Technical Note

J Minim Invasive Spine Surg Tech 2022;7(1):151-156
eISSN: 2508-2043
https://doi.org/10.21182/jmisst.2021.00311

JMISST
Journal of Minimally Invasive Spine Surgery and Technique

# Unilateral Biportal Endoscopic Translaminar Keyhole Approach to Treat High-grade Up-migrated Lumbar Disc Herniation: Technical Note

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Received: November 15, 2021
Accepted: February 23, 2022

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The incidence of lumbar disc fragment migration is approximately 35%–72% of which 34% are high-grade up-migrated discs. Translaminar keyhole approach is a minimally invasive and true tissue sparing technique which has been applied to approach migrated disc herniation. The unilateral biportal endoscopic approach is an emerging technique among endoscopic spine surgery that combines the advantages of microscopic surgery with endoscopic surgery. In this technical report we demonstrate the surgical technique of performing the translaminar keyhole approach with unilateral biportal endoscopic spine surgery to treat high-grade up-migrated discs. As far as we know, this is the first technical report of unilateral biportal endoscopy with translaminar keyhole approach to treat high-grade up migrated lumbar disc herniation.

**Key Words:** Disc herniation, Intervertebral disc, Lumbar disc disease, Minimally invasive surgical procedures

## INTRODUCTION

The incidence of lumbar disc fragment migration is approximately 35%–72%, of which, 34% are high-grade migrated discs [1]. The treatment of migrated disc herniation requires laminotomies, interlaminectomies or partial or total facetectomies [2]. However, these surgical procedures may alter normal spinal segment biomechanics, leading to an iatrogenic instability, worsening patients' back pain symptoms and requiring fusion surgery [2,3]. Translaminar approach is a minimally invasive and true tissue-sparing technique which has been applied to approach migrated disc herniation [4]. Unilateral biportal endoscopy (UBE) is an emerging technique among minimally invasive spinal surgery. By using 2 portals, high resolution and magnified visualization is possible with simultaneous free handling and angulation of surgical instruments without crowding of the instruments [1]. Minimal anatomical disruption by UBE with the benefit of translaminar approach to treat the up-migrated lumbar disc herniations allows access to the surgeon to difficult areas, without compromising segmental spinal stability. As far as we know, there are few journals of uniportal endoscopic spine surgery by translaminar keyhole approach, but this is the first technical report of UBE utilizing translaminar keyhole approach for high-grade up migrated lumbar disc herniation.

### Surgical Technique

The exact location of migrated disc fragment and the ideal keyhole trajectory are planned with preoperative images, such

as anteroposterior and lateral radiographs, computed tomography (CT) and three-dimensional (3D) CT scans, magnetic resonance imaging (MRI), and MRI with myelogram (Figure 1). The target point was located under fluoroscopy. Two skin incisions were made above and below the target point, slightly separated from the midline (Figure 2); a 6–8-mm incision was made for the endoscope portal and an 8–10-mm incision for the working portal. The average distance between the portals was 2 cm. After introducing the 0° endoscope, a saline irrigation pump was connected to the viewing portal and set to a pressure of 30 mmHg. Continuous irrigation was essential to prevent excessive elevation of epidural pressure. Working space was created through working portal using forceps and radiofrequency (RF) ablation probes (RF® Ablation system, Stryker Kalamazoo, MI, USA) to contract the connective tissue until the bony surface of the lamina was exposed. The first landmark that was localized was the isthmus followed by the exact target point to drill. Before drilling the keyhole, it is very important to spare at least 3 mm of the lateral border of the isthmus to avoid unwanted fracture of the pars interarticularis causing iatrogenic instability [5]. The 5–7-mm translaminar keyhole was drilled using high-speed diamond burr on the lamina. The drilling in this area was performed with caution since there is no ligament flavum in this area, and the drill could enter directly to the epidural space. After removal of the thin shell of inner cortical bone, epidural fat, and a small portion of the ligament flavum was seen in the caudal margin of the keyhole. This point was considered as the second landmark and was cautiously drilled to approach the axillary portion to prevent injury of the thecal sac or the nerve root. Migrated discs are usually identified at this point,

