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Transforaminal Endoscopic L5–S1 Discectomy Case Series One Year Experience

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Abstract: With recent advances in minimally invasive surgery, full endoscopic discectomy has been more involved, not only the interlaminar approach but also the transforaminal. Transforaminal endoscopic surgery (TFES) can decompress the nerve root with less insult to surrounding soft tissues compared to interlaminar or open approaches, resulting in less postoperative pain, reduced length of stay, and early return to work. We reviewed retrospectively the clinical presentation of 20 patients with symptomatic L5-S1 disc prolapse with unilateral radicular pain whom underwent Transforaminal endoscopic surgery (TFES). Clinical and satisfactory outcomes were assessed using the visual pain analogue scale (VAS), Oswestry disability index (ODI) at follow up period 6 months postoperative. This study included 20 patients 14 males (70%) and 6 females (30%) Male to female ratio was 2.3: 1 with a mean age of 42.38 years ± 13.1 (range 25- 58 years). The preoperative mean VAS scores for radicular pain significantly decreased from 8.1± 14 to 2.8± 1.1 at 6 months follow-up (p = 0.0034). There was significant difference in VAS scores for back pain (5.7± 2.1) preoperatively to 1.9± 2 (p=0.02). ODI decreased from 57±2.5 to 11±10.5. Average length of stay was 1-3 days (1±0.5). TFES can be done for herniated L5-S1 discs bypassing the iliac crest barrier, by using an appropriate suprailiac trajectory and tailoring the entry point based on the patient's body mass index guided by fluoroscopy.

Keywords: Endoscope, Lumber Disc, Transforaminal, Minimally Invasive

1. Introduction

With recent advances in minimally invasive surgery, full endoscopic discectomy has been more involved, not only the interlaminar approach but also the transforaminal. Transforaminal endoscopic surgery (TFES) can decompress the nerve root with less insult to surrounding soft tissues compared to interlaminar or open approaches, resulting in less postoperative pain, reduced length of stay, and early return to work. [1]

As the surgery can be performed under local anesthesia, this can help in avoidance of root injury by direct communication with the patient and examination during the procedure. [2] Although there are many advantages, there are also barriers that cause failure or complications of such approach. Transforaminal approach to the L5-S1 level may be more technically challenging due to high iliac crest and narrower exit foramen compared to higher levels particularly with large L5 transverse process or hypertrophic facet joint. [3] Several techniques were proposed to overcome such anatomical limitations. In published literature, many authors have suggested to use interlaminar approach for L5/S1 level [4, 5]. Yeung and Tsou [6] suggested that TFES can be done for all lumbar levels including L5-S1. However, iliac crest height still is an essential factor in the applicability of TFELS at the L5–S1 level. [7] In the case of the high iliac crest, TFES is technically difficult even for experienced surgeons. [1]

This is a retrospective study of our early experience of

TFES for L5/S1 disc prolapse, we reviewed patient data and studied patient outcomes to evaluate the suitability and efficiency of TFES at L5/S1 level.

2. Patients and Methods

In this study, we reviewed retrospectively the clinical presentation including neurological examination, radiological investigations and operative data of 20 patients with symptomatic L5-S1 disc prolapse, who failed conservative treatment and had unilateral radiculopathy. All patients had surgery in Ain Shams university Hospitals and its affiliated hospitals in between August 2021 till April 2022. Patients with pervious spine surgeries or associated other levels of prolapsed disc or instability have been excluded. Data were collected by reviewing our patient medical records; demographics, the presence of unilateral radicular pain, motor weakness and/or sensory deficits. On the magnetic resonance (MR) imaging; type of disc herniation was recorded.

Surgical technique: All patients in this study had total intravenous anesthesia (TIVA), they only had one dose of muscle relaxants with the induction of anesthesia. We placed all patients in prone position. Fluoroscopy were used to obtain Antero-posterior (Figure 1) and lateral views to confirm the level and draw a line connecting the iliac crest with the superior articular process (SAP) of S1. Our standard entry point is 12 cm from the midline along this line. We however displace the entry point more medially in slim patients and more laterally with overweight or obese patients. The trajectory line aiming at the junction point of the S1 SAP and the pedicle.

