Percutaneous Transforaminal Endoscopic Lumbar Discectomy: Early Experience of the First Fifty 50 Cases

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Abstract

Background: Many kinds of surgical approaches from standard discectomy, microdiscectomy, percutaneous interlaminar and transforaminal endoscopic discectomy have been in use for treatment of prolapsed intervertebral disc. Transforaminal endoscopic discectomy through a safe triangle (Kambin triangle) is a stitchless minimal invasive approach, doesn’t require muscle splitting, can be done under local anaesthesia with short hospital stay and minimal complication.

Aim of Study: The aim of this study is evaluation of early experience of transforaminal endoscopic lumbar discectomy, surgical technique, complications, overall results in single and multilevel lumbar disc herniation.

Patients and Methods: A retrospective study involved fifty patients with low back pain and unilateral sciatica due to prolapsed intervertebral disc were treated with endoscopic transforaminal discectomy at Zagazig University Hospitals, Al-Helmaiia and Al-Agoza Military Hospitals from Jan 2016 to June 2017 (35 patient under local, 15 patients under general anesthesia). Preoperative clinical assessment of the patients has done using visual analogue score (VAS) and Oswestry Disability Index (ODI) and follow-up was done at 1, 6, 12, months postoperatively. Surgery done by surgeons have never practicing endoscopic transforaminal approach before.

Results: Using Modified MacNab’s criteria, good to excellent outcome was noted (45 patients, 90), fair outcome (2 patients, 4%) and poor results (3 patients, 6%). No major complications were noted, dural tear in (2 patients, 4%), no wound infection reported, mean operative time 55 minutes, mean hospital stay (12 hours, 4 days), mean return to work.

Conclusion: Since the introduction of percutaneous posterolateral approach by Kambin in the year of 1973, for treatment of herniated LDP, the procedure has advanced over the last decades and becoming more popular as the treatment of choice for treatment of herniated lumbar disc in selected cases.

Percutaneous transforaminal discectomy is a relatively safe and successful alternative approach for treatment of lumbar disc prolapse and associated sciatica, although microdiscectomy still remains the gold standard approach.

Key Words: Transforaminal, Endoscopic – Kambin – Lumbar discectomy.

Introduction

PROLAPSED intervertebral disc sits on top of the causes of low back pain and sciatica and it is the most common pathological spinal disorders needs surgery between the causes of low back pain [9,29]. Many surgical procedures from standard open discectomy, microdiscectomy, percutaneous interlaminar and endoscopic transforminal discectomy have been used in treatment of prolapsed intervertebral disc and sciatica. The first laminectomy and discectomy has been done by Oppenheim and Fedre Krause in 1906 [25] Yasargil and others had created the microdisectomy by using the microscopic to avoid the extensive soft tissue dissection and bony manipulation in classic laminectomy and discectomy [3,31,32].

Trials for posterolateral discectomy started by Hijikata through mechanical nucleotomy by inserting cannula into the centre of the disc [12], followed by automated percutaneous discectomy by Onik [24]. Since the introduction of percutaneous posterolateral approach by Kambin in the year of 1973, for treatment of herniated LDP, the procedure has advanced over the last decades and becoming more popular as the treatment of choice for treatment of herniated lumbar disc in selected cases [5,35].

Kambin, and Schaffer have used the arthroscopy for discectomy [14]. In 1997, Foley and Smith described endoscopic discectomy produces [7].
Yeung developed a rigid working channel endoscope for percutaneous endoscopic lumbar discectomy (PELD) or (YESS) technique through the Kambin safe triangle which has been identified as a safe working corridor in the posterolateral corner of the disc with less muscle, ligamentous damage and without bone or facet resection [33]. The main difference between the transforaminal endoscopic approach (TED) and microdiscectomy is not only the length of the wound, but the philosophy itself, in TED we are targeting the pain generators without disturbing the posterior element of the spine [33]. Major complications during TED such as, nerve root injury, vascular injury, dural tear and visceral injury are not common but may occur due to lack of skills and improper leaning [34,35].