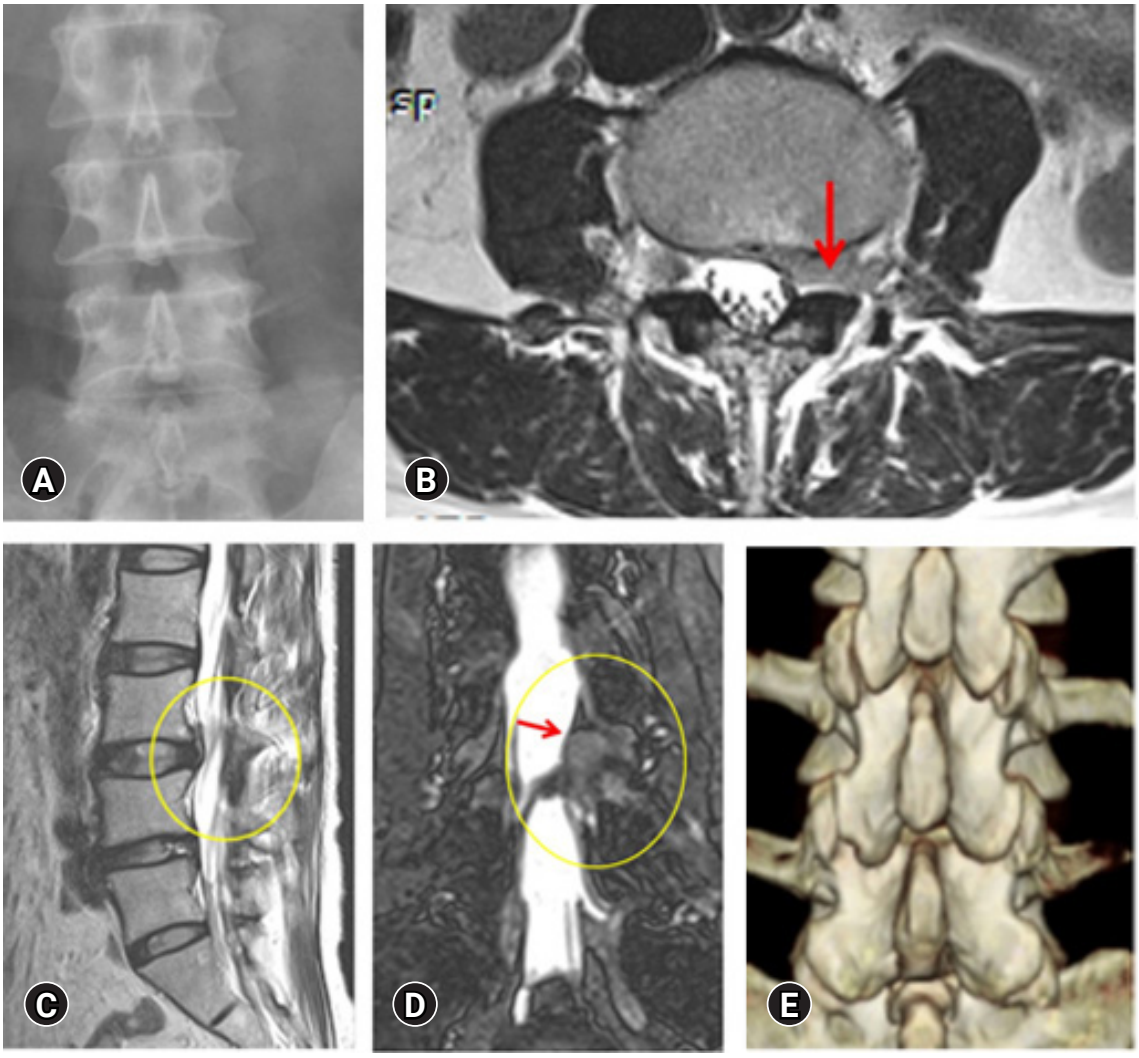


**Figure 1.** Different preoperative images that helps to localize the exact position of up-migrated disc and plan the exact target point of keyhole. (A) X-Ray, (B) MRI Axial, Red arrow showing migrated disc fragment. (C) MRI Saggital, Yellow circle showing migrated disc fragment (D) Myelogram, Yellow circle and red arrow showing migrated disc fragment (E) 3D CT.


