Original Article

Endoscopic Disectomy: Learning Curve and Outcome Evaluation

Muhammad Riaz Akhtar, Ahmed Tashfeen Ashraf, Sadaat Ali janjua

ABSTRACT

Background: Minimally invasive techniques for Lumbar disc surgery are becoming common. It is therefore essential that we assess their learning curve and evaluate their results before their across the board application to lumbar disc herniation surgery. **Objective:** This prospective study was conducted to evaluate steepness of learning curve and outcome of Endoscopic disectomy. **Study Design:** This is a prospective study carried out at PNS Shifa, which is a tertiary care hospital, from Jan 2011 to Jan 2013. **Patient Interventions:** Forty three patients underwent Endoscopic disectomy for a single level herniated disc using an interlaminar approach; all procedures were performed under general anesthesia. All patients were followed prospectively. Endoscopic system used in this study consisted of tubular dilators and an endoscope with xenon light source and HD image system from Karl Storz co. Germany. **Outcome measures:** Outcomes were assessed by analyzing the video of the procedure to pinpoint the areas where maximum time was spent and thus devising ways to cut down the operating time. Patient outcome was measured by using Oswestry disability index and Macnab criteria. **Results:** 43 patients (29 males, 14 females) underwent Endoscopic disectomy for prolapsed lumbar intervertebral disc. Mean operating time was 70 minutes. The mean operation time for the first and last 10 cases was 140 and 58 minutes, respectively. The procedures affecting a prolonged operation time were evaluated. The time required for surgery reduced considerably after 12 cases. Follow up ranged from 3 to 15 months with a mean follow up of 10.8 months. Thirty five patients had an excellent outcome while five had a good outcome. Three patients had a poor outcome and underwent open disectomy. Five patients early in the study had to be converted to open disectomy due to technical difficulties. These cases were excluded from the study. **Conclusions:** Endoscopic disectomy is clinically effective and reliable. The learning curve, however, is steep. It requires at least 10-15 cases before surgeon can achieve command of the procedure. **Key Words:** Lumbar herniated disc.

- Endoscopic discectomy
- Operating time.

INTRODUCTION

In recent years new minimally invasive technologies have come up which have been applied to spinal surgery. The advantages of minimally invasive techniques have included smaller incision, improved illumination and visibility, less tissue trauma and peri-operative pain, early ambulation, short hospital stay and early return to work, easier revision surgery due to less scarring and overall less complications [1]. Despite many advantages, Neurosurgeons express reluctance to learn MED, citing its long learning curve, limited view of the operation field, high level of hand-eye coordination required and possible harm from radiation to patients and medical staff [2, 3]. To provide guidance for MED promotion, this study analyzes the learning curve of one surgeon in this procedure at one hospital. We report our results in 43 patients who underwent minimally invasive disectomy using an endoscope and a new tubular dilator system.

Corresponding Author
Dr. Ahmed Tashfeen Ashraf
Assistant Professor Neurosurgery
PNS Shifa Hospital, Karachi
E-mail: ahmedtashfeen@yahoo.com

Abbreviations used in this paper:

ED: Endoscopic discectomy, MED: Microendoscopic disectomy, HD: High Definition, OWI: Oswestry disability index

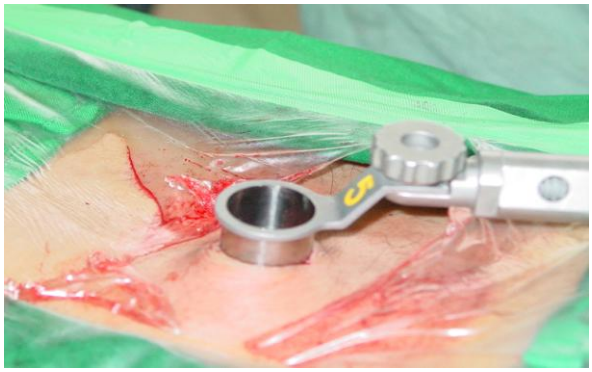
MATERIALS AND METHODS

Study design: Forty three patients with prolapsed lumbar intervertebral disc who were seen at our institution between Jan 2011 and Jan 2013 were included in the study. There were 29 males and 14 females. Pre-operatively all patients had a trial of conservative therapy before surgery was offered. This included a minimum period of 6 weeks of analgesics and rest. All patients had a pre-operative MRI of the lumbar spine. Lateral recess stenosis at the involved level was not a contraindication to ED. Informed written consent was taken from all patients. All patients completed a consent form and Patient Questionnaire–A form, prior to surgery. Detailed history and neurological examination were undertaken. Bladder and bowel dysfunction were specifically asked. All cases of suspected cauda equina lesion, multiple and recurrent disc herniations and all cases of spinal stenosis and lumbar instability were excluded from the study.