**Patients and Methods**

A total of fifty (50) patients who had treated with transforaminal endoscopic discectomy between January 2015 and June 2017 with a mean follow up one year. The cases operated at Neurosurgical Department, Zagazig University Hospital and Al Galaa, Al Helmia Military Hospitals. Informed written consents were obtained from the patients and approval from the Zagazig University review board (IRB) was taken.

**Inclusion criteria:** (1) Patients with unilateral sciatica due to LDP and conservative treatment has failed for 6 weeks; (2) Patients with lumbar disc prolapse and neurologic defects without segmental instability; (3) Recent MRI scan of lumbar spine revealed posterolateral disc prolapsed correlating with clinical presentation.

**Exclusion criteria:** (1) Patients of lumbar canal stenosis (central or lateral); (2) Bilateral sciatica; (3) Sciatica due to other pathologic conditions (fracture, trauma, tumour, infection); (4) Cases of sciatica and complete disc collapse; (5) Cases of spinal instability, highly migrated disc; (7) Cases of calcified discs diagnosed by CT lumbar spine and cases of high iliac crest in cases of L5-S 1, disc prolapsed; (8) Significant foot drop.

**Operative technique:**

All patients had a preoperative radiological and laboratory investigations, all patients received 2g third generation cephalosporin intravenously as antibiotic prophylaxis, patients were placed prone on a radiolucent operative table, true anteroposterior (AP) and lateral view before needling this will avoid radiographic error and malpositions of the needle, cannula and the endoscope. The procedure was done under local anathesia (midazolam and fentanyl 100-200mg) with monitoring and additional sedation can be used when needed (nitrous oxide mask or propofenol infusion) except 15 patients were choosed GA.

**Needling:** All lumbar area painted with iodine and drapping was done wide enough. Skin, fascia, muscles were infiltrated with 1% lidocaine. Initial needle placement is very important because for proper endoscopic view. The needle entry point typically starts about 10 to 14cm from the midline, to optimize the approach to access the specific herniation type, the entry point can be a little more medial (for foraminal or extraforaminal discs) or lateral (for central and some paracentral disc). Typically, start as lateral as possible to create a shallow entry trajectory (15-20 degree to the floor) to the lateral facet, then slide the needle ventral to the facet, using the facet as a lever arm. A 18 gauge aspiration needle (21 inch length) inserted from the entry point to land in the disc at the medial pedicular line in A/P view and at posterior vertebral line in the lateral view, then the needle advanced to be in the midline in A/P view X-ray. The stylet of the needle removed, a guide wire was passed into the disc space and the needle was removed. Skin was incised at the entry point for a 7mm length using another needle, the track of the guide wire till the annulus infiltrated with local anesthesia, when the dilator was over the guide wire, the track of the guide wire put operation sheath over the dilator, then dilator removed and the endoscope was inserted through the operation sheath. Most of the cases operated by in-out technique, but sometimes we used out-in technique and half-half technique, the disc was seen directly and removed. We considered the surgery was satisfactory when; (1) A big disc fragment or considerable multiple disc fragments were removed with visualization of epidural fat and traversing root (sometimes we couldn’t see the decompressed traversing nerve root); (2) The amount of disc material matched with the MRI findings; (3) Visualization of spontaneous dural pulsation or dural cough impulse; (4) Relief of sciatica as reported by the patient in cases of local anathesia. Once discectomy was finished, the endoscope and operative sheath removed and wound closed with single stitch, bleeding control done by continuous washing during procedure and by biopolar cautery. Before removing the endoscope, we also routinely visualize and confirm the exiting nerve root or the perineural fat encasing the nerve root is uninjured and inject 1ml of 80mg depomodrol in the foramen to help decrease the inflammation and reduce the incidence of dyesthesias. The
endoscope and operative sheath removed and wound closed with a single stitch. Postoperatively: All patients were mobilized as soon as the pain subsides and discharged within 24 hours unless there was no complications. Postoperative MRI done only when needed not as a routine.