https://doi.org/10.21182/jmisst.2021.00311

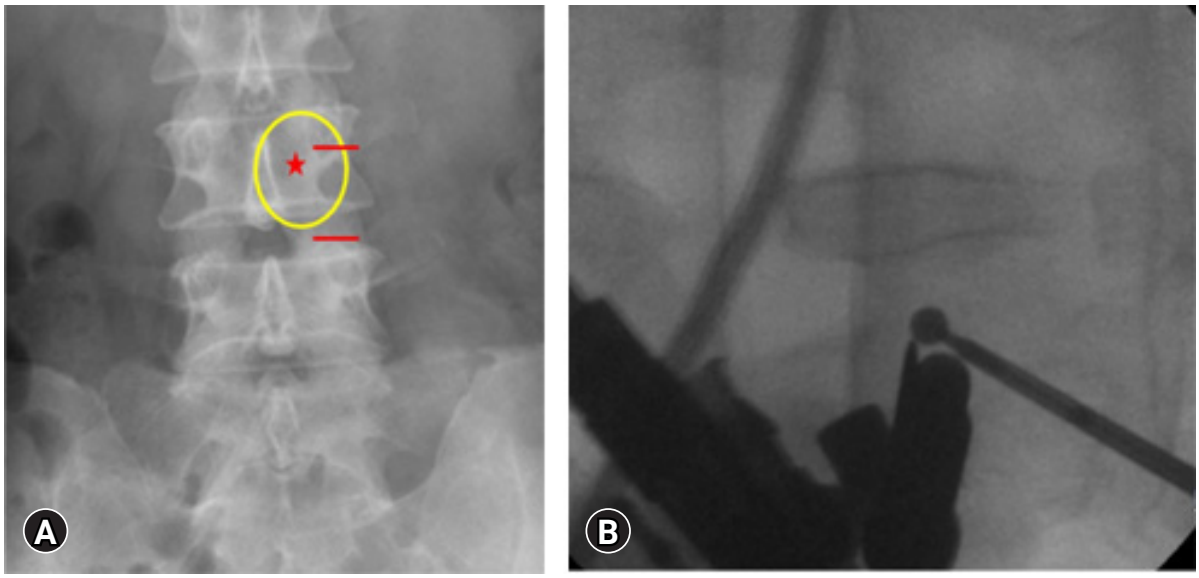


**Figure 2.** Skin incision point (A) Two skin incisions (two red horizontal lines) were made above and below the target point (red star), slightly separated from the midline, yellow circle showing working zone (B) C-Arm intraoperative image of the scope and diamond burr drilling the keyhole.

compressing the nerve root. The pedicle was identified to verify the exiting root. Subsequently, endoscopic forceps, probes, RF and holmium:yttrium-aluminum-garnet (Ho:YAG) laser are used to remove the migrated or sequestrated disks. Complete decompression and elimination of fragment was verified using the probe. Floseal® (Baxter biosurgery, Vienna, Austria) was used to control any residual bleeding. Drainage was collocated under endoscope guidance. The incision was closed with 3-0 nylon suture. The average operative time was 30 minutes.

## CASE REPORT

### 1. Case 1

A 77-year-old woman complained of progressive low back pain irradiating to the right leg. MRI showed a right paracentral extrusion with high-grade up-migrated disc from L2-3 (Figure 3A–C). We decided to use translaminar keyhole discectomy by UBE to remove the migrated disc (Figure 3D–G). One-day postoperative MRI revealed successful removal of the very high-grade up-migrated disc from L2-3. Patient was discharged 8 days after surgery.

### 2. Case 2

A 55-year-old man came to emergency room complaining of acute low back pain which started at the same day of his visit trying to wear his pants. At the examination the SLRT was positive and no signs of motor weakness or sensitive alteration. The patient had history of L3-4-5 neurolysis 8 months before his visit. Preoperative MRI showed mild listhesis and high-grade up-migrated disc herniation at L3-4 (right). Translaminar Keyhole UBE was performed to remove the migrated disc (Figure 4). One-day postoperative MRI showed complete removal of migrated disc.

## DISCUSSION

Disc fragment migration is a common condition. In 35%–72% of cases, the fragment enters the anterior epidural spaces through the posterior longitudinal ligament and migrates. Cranially extruded disc fragments can migrate to different zones; they can be localized in central, subarticular, foraminal, extraforaminal, and preforaminal zones (Figure 5A) [2,4]. Macnab referred preforaminal or foraminal zone as hidden zone because of their unusual and hard-to-reach feature [4]. Generally, removal of migrated disc fragments requires extensive bone resection, including lamina, pars interarticularis, and facet joints, which can cause iatrogenic instability [3].