We introduce 150 mm 18G spinal needle from the entry point towards the L5/S1 foramen under fluoroscopic guidance. We aim to place the needle in the caudal part of the foramen just above the S1 pedicle to avoid injuring the exiting L5 nerve root. On AP X-ray we aim to position the tip of the needle at the medial pedicular line and on Lateral X-ray we aim to for the epidural space just outside the disc space. Once the needle is in a good position, we do a stab incision less than 1 cm in length to the skin and fascia at the entry point. We then remove the stylet and insert a guide-wire though the spinal needle. We confirm the guide-wire position on X-ray then remove the spinal needle. We then use Seldinger technique to insert sequential dilators and reamers under fluoroscopic guidance followed by the endoscope sleeve. Once the sleeve is docked in the required position and confirmed by fluoroscopy, we remove the dilators and guide-wire and introduce the endoscope (Figure 2).

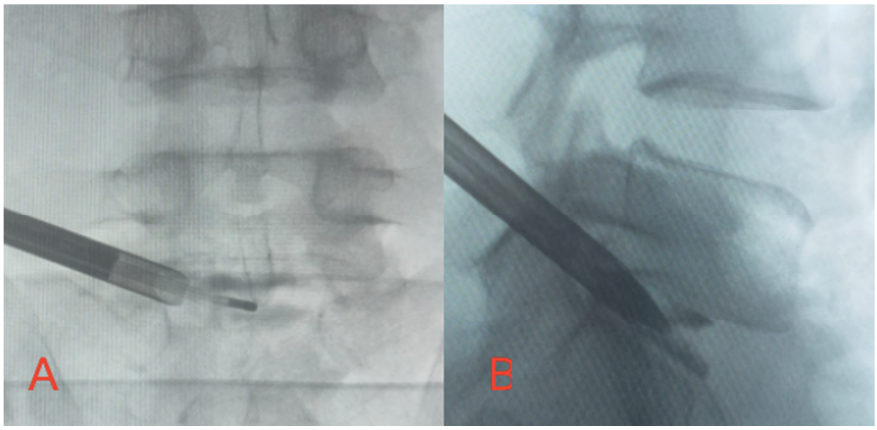

Figure 1. *a) Fluoroscopy were used to obtain Antero-posterior view to confirm the level and iliac crest marking, Sheath at medial pedicular line b) Lateral view at lower part of the foramen.*

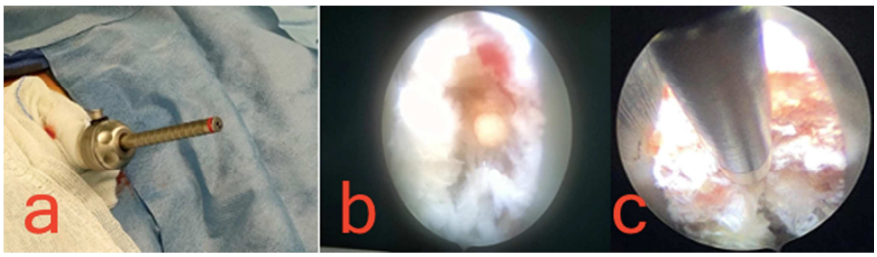

Figure 2. *a) Through the cannulated needle a guide-wire was passed then the sequential dilators application to form the surgical corridor b) endoscope is applied under continuous saline irrigation the herniated disc could be visualized and discectomy is performed by excising around 1/3 of the posterior part of nucleus pulposus and annulus first then the herniated fragment. c) cauterization of the annuls after discectomy.*

Postoperative outcome: The clinical and satisfactory outcomes were assessed using the visual pain analogue scale (VAS), Oswestry disability index (ODI) at follow up period 6 months postoperative.

All data were analyzed by SPSS22 (IBM SPSS Statistics Version 22, International Business Machines Corp., Armonk, NY, USA). Results are defined as mean ± standard deviation. All normally distributed continuous data were analyzed using

unpaired t-tests and expressed as means and standard deviation. P < 0.05 considered statistically significant.