OPERATIVE TECHNIQUE

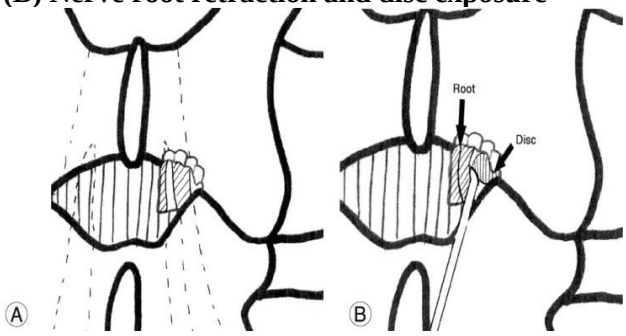
Under general anesthesia the patient was positioned prone on a spinal frame. Skin preparation was done with povidone iodine. The ED system used for the procedure consisted of 20 mm tubular retractor system, endoscope with xenon light source and High definition image system. Under X-ray control a spinal needle was placed paramedian (1 cm lateral to midline) on the side of disc herniation and the position of the needle was adjusted till it was parallel to the center of the involved disc space. Subsequently a small incision was made and a K wire was placed under X-ray control at the offending disc level parallel to the disc space. Serial dilators were then passed over this Fig 1.

Figure-1
Tubular dilators being inserted



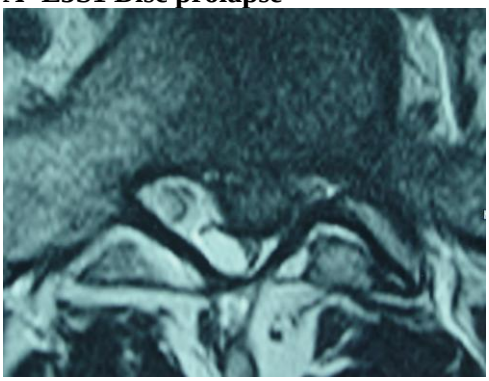
Finally, the largest 20mm dilator was placed and fixed to the holding arm. Endoscope was then attached to the tubular retractor and rest of the procedure was done under endoscopic control. The laminae, facet and ligamentum flavum were identified and a proper orientation and focus was achieved. Laminotomy and medial facetectomy was done using kerrison punches. Ligamentum flavum was then cut using a knife and flavectomy achieved using a Kerrison rongeur. The nerve root and dural tube and protruded disc were identified. Discectomy and rhizolysis of the involved nerve root was carried out. Where necessary posterior osteophytes were also removed and lateral recess was adequately decompressed Fig2. Closure involved subcuticular absorbable stitches. Perioperative antibiotics were given for 48 hours.

Figure-2
Resection of ligamentum flavum and Laminotomy (B) Nerve root retraction and disc exposure

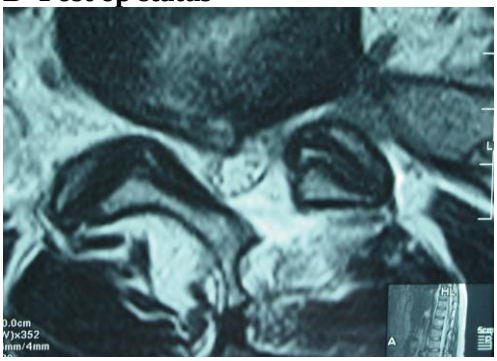


The patients were ambulated as soon as the effects of general anaesthesia wore off (usually within 6 to 8 hours of the surgery) and were discharged on the 2nd post operative day. Postoperative MRI was done in early cases in the series to assess the postoperative status Fig 3.

Figure-3-
A- L5S1 Disc prolapse



B- Post op status



Outcome assessment was done using the modified Oswestry disability index and Macnab criteria [Table 1].