Translaminar keyhole approach was introduced recently to treat patients with high-grade up-migrated lumbar disc herniation. It is a minimally-invasive technique where small (6–8 mm) translaminar fenestration is made to directly access the foraminal space and migrated disc fragments [2]. One of the greatest advantages of this approach is that it offers minimal disruption of the soft tissues and posterior bone elements avoiding iat-

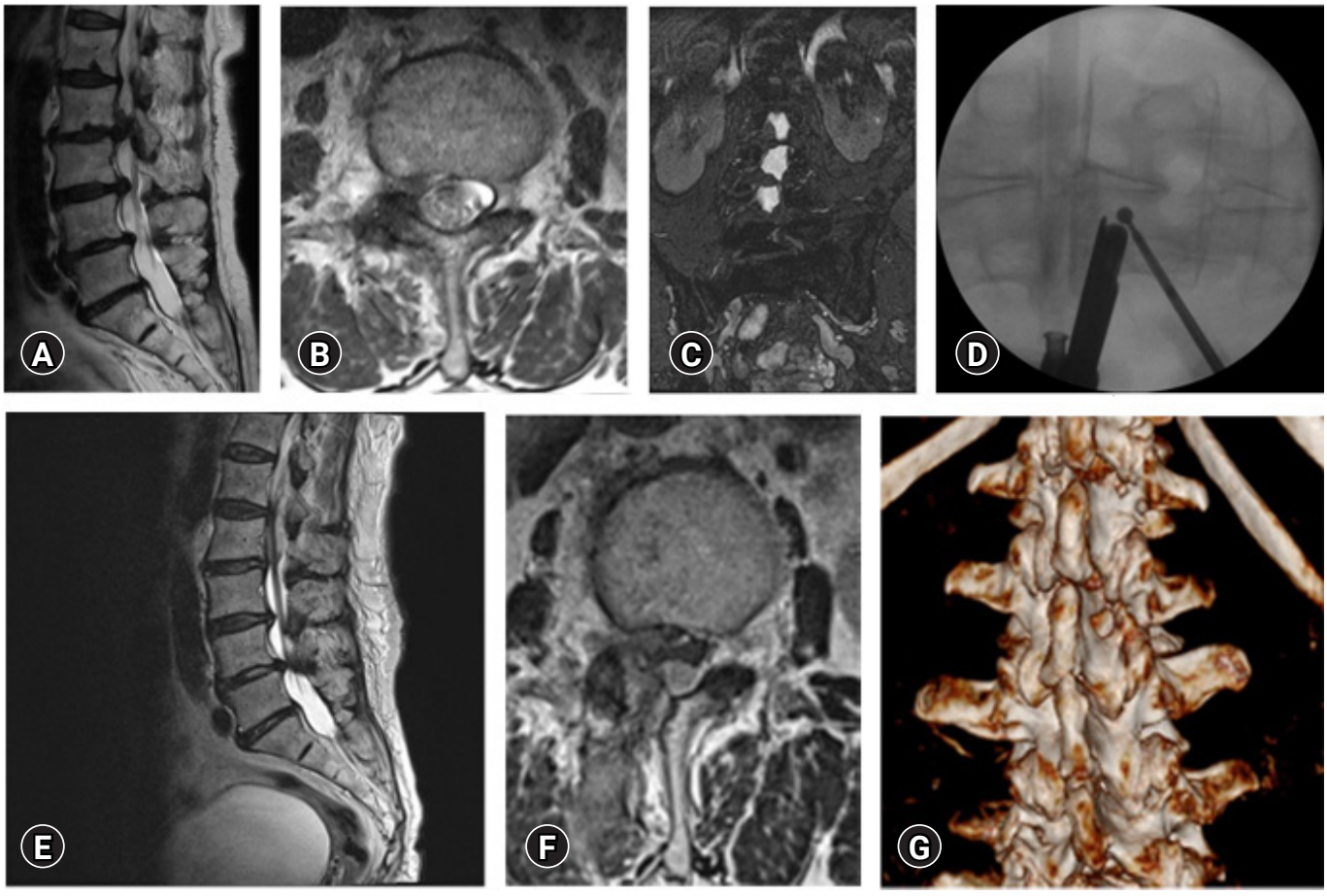


**Figure 3.** Preoperative sagittal MRI showing right paracentral extrusion with high-grade up-migrated disc from L2-3. (A) Sagittal MRI, (B) axial MRI, (C) myelogram. Images during and after translaminar keyhole discectomy by UBE. (D) C-arm intraoperative image of the scope and diamond burr drilling the keyhole. (E) Postoperative sagittal MRI, (F) postoperative axial MRI, (G) postoperative 3D-CT.

