

# The Use of Tubular Retractors for Translaminar Discectomy for Cranially and Caudally Extruded Discs

## Abstract

**Background:** The conventional interlaminar approach is adequate for access to most disc herniations in lumbar spine surgery. The access to cranially and caudally migrated disc fragments, by conventional interlaminar fenestration, requires an extension of the fenestration with the potential destruction of the facet joint complex and consequent postsurgical instability. To describe the technique and results of the translaminar technique of targeted discectomy using tubular retractors for the surgical treatment of cranially and caudally extruded discs. **Materials and Methods:** The study period extended from January 2008 to December 2014. All patients with lumbar herniated discs who failed conservative management were selected for surgery and underwent routine erect radiographs and magnetic resonance imaging (MRI) of the lumbar spine. The patients with cranially or caudally migrated discs were included in this study. The technique involves approaching migrated disc through an oval window (sculpted through an 18 mm tubular retractor using a burr) in the lamina precisely over the location of the migrated disc as predicted by the preoperative MRI (inferior lamina for inferior migration and superior lamina for superior migration). The perioperative parameters studied were operative time, blood loss, complications, Oswestry Disability Index (ODI), and visual analog scale (VAS) for leg pain before surgery and at last followup. In the study, 4 patients underwent a postoperative computed tomography-scan with a three-dimensional reconstruction to visualize the oval window and to rule out any pars fracture. All technical difficulties and complications were analyzed. **Results:** 17 patients in the age group of 41–58 years underwent the translaminar technique of targeted discectomy. The migration of disc was cranial in 12 patients and caudal in 5 patients. Fourteen of the affected discs were at the L4–L5 level and three were at the L5–S1 level. The mean VAS (leg pain) scale improved from 8 to 1 and the mean ODI changed from 59.8 to 23.6. There were no intraoperative or postoperative complications encountered in this study. Furthermore, no patient in the present study required a conventional laminotomy or medial facetectomy. There was no evidence of iatrogenic pars injury or instability at the last followup. There were no recurrences till the last followup. **Conclusions:** The targeted translaminar approach preserves structures important for segmental spinal stability thus causing minimal anatomical disruption. This approach allows access to the extruded disc fragment and intervertebral disc space comparable to classical approaches.

**Keywords:** Laminotomy, migrated discs, minimally invasive surgery, translaminar discectomy

**MeSH terms:** Magnetic resonance imaging; nucleolysis, intervertebral disc; lumbar vertebrae

## Introduction

The conventional interlaminar approach is adequate for access to most disc herniations in lumbar spine surgery.<sup>1</sup> However, the access to cranially and caudally migrated disc fragments, by conventional interlaminar fenestration, requires an extension of the fenestration with the potential destruction of the facet joint complex and consequent postsurgical instability.<sup>2–4</sup> Di Lorenzo *et al.*<sup>5</sup> in 1988 was the first to describe a pars interarticularis fenestration approach for cranially migrated disc herniations. Since then

several modifications of the translaminar approach have been described.<sup>6–9</sup> The most recent of these descriptions have entailed the application of minimally invasive techniques such as tubular retractors and percutaneous endoscopes.<sup>10–12</sup> The application of the minimally invasive technique to the translaminar approach has been proposed to provide a more direct targeted approach with minimal anatomical disruption.<sup>11</sup> Microendoscopic discectomy (MED) through tubular retractors for surgical treatment of a cranially migrated lumbar disc herniation has been previously reported by authors<sup>10,11</sup>

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with the sparse literature on its application for caudal disc migrations. To our knowledge, this is the first study to describe the use of tubular retractor-guided translaminar technique for caudally migrated disc herniations as well.

## Materials and Methods

17 patients with cranially or caudally migrated discs underwent the MED using tubular retractors between January 2008 and December 2014. The surgery was performed by a single surgeon (AG).

The radiographs and the magnetic resonance imaging (MRI) scans were carefully studied to accurately mark the fragment location in relation to the pedicles and the pars interarticularis.

## Operative procedure

An approach to a superiorly migrated L4/L5 disc would include laminotomy of the L4 lamina and approach to an inferiorly migrated L4/L5 disc would include laminotomy of the L5 lamina [Figure 1].