For evaluating pre and postoperative pain, we had used visual analogue scale (VAS, 0-10 points), and Oswestry disability index (ODI) to evaluate the functional status. We had used these scores and indices preoperatively, one month, 6 months and after one year postoperatively. Outcome has been evaluated using a modified Macnab's criteria, follow-up sheets were filled out at discharge and with each visit indicating the location, severity and duration of pain using VAS. Each patient had a preoperative lumbosacral MRI showed the herniated disc.

**Results**

Table (1):

<table>
<thead>
<tr>
<th>Number of patients:</th>
<th>50</th>
</tr>
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<tbody>
<tr>
<td>Male</td>
<td>33</td>
</tr>
<tr>
<td>Female</td>
<td>17</td>
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<tr>
<td>Mean age</td>
<td>17-69 (44.6±7.06 years)</td>
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<tr>
<th>Sciatica:</th>
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<td>Rt</td>
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<td>Let</td>
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<table>
<thead>
<tr>
<th>Disc level:</th>
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<tbody>
<tr>
<td>L4-5</td>
</tr>
<tr>
<td>LS-S1</td>
</tr>
<tr>
<td>L3-4</td>
</tr>
<tr>
<td>Two disc levels</td>
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<tr>
<th>Straight leg raising:</th>
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Mean operative time 25-120 minutes
Mean hospital of stay 6h-8 days
Mean time to return to work 10-90 40 days
Mean VAS back preop 6.56
Mean VAS back postop 6w 2.65
Mean Vas back postop 6 m 2.26
Mean follow up period 6(6-24) 1.5 year
MeanVAS sciatica 7.64
Mean VAS sciatica postop 6w 1.94
Mean VAS sciatica postop 6m 1.72

Mean ODI:
Pre op 34.76
Post op 6 w 15.54
Post op 6m 4.66
Complication rate related procedure 8 16%
Recurrence rate 3 6%
Reoperation 5 10%

Macnab's outcome criteria:
Excellent 29 58%
Good 14 28%
Fair 3 6%
Poor 4 8%

Anesthesia:
Local 35 70%
General 15 30%

**Complications:** Dural tear in 2 patients (4%), discitis in 2 patients (4%), recurrence in 3 patients (6%) and dysaethesia in 3 patients (6%).

**Outcome results:**

Table (2):

<table>
<thead>
<tr>
<th>Mayer and Brook, 1993</th>
<th>Same as miucrodiscectomy</th>
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<tbody>
<tr>
<td>Hermantin, 1999</td>
<td></td>
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<tr>
<td>Yeung and Tsou, 2002</td>
<td>89.7% satisfactory results</td>
</tr>
<tr>
<td>Kim et al., 2007</td>
<td>84.7% good the excellent results</td>
</tr>
<tr>
<td>Rutter et al., 2008</td>
<td>96% good the excellent nearly the same microdiscectomy</td>
</tr>
<tr>
<td>Chae et al., 2009</td>
<td>94.77 satisfactory results</td>
</tr>
<tr>
<td>Gibson et al., 2012</td>
<td>Same as microdiscectomy</td>
</tr>
<tr>
<td>Mahesha, 2017</td>
<td>96% satisfactory results</td>
</tr>
<tr>
<td>Our study</td>
<td>86% good to excellent</td>
</tr>
</tbody>
</table>

Fig. (1): Drawing the lines, direction of the pathway.

Fig. (2): Guide wire through the needle after stylet removal.
Discussion

In our study, the mean age was 44.6 ± 7.06 year and the age group (30-40 years) is the most affected one, male 33 patients (66%) and female 17 patients (34%) and it is in correlation with most of the studies which stated that LDP has a high incidence in males specially in the productive age group [27].

L4-5 LDP constitutes 68% of the cases, followed by LS-S1 (18%) and L3-4 (6%) and this comparable with the same findings in other series [13,20,10].