Table-1
Modified Macnab criteria to assess clinical outcome following ED

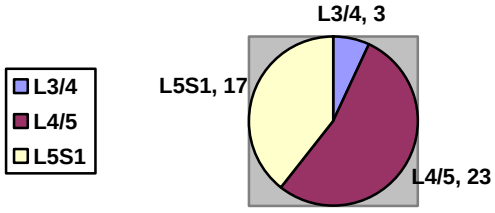
Excellent	
	Free of pain
	No restriction of mobility
	Able to return to normal work and activities
Good	
	Occasional nonradicular pain
	Relief of presenting symptoms
	Able to return to modified work
Fair	
	Some improved functional capacity
	Still handicapped and/or unemployed
Poor	
	Continued objective symptoms of root involvement,
	Additional operative intervention needed at the index level, irrespective of repeat or length of post operative follow up

A score of >25% on OWI was taken as a measure of improvement.

RESULTS

Forty three patients underwent ED at our institution between Jan 2011 and Jan 2013. There were 29 males and 14 females. The age group ranged from 22 years to 58 years. All patients had a virgin posterolateral disc herniation and of these 2 patients also had associated lateral recess stenosis. L4-5 and L5-S1 were the most commonly involved levels [Table 2].

Table-2
Level of Disc Herniation in study



All patients were ambulated within 6 hours of the surgery and were discharged within 48 hours of the surgery. During the latter part of series, patients were discharged within 24 hours of surgery. Duration of post operative follow up ranged from 3 months to 15 months with a mean follow up of 10.8 months. Thirty five patients had excellent outcome, five patients had a good outcome and three had a poor outcome as measured on OWI. Thus, overall success rate was 93.03% in our series.

LEARNING CURVE

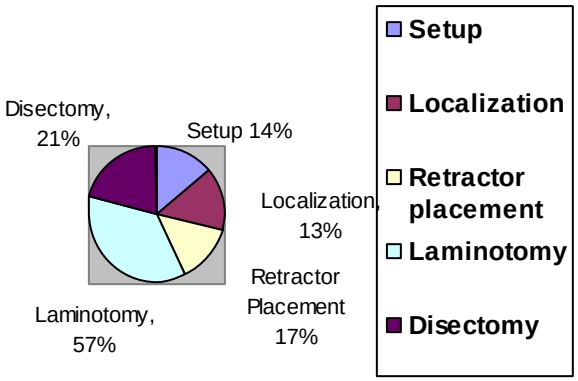
Mean operating time was 70 minutes. The mean operating time in patients varied depending on whether they required bone removal (Laminectomy) or not. The operating time for those requiring or not requiring partial removal of the lamina were 96 minutes (48 minutes~140 minutes) and 54minutes (34 minutes~96 minutes), respectively. The mean operation times for the first and last 10 cases were 140 and 58 minutes, respectively. Moreover L5S1 disc surgery required less time than L4/5 and L3/4, probably due to less bone removal. The comparison of time taken for first ten cases and the last ten cases is given in Table 3.

Table-3
Comparison of Operating Times

Surgical step	Early cases 140mins	Late cases 58 mins
Instrument set up	20 mins	10 mins
Disc space localization	25 mins	5 mins
Insertion of tubular retractor	25mins	5 mins
Laminotomy and exposure of disc	45 mins	28 mins
Excision of disc and closure	25 mins	10 mins

The procedures affecting a prolonged operation time were evaluated. The time required for surgery reduced considerably after 12 cases. After analyzing the surgical video, time spent during various steps of ED was calculated. Time consuming steps were then scrutinized and appropriate remedial measures adopted to reduce operating time. This included among other things; prior familiarization and rehearsal of instrument setup by the surgical team, extra assistant for handling of tubular retractor, usage of high speed Endoscopic drill for bone removal, minor technical adjustments in the placement of tubular retractor and above all familiarization of the surgeon with high definition 2 D image on the monitor and adequate adjustment of direction of camera by rotating the sleeve for inspection of all 'corners' of the surgical field for possible missed fragment. All these steps led to reduction of operating time see Table 4.