The procedure involves insertion of a 20 G spinal needle using lateral fluoroscopy at the level of the cranial pedicle for cranial herniations, and the caudal pedicle in cases of caudal herniations and 5cc of 0.5% sensorcaine diluted in 15cc of saline is infiltrated for preemptive analgesia. The needle is inserted at distance of 0.8–1.2 cm lateral to the mid-line depending on the location of the migrated disc in mediolateral anatomical disposition. An 18–20 mm incision is then centered over the needle and is deepened till the fascia. The blunt end of the guidewire is then inserted under fluoroscopy guidance. The target site is the pars interarticularis just medial to the pedicle. Sequential dilators are then inserted while confirming the target site under fluoroscopy. The tubular retractor, which is

16/18 mm in diameter, is then docked with the flexible arm as the final working channel. The targeting of the site under image guidance at successive steps of the dilator insertion and finally, the tubular retractor placement ensures precise positioning. After confirmation of the position of the tube, oval laminotomy (approximately 6 mm × 6 mm) is performed using a 4 mm highspeed cutting burr, to access the epidural space. Space is explored up to the axilla of the exiting root and usually, the fragment can be visualized in cranial disc migrations. Since the hole is made proximal to the insertion of ligamentum flavum, it does not need excision. The visualized fragment is gently teased out with blunt nerve hooks and pituitary rongeurs. In cases of inferiorly migrated herniated nucleus pulposus (HNPs), a caudal laminotomy is performed, and the axilla of the nerve root is explored to visualize the fragment. Then, the fragmentectomy is performed as described earlier. Multiple attempts are made to seek hidden disc fragments with a nerve hook till adequate nerve root decompression is performed. A pulsatile dural sac and a mobile nerve root are considered the endpoints of an adequate decompression surgery. After inspecting the thecal sac and exiting nerve root, the site is copiously irrigated with saline. Epidural bleeding can be quite troublesome during the approach and can be managed with gel foam, neurosurgical patties, and tamponade. The other caution during the use of burr is that the dural sac is encountered immediately after burring down the inner cortex since the area of laminotomy is above the attachment of ligamentum flavum. Figures 2 and 3 are the case examples of superior and inferior disc migration at the L4/L5 level in two different patients accessed through L4 and L5 laminotomy, respectively.

Only one dose of intravenous antibiotic is given at the same night as a standard protocol. Postoperatively, all patients were mobilized as soon as the pain subsided and discharged

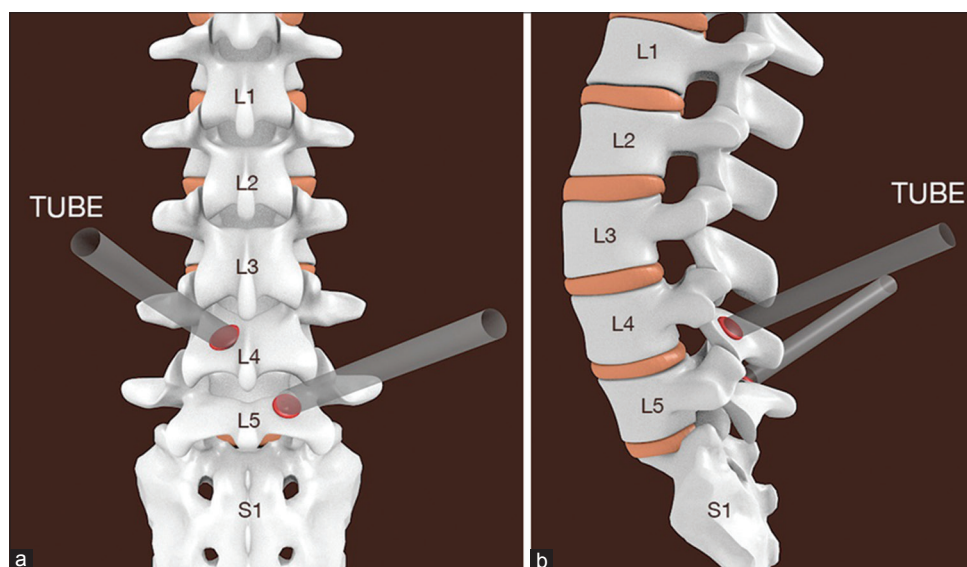


Figure 1: Diagrammatic representation of saw bones showing (a) Coronal illustration of a left sided L4 and a right sided L5 laminotomy hole. (b) Sagittal illustration of the laminotomy holes

within 24–48 h postsurgery and shower was allowed the next day of surgery. The patients are allowed to go back to work after 3 weeks. A gradual back strengthening program is started after 6 weeks.