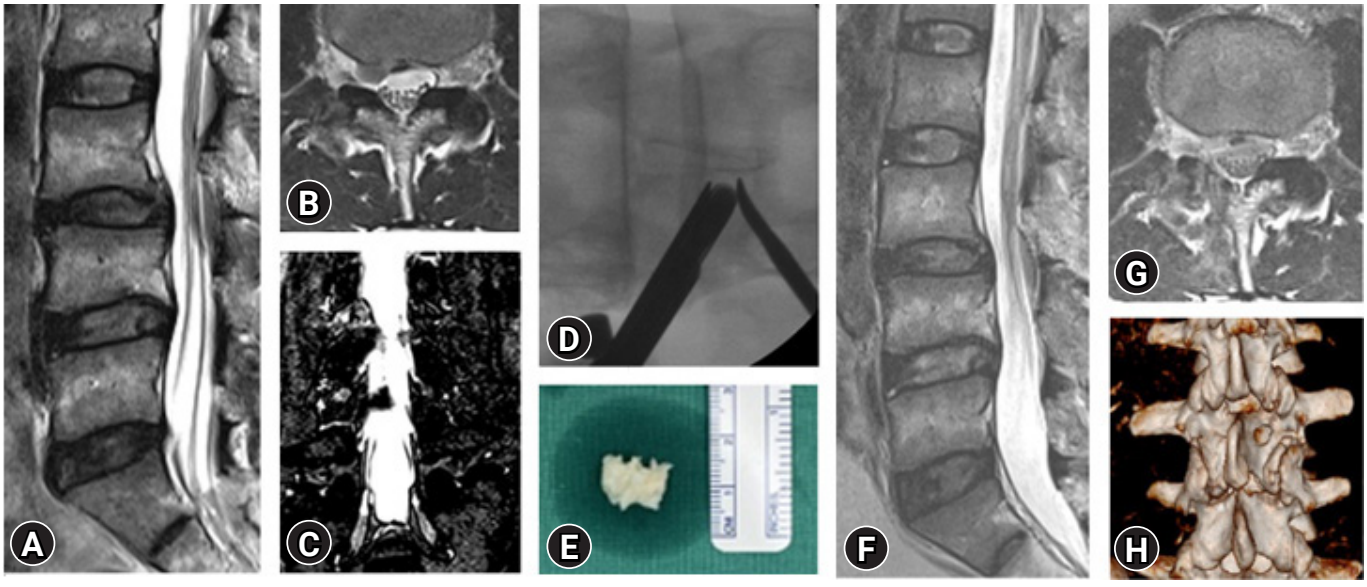


**Figure 4.** Preoperative sagittal MRI showing mild listhesis and high-grade up-migrated disc herniation at L3-4 (right). (A) Sagittal MRI, (B) axial MRI, (C) myelogram. Images during and after translaminar keyhole discectomy by UBE. (D) C-arm intraoperative image of the scope and diamond burr drilling the keyhole. (E) Fragment of disc herniation. (F) Postoperative sagittal MRI, (G) postoperative axial MRI, (H) postoperative 3D-CT.


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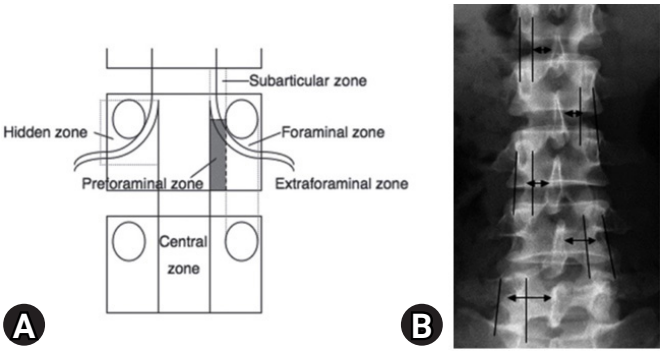


**Figure 5.** (A) Different zones of cranially extruded disc fragments. (B) The gradual decrease of width of the lamina in a cranial-caudal direction as width of isthmus increases.