Table-4
Percentage of Mean Time Spent at Each Stage



DISCUSSION

Compared with conventional surgical methods, ED or MED is known to have disadvantages such as a longer operative time and steep learning curve. Because minimally invasive surgery generally observes the operative field using specialized equipment with a restricted vision, it is difficult to identify the orientation of the operation target, and this procedure requires the surgeon to become familiar with the special visual equipment, surgical instruments, and the procedure quickly. The term "learning curve" is often used in the literature to describe the difficulty in mastering these techniques. Attempting a new surgical procedure without understanding its learning curve may cause repeated and unnecessary errors. The learning curve for minimally invasive surgical techniques (MIST) is longer and more flat than that of traditional open surgery due to limited view of

operation field and the need for specialized surgical instruments and equipment [4,5]. The acceptability of specific technique is determined by the following objective indexes: operation time, blood loss during operation, operation effectiveness and complications [6]. Operators' skills become relatively stable, which represents surgeons' mastery, when the indexes undergo no drastic fluctuations on the learning curve [7]. In the current study, we formed a preference for MED after the experience of 10–15 cases. Operation time and blood loss declined gradually within the first 10 cases, and after that, the indexes tended to become steady. The most serious complication noted was dural tears which occurred in three cases. Besides, few of the early cases had to be converted to open surgery due to technical difficulty.

FACTORS AFFECTING LEARNING CURVE AND HOW TO OVERCOME THEM

Factors influencing the MED learning curve are the same as those of other kinds of minimally invasive surgery: complexity of patient's condition, operator's knowledge of local anatomy and operator's psychological diathesis. Initial case selection is important. Early on, patients with classic symptoms were selected and senile patients and patients with difficult perceived anatomy were excluded.

Anatomical factors affecting the learning curve include limitations caused by facet joints, laminae, pedicles and exiting nerve root. These can be overcome by Endoscopic drill, burrs, and fine rongeurs for bone resection. Biplanar fluoroscopy is a prerequisite for this procedure. The key step in success of the operation lies in inserting the tubular retractor vertical to the inter-laminar spaces.

As a result, surgeons should invest considerable time initially in positioning the tubular retractor at the correct place. The benefit lies in the fact that when the operating passage is established it is also immobilized, allowing operators to make observations and perform the operation through the same passage without searching for lesions or surgical instruments, as in laparoscopy or arthroscopy. Strict eye-hand coordination, between operators' eyes and hands under the display screen is also an influencing factor. A comprehensive understanding of relevant surgical instruments and equipment should be obtained before surgeons enter MED training [8].

INFLUENCE OF LEARNING CURVE ON RESULTS AND COMPLICATIONS

In the last five years the quality of the equipment available has dramatically improved, particularly in respect to the Endoscopic instrumentation systems that are now coupled to high definition TV monitors. The development of angled instruments, Endoscopic shavers and burrs has all facilitated surgical access. This improves the ability to teach the technique and reduces the exposure of multiple patients to surgeons learning these skills. Access through the translaminar route makes this a familiar approach to most surgeons.

Learning curve for Endoscopic spinal surgery for any indication usually flattens after 15-20 cases [9], (10-15 cases in our study). After that the results and outcome of this surgical technique compares favorably with traditional microdiscectomy [10, 11]. It is in any case superior to other percutaneous disectomy techniques such as lumbar laser disc decompression [12]. Outcome after ED as measured by OWI and Macnab criteria indicates that freedom from sciatic pain as well as minimal local wound pain is a good predictor of success of this procedure. Long term recurrence rates are low and patient satisfaction is high. Moreover once this technique is mastered, the image quality of high definition camera makes this procedure a very gratifying alternative to standard microdiscectomy.

CONCLUSIONS

Endoscopic discectomy using tubular dilators is a safe and effective procedure for the treatment of prolapsed lumbar intervertebral disc. Its results are comparable to standard microdiscectomy. The learning curve for this procedure is long and requires practice, patience and persistence.

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AUTHORS

- **Dr. Muhammad Riaz Akhtar**
  Assistant Professor Neurosurgery
  PNS Shifa Hospital Karachi
- **Dr. Ahmed Tashfeen Ashraf**
  Assistant Professor Neurosurgery
  PNS Shifa Hospital Karachi
- **Dr. Sadaat Ali janjua**
  Assistant Professor Neurosurgery
  PNS Shifa Hospital Karachi

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