4 patients underwent a postoperative computed tomography scan with a three-dimensional reconstruction to visualize the oval window. All technical difficulties and complications were analyzed. The outcomes were measured by preoperative and postoperative Oswestry Disability Index (ODI) and visual analog scale (VAS) for leg pain.

## Results

17 patients of lumbar disc herniation with mean age 45 years (range 41–58 years) operated with translaminar technique discectomy were included in this study. There were two patients with Diabetes mellitus, with no comorbidities in other patients. There were 10 female and 7 male patients. The mean final followup was 14 months (range 12–36 months). The migration of disc was cranial in 12 patients and caudal in 5 patients. Fourteen of the

affected discs were at the L4–L5 level and three were at the L5–S1 level.

The patients had an appreciable relief of radicular pain as evidenced by a change in VAS (leg pain) from a mean value of 8 to 1 and the mean ODI changed from 59.8 to 23.6. The average followup was 14 months. Average blood loss was 20 ml (range 10–70 ml). The mean duration of surgery was about 50 min (range 30–90 min). The average radiation exposure time was 2.58 s per patient (range of 1.68–4.73 s). There were no intraoperative or postoperative complications encountered in this study. Furthermore, no patient in this study required a conventional laminotomy or medial facetectomy. There was no evidence of instability at the last followup. All the patients were able to resume work within 4 weeks of surgery. There were no recurrences till the last followup.

## Discussion

Microdiscectomy, as described by Caspar,<sup>1</sup> is considered to be the gold standard procedure for the treatment of HNP. The technique utilizes the interlaminar window to access

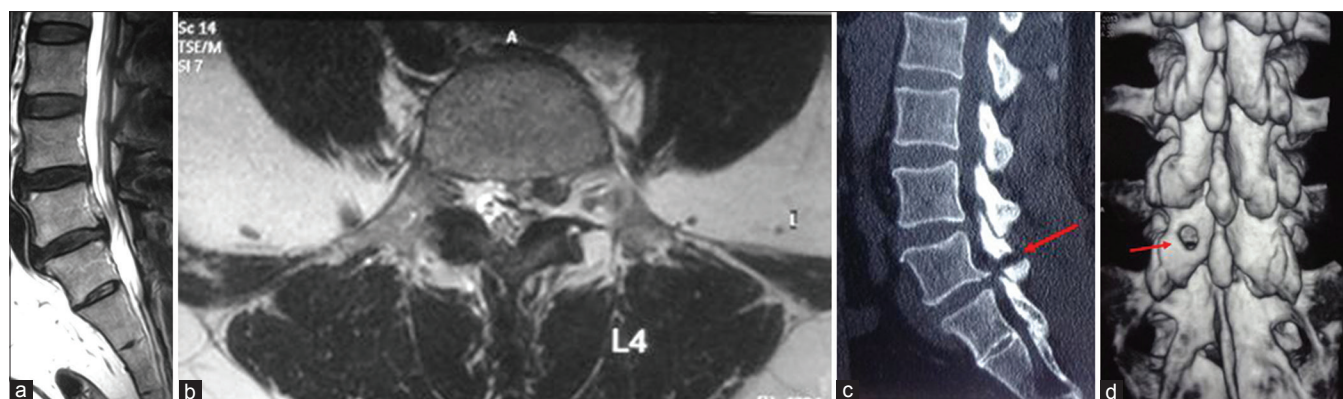


Figure 2: (a) Preoperative T2-weighted sagittal magnetic resonance imaging showing the superiorly migrated L4 L5 disc (sacralization of L5). (b) Preoperative T2-weighted axial magnetic resonance imaging showing the migrated disc at left L4 pedicle level. (c) Postoperative sagittal computed tomography scan showing laminotomy of the L4 lamina (sacralization L5). (d) Postoperative three-dimensional reconstruction computed tomography scan showing the laminotomy hole in L4 (sacralization L5)

