operative time and complications reduce.<sup>50</sup> METRx™ tubular system is a highly versatile system. It can be used for doing advanced procedures like decompression of central canal and lateral recess stenosis, cervical foraminotomies, tumor removal and minimally invasive fusions (TLIF (transforaminal lumbar interbody fusion)), etc., There is a growing interest in this technique in the subcontinent with increasing number of authors reporting its successful usage in the management of disc herniations.<sup>25-27</sup>

To conclude microendoscopic surgery for herniated discs effectively achieves the goals of surgery with minimal access. There is a learning curve associated with the procedure to reach an adequate level of expertise. Adequate training of surgeons and effective utilization of the technique can harness the benefits of this procedure and make it a gold standard in management of prolapsed lumbar discs.

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