3. Results

Patients' demographic and clinical presentation:

This study included 20 patients 14 males (70%) and 6 females (30%) Male to female ratio was 2.3: 1 with a mean age of 42.38 years ± 13.1 (range 25- 58 years). All patients had unilateral sciatica and 12 (60%) patients had also back pain, sensory change had been described by 14 (70%) patients, 3 (15%) patients showed motor deficits in form of unilateral partial foot drop. (Tables 1, 2).

Table 1. *Patients Demographics.*

Variable	Value
Age (year)	42.38±13.1 (25- 58)
BMI <18.5	9
BMI >18.5-25	4
BMI>25	7
Sex	
Male	14
Female	6

Table 2. *Clinical presentation and disc herniation.*

Disc	Protrusion	Extrusion
Motor Deficits	2	1
Unilateral Sciatica	12	8
Sensory changes	6	8

Operative data:

17 patients had a successful TFES (Figure 2), in 2 patients we could not cannulate the foramen and we could not do a TEFS discectomy. We did an interlaminar approach instead in same setting. One patient had persistent postoperative pain and an MRI confirmed a residual disc fragment. The patient had redo surgery (microscopic). (Figure 3).

There were 2 cases of unintended durotomy but no postoperative CSF leak. BMI was corelated to the location of entry point from midline distance, the more BMI to more the distance form midline. (Table 3).

Table 3. *Average of Midline in cm in relation to BMI.*

BMI	Patient number	Entry from Midline in cm
<18.5	9	9 (9-10)
=18.5-25	4	11 (8-12)
>25	7	12 (9-12.5)

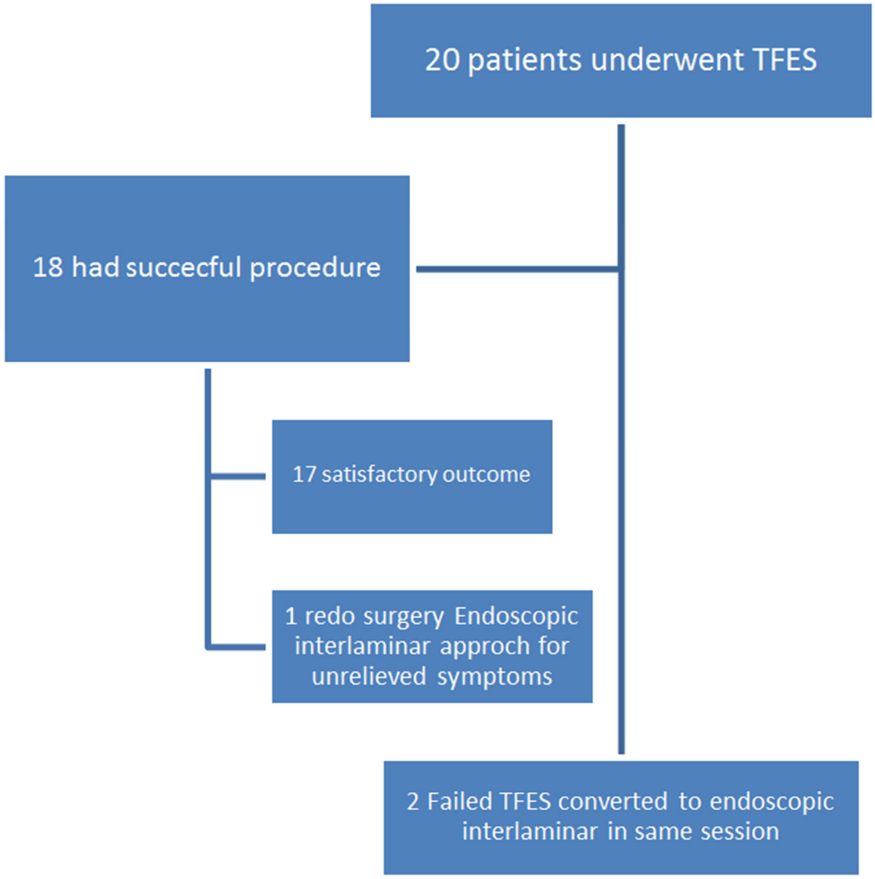

Figure 3. *Operative data analysis regarding approach and failure.*

Patients` outcome:

The preoperative mean VAS scores for radicular pain significantly decreased from 8.1± 14 to 2.8± 1.1 at 6 months follow-up (p = 0.0034) (Table 3). There was significant difference in VAS scores for back pain (5.7± 2.1 preoperatively to 1.9± 2 (p=0.02). ODI decreased from

57±2.5 to 11±10.5. Average length of stay was 1-3 days (1±0.5). (Table 4).

Table 4. *Postoperative outcome as regard radicular pain VAS, ODI.*

	Preoperative	6 months postoperative	P value
Radicular pain VAS (mean±SD)	8.1± 14	2.8± 1.1	0.0034
Back pain VAS (mean±SD)	5.7± 2.1	1.9± 2	0.02
ODI	57±2.5	11±10.5	0.002
Postoperative length of stay	1-3 days (1±0.5)		

Illustrative cases:

Figures 4 and 5 are examples for two different patients.

Case number 1: Male patient 42 years underwent TFES at the L5–S1 level (Figure 4), BMI =18-25, entry point located 9 cm from midline. Preoperative VAS for sciatica was 6, postoperative at 6 months was 1, While ODI was 50 dropped to 10. Length of stay was 1 days with unremarkable postoperative complications.

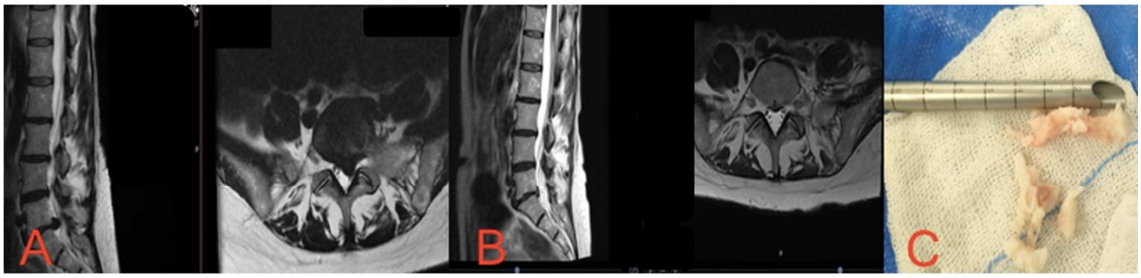

Figure 4. *a) MRI T2 axial and coronal showing large left sided extruded disc material causing left sciatica. b) MRI T2 axial and coronal showing postoperative showing well decompression c) Large fragment extracted by endoscope.*

Case number 2: Male patient 39 years old underwent TFES, his postoperative VAS was unsatisfactory, MRI LSS was done showed huge residual so another session of interlaminar approach was done (Figure 5).