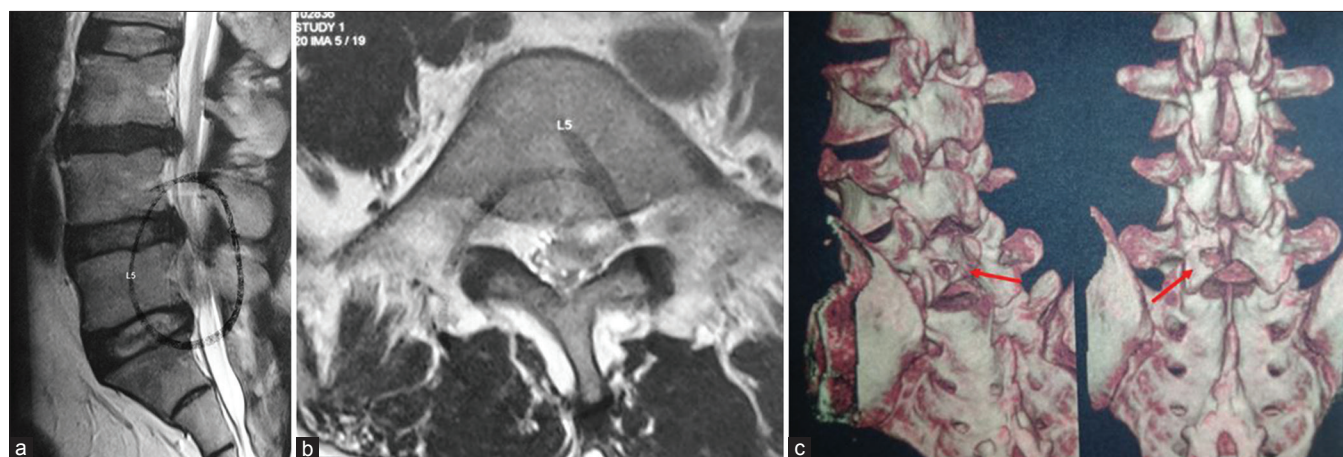


Figure 3: (a) Preoperative T2-weighted sagittal magnetic resonance imaging showing the inferiorly migrated L4 L5 disc. (b) Preoperative T2-weighted axial magnetic resonance imaging showing the migrated L4 L5 disc at left L5 pedicle level. (c) Postoperative three-dimensional reconstruction computed tomography scan showing the laminotomy hole in L5 on the left side

the epidural space. This technique is best utilized for paracentral and central HNPs. However, this technique has some limitations in relation to cranially or caudally migrated HNP. A fraction of cranially migrated HNPs lie behind the posterior wall of the vertebra above and just medial to the medial margins of the cranial pedicle. This area is termed the “hidden zone” by Macnab, and the area is known to be associated with difficult surgical exposure.<sup>13</sup> Similarly, caudally migrated HNPs push the nerve root medially and lie just medial to the caudal pedicle. The access through the interlaminar window is not possible in these cases. Consequently, the surgical approach would encompass a wider laminotomy and even medial facetectomy to access the migrated fragments. This excess bone removal can lead to iatrogenic instability.

The translaminar approach was first described by Di Lorenzo *et al.*<sup>5</sup> in 1988 to approach foraminal HNPs. It entailed the creation of an oval window in the pars interarticularis to directly access the fragment. There was an initial criticism against this approach, due to the possibility of an iatrogenic pars fracture which could progress to the instability of that level. Subsequently, multiple authors have described a modification of the fenestration with smaller windows and no postoperative instability.<sup>6-9</sup> In the recent study, Vanni *et al.*, reported good results in 38 patients with cranial disc herniations, who underwent a microdiscectomy by the translaminar approach. The authors stressed on the possibility to spare the flavum ligament as one of the main advantages of this technique.<sup>14</sup>

Since the introduction by Smith and Foley,<sup>15</sup> the indications of minimally invasive spine surgery utilizing tubular retractors have been extended to include varied pathologies with favorable results.<sup>16,17</sup> The technique has been previously used by authors for cranial disc migrations. Vogelsang<sup>10</sup> was the first to use the translaminar approach in combination with a tubular retractor system for craniolaterally migrated lumbar disc herniations. Fifteen patients with far craniolaterally migrated disc herniations underwent translaminar discectomy through a 10 mm × 5 mm fenestration. Long term followup (23 months) demonstrated excellent results in six, good results in seven, a fair result in one, and a poor result in one patient according to the modified Macnab criteria. Subsequently, Ikuta *et al.*,<sup>11</sup> described a similar technique with good short-term results in seven patients with cranially migrated disc herniation. Dezawa *et al.*,<sup>12</sup> described the percutaneous endoscopic translaminar approach in nine cranially migrated disc herniations. To our knowledge, this is the first study to investigate the technical feasibility and the efficacy of MED utilizing the TLA for caudal herniations as well.