rogenic instability. As a ligament flavum-sparing approach, it offers several advantages. Ligament flavum is known as the essential stabilizer of the lumbar spine as it offers translational control of the angular and segmental motion of the spine [4]. It also provides proprioception by high threshold dynamic mechanoreceptors, and protects spinal cord from damage especially during flexion-extension movements [4]. Without the need of flavectomy, which is an essential step in other approaches such as interlaminar approach, the risk of epidural bleeding reduces which is known to cause acute compressions of the roots or spinal cord due to epidural hematoma and iatrogenic stenosis because of the fibrosis [4]. Another point to consider in translaminar approach is the width of the lamina and the isthmus, which vary depending on the lumbar intervertebral space. The width of the lamina gradually decreases in a cranial-caudal direction as width of isthmus increases (Figure 5B). Because of these anatomical characteristics, breakage of the isthmus or excessive facet joint violation is common [2]. It is important to consider the caudo-cranial direction and oval shape of the keyhole [4]. The preoperative images such as AP and lateral radiographs, CT and 3D CT scans, MRI, and MRI with myelogram help us to pre-check the interlaminar and isthmus width to consider the viability of translaminar keyhole approach. Coronal scans of MRI with myelogram are useful in characterizing the migrated fragment and identifying the compression site of the roots [4]. CT scans are helpful to exclude any bony abnormalities causing lateral recess stenosis or foraminal spondylosis that contraindicates this approach [4]. Vogelsang was the first to describe translaminar approach in combination with a tubular retractor system in 15 patients with good results according to Macnab Criteria [6]. Dezawa et al. [7] described percutaneous endoscopic translaminar approach to treat nine cranially migrated disc herniation in 2012, and in 2020, Lin et al. [8] described 13 high-grade up-migrated lumbar disc herniation full endoscopic procedures using a translaminar approach with great results.

UBE is an emerging minimally invasive technique that offers several advantages with minimal limitations [3]. Under a microscope, the translaminar procedure of removing a herniated disk by laminar fenestration requires a traumatic muscle approach with a larger opening of the spine due to the limited surgical vision [8]. This is when the use of an endoscope is clearly advantageous compared to the microscope assisted surgery [8]. There are several advantages of translaminar discectomy using UBE. Unlike uniportal endoscopy, the extra working portal in UBE permits free movement, handling, and angulation of the instruments; therefore, the keyhole laminotomy is performed precisely over the migrated fragment. Further, high-definition (HD) endoscopic vision is allowed without crowding of instruments [3]. The endoscopy facilitates a close view of the lesion, easier disc dissection, ruptured fragment removal, and better and safer manipulation than the conventional microscopic technique. The extra incision in comparison to uniportal endoscopy, offers these advantages to undertake a minimally invasive and precision-requiring surgery. Compared to conventional microscopic technique, the intraoperative c-arm fluoroscopy enables the surgeon to continuously check the exact position of keyhole laminotomy in comparison to the site in the surgery plan. Ordinary arthroscopic and spine instruments can be used through the working portal, and the endoscopic trajectory is the same as that in conventional surgery, for which an experienced microscopic spine surgeon can attain the necessary surgical skills without a steep learning curve [9]. Continuous saline perfusion can control bleeding and reduce the risk of infection [3]. Other advantages over conventional surgery are that UBE allows minimized skin incision with muscle-preserving and minimized injury to the posterior musculoligamentous structures reducing postoperative back pain, shorter hospital stays, and faster return to work [9].

Numerous microscopes assisted translaminar keyhole discectomy procedures were undertaken by the author before realizing translaminar keyhole approach by UBE technique. In our experience, translaminar discectomy using UBE is the true minimally invasive surgery that sums up the advantages of both techniques to treat up-migrated disc herniations. Minimal anatomical disruption by UBE with the benefit of translaminar approach to treat the up-migrated lumbar disc herniations allows access to the surgeon to difficult areas, without compromising segmental spinal stability. Further studies will be essential to accurately establish the efficiency and safety of UBE translaminar keyhole approach. But to our knowledge, this is the first

technical report of UBE utilizing translaminar approach for high-grade up migrated lumbar disc herniation and our intention with this technical report is to share our own experience to colleagues.

## CONCLUSION

The UBE translaminar keyhole approach is the combination of the minimally invasive endoscopic technique that permits the free movement of the dominant hand of the surgeon to realize precise and exact control of the instruments with the most segmental spinal stability-preserving and "straightforward" approach, to treat up-migrated lumbar disc herniations. The minimal anatomical disruption claimed by UBE, adding the benefit of translaminar approach to treat the up-migrated lumbar disc herniations allows access to the surgeon to difficult areas, without compromising segmental spinal stability.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article.

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