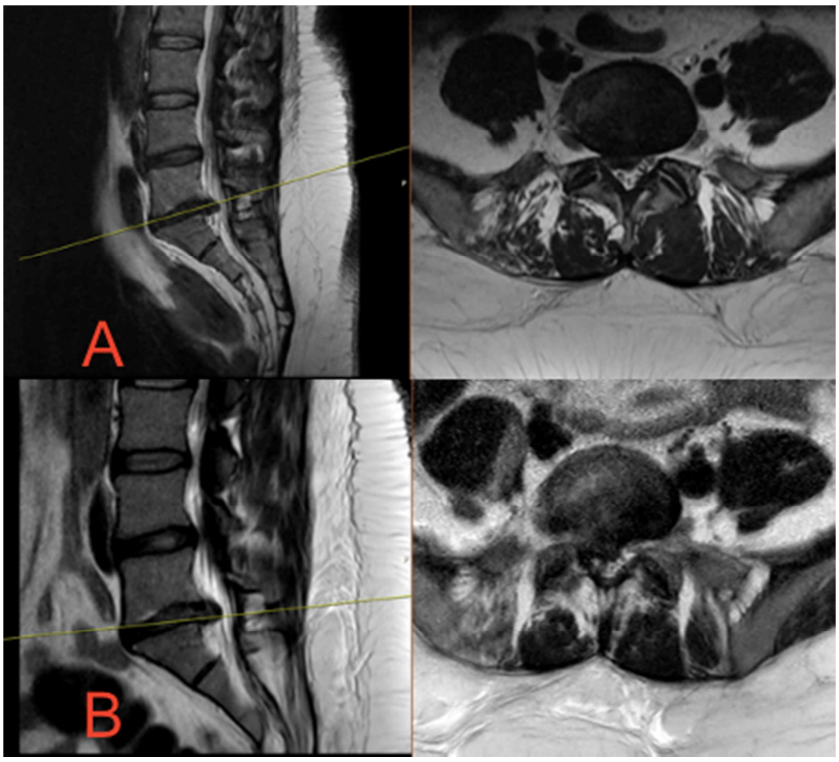

Figure 5. *The preoperative (A) and postoperative (B) magnetic resonance imaging showed uncompressed nerve root.*

4. Discussion

TFES at L5-S1 level is technically challenging due to anatomical barriers. [7] Good preoperative planning with evaluation of iliac crest height and the direction of the disc is of paramount importance as such factors can make the trajectory steeper and can make it more difficult to reach the

prolapsed disc. [3]

The entry point varied from 9 to 12.5 cm (mean 11) from midline. Yeung and Tsou described entry point being 12 ± 2 cm away from the midline for transforaminal approach [6]. The more the BMI the more the distance (Table 3). The entry point determines the trajectory of the cannula which is one of the main factors for success of TFES. [9] The literature describes different approaches for L5-S1 TFES including transiliac and supra-iliac entry. [10]–[12] Authors who described a transiliac approach drilled a hole through the iliac bone aiming towards to the pathologic disc, a larger hole allows more movement with better ability to manipulate the endoscope [13]. The supra-iliac entry is more challenging with a high iliac crest as this results in a more inclined trajectory, making disc fragment removal more difficult. [14] Choi and Park evaluated the iliac crest height and concluded that a foraminoplasty at the beginning of the procedure is required in high iliac crests where the iliac crest is above the mid L5 pedicle on lateral X-ray. [15, 7, 8]. Drilling the ventral aspect of the SAP is viewed by some authors as a means to achieve lateral recess decompression in addition to facilitating removal of the prolapsed disc [16].

Interlaminar endoscopic lumbar discectomy (IELD) is more commonly used for treating L5-S1 herniated discs being safe and efficient for discectomy and decompression. From an anatomical point of view, it provides more wider view and access [11]. However, some studies showed that TEFS and IELD have almost same outcome and safety. [9, 16] Also, IELD has less operative length and radiation dosage but it increases the risk of root irritation and postoperative dysesthesia due to more exposure of nerve roots and thecal sac compared to TEFS [11, 15]. On the other hand, TEFS has less anesthetic risk when local anesthesia when done, that what may use in elderly and high-risk patients. [9, 11] Some authors suggested tailoring the technique to the offending pathology where TFES could be the approach of choice for shoulder herniation and contained central herniation while IELD could be more suitable for axillary herniation and migrated fragments [9].

This study has some limitations, being a retrospective. Patients underwent operations by more than one surgeon, which cause heterogeneity in the outcome. The study had a small sample size and short follow up period. Also, the surgeons are in an early stage of their learning curve. Our initial results highlight the need for more studies with a more thorough clinical analysis aided by postoperative MRI scans with longer follow up.

5. Conclusion

Our initial results showed that TFES can be done for herniated L5-S1 discs bypassing the iliac crest barrier, by using an appropriate suprailiac trajectory and tailoring the entry point based on the patient's body mass index guided by fluoroscopy. More number of cases and with longer follow up period is required for stronger evidence of applicability and safety of TEFS for L5-S1 prolapsed disc.

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