The MED, using tubular retractors, is an established technique in the management of herniated discs.<sup>16</sup> There are several advantages of the use of translaminar discectomy by MED. The oval laminotomy is made

precisely over the fragment that lies just medial to the pedicle. The laminotomy approach spares damage to the ligamentum flavum attachment. This reduces the chances of epidural fibrosis.<sup>18,19</sup> Furthermore, since the laminotomy is directly over the HNP, there is little handling of the root. In addition, the superiority of MED over a conventional open discectomy has been proven in many studies.<sup>19-22</sup> The advantages include small incision leading to better cosmesis, early ambulation, less postoperative pain, less blood loss, short hospital stay, less analgesics, early return to work, and consequent decreased hospital costs. Furthermore, MED is shown to be equally efficacious to microdiscectomy. MED is a muscle splitting approach and so does not damage these structures. Hamasaki *et al.*<sup>23</sup> have demonstrated 80% maintenance of native stiffness in MED procedures as compared to open procedures. Furthermore, the success of a TLA in MED requires: (1) meticulous preoperative planning with accurate localization of the disc fragment, (2) fluoroscopy-guided docking of the tube, and (3) microsurgical skills to work through a small hole. It is also imperative to spare at least 3 mm of the lateral border of the pars to leave behind enough bone to maintain stability. We agree with Papavero and Kothe<sup>24</sup> to drill off the translaminar hole as an inverted-truncated cone to gain access to the fragment. In the present small series, there were no recurrences and no incidence of iatrogenic instability. This is a series of 17 patients, and we believe that a larger series with a longer followup should be prospectively followed up to better judge the efficacy of MED through TLA for cranial or caudal herniations. However, at the short term, this technique has shown good to excellent results. Overall, the combination of two tissue-sparing techniques (MED-tubular retractors and translaminar approach) is a viable alternative to traditional discectomy approach for cranially and caudally migrated disc herniations.

As previously stated, there is very sparse literature on the application of the translaminar technique for caudal disc migrations. Du *et al.*<sup>25</sup> have recently reported on 7 patients with caudally migrated lumbar disc herniations who underwent percutaneous endoscopic lumbar discectomy through a translaminar approach under local anesthesia. The authors reported consistent and maintained improvements in VAS and ODI after the endoscopic discectomy. No recurrence was seen in any of the seven patients during the followup period.

There are some concerns and limitations to the application of translaminar technique. This technique does not afford the opportunity to explore the annulus for a potential defect. However, the decision to explore the disc space has been in itself a topic of considerable controversy and debate. Although there were no misadventures in this cohort, choosing not to expose the relevant anatomy such as the disc space and the pedicle below can potentially increase the complication

rate particularly in cases of the conjoined nerve root and a higher than usual takeoff of the root. A thorough preoperative evaluation of the radiological anatomy is key to the effective application of this technique. The small keyholes would make epidural maneuvers difficult in the case of a disc migrating between the time of the preoperative MRI and the time of surgery. An MRI done as close to the time of surgery can ameliorate this problem. Furthermore, the surgery involves a targeted fragmentectomy with no exploration of the central disc/annulus by the aim of removal of symptomatic migrated disc fragments. Although there were no recurrences in our series, with the relatively shorter duration of followup available, it is not possible to draw definite conclusions about the recurrence of disc herniation with this technique, over the long term. This small case series may not be generalizable to a larger group of surgeons and has potential drawbacks in case the disc herniation cannot be adequately identified intraoperatively. Large prospective randomized trials are needed to assess the preservation of spinal stability and recurrences in comparison to conventional approaches.

## Conclusions

The tubular retractor guided targeted translaminar approach preserves structures important for segmental spinal stability thus causing minimal anatomical disruption, and procedure saves the posterior soft tissue band. The approach allows access to the migrated disc fragment and intervertebral disc space comparable to classical approaches. In conclusion, this technique utilizes the advantages of MED with the added benefit of a TLA to approach the HNP in areas difficult to access, without compromising stability.

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## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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