In our study the average operative time was 55 minutes (35 to 120 minutes) and this comparable to other studies which was (40.7 ± 11.3 minutes), 51.0 minutes (34-94 minutes), (28 ± 11 minutes), 45 minutes (15-180 minutes) respectively [8,9,20,20], we noticed a long operative time in the first ten cases which become less during the following cases due to improving learning curve. All seniors have mastering the endoscopic transforaminal procedure stated that it has a steep learning curve which it will take time and with experience the operation time will by shorten and complications become less [2,36,35], they advised the beginners to start with transforminal epidural injection to develop a proper a good learning curve and be familiar with the procedure of TFE [12]. Complication rate and the need for conversion to open techniques mostly obviously decreases after the first twenty cases [19,30].

In our study, no patients had wound infection and the consistent with that reported in the literature (0.1-0.65%) [5,34].

Two patients (4%) has suffered from postoperative discitis and this comparable with the percentage of discitis in Kaushal and Sen series (5 patients in 300 patients operated), Kim et al., (2 cases between 301 operated cases), Gotecha et al., (2 cases between 120 operated cases) [16,17,10]. Dural tear noticed in 2 patients (4%) in our study and this comparable to the same percentage of other studies [16,18,36].

Prevalence of accidented dural tear is variable (1.8 to 17.4%), and the rate of dural tear decreased with the increase of the experience [1,2,36]. Zhu et al., reported in higher rate of dural tear than that reported in the literature 482 between 10120 operated cases, and the main causes of dural tear were; (1) Wrong identification of endoscopic structure, (2) Rough operation of sharp tools (Trephine, scissor, punch).

In our study, 3 patients (6%) suffered from recurrent LDP and sciatica at 4, 9, 12 months postoperatively respectively, operated later on by microscopic discectomy and they have doing fine. This rate of recurrence is comparable to other series which ranged from (4.7%-8%) [8,9,17,36].

Three (3) patients (6%) in our study have suffered from dyseaethesia, all 3 cases happened in the first 10 cases and relieved within 6 weeks without additional treatments, after that we have use transforminal injection by the end of the procedure as a routine and we didn't notice it later on. 6% dyseaethesia in our study is comparable to that reported in other studies as Choi et al., reported (1.0% to 6.7%) as postoperative dyseaethesia. 6%
dysaesthesia in our study higher than some previous reports as Yeung and Tsou, reported 6 patients (about 2%) of dysaesthesia between 307 patients operated, Gotcha et al., (one patient in 120 operated pt), Zhu et al., (2017) reported 406 cases of transient postoperative dysaesthesia between 10120 operated cases [31,10,36]. Dysaesthesia may be due to thermal modulation or mechanical trauma of these called fucral nerves (accessory foraminal nerves of various diameters), treatment with transforaminal injection will provide relief dysesthesia that is usually temporary [34].

The mean VAS score for sciatica preoperatively, 6 weeks postoperatively, 6 months postoperatively as follow 7.64,1.94,1.72 respectively and it was significant.

Statistical analysis of visual analogue score for preoperatively, 6 weeks and 6 months postoperative sciatica showed there was a high significance between preoperative VAS and 6 weeks and 6 months postoperative VAS \( p<0.001 \), but there was no significance between VAS of 6 weeks and 6 months postoperatively, \( p=0.46 \). The mean VAS score for preoperatively, 6 weeks postoperatively, 6 months postoperatively back pain as follow 6.56, 2.64,2.28 respectively and it was significant \( p<0.001 \). The mean ODI preoperatively, 6 weeks postoperatively, 6 months postoperatively as follow 34.76, 15.54, 4.66 and it was significant \( p<0.001 \). But no significance between post operative 6 weeks and 6 months ODI, \( p=0.225 \).

According to Macnab's Outcome Criteria, In our study, overall good to excellent results (43pt, 86%), fair (3pt, 6%), poor outcome (4pt, 8%) and this was comparable with other results discussed the same issue as Yeung and Tsou, (89.7% satisfactory results, Kim et al., 2007 (84.7%) good the excellent results.), Gibson et al., (same as microdiscectomy) and Nellensteijn et al., in their systemic review stated that Successful outcome was 85% (72-94%) [34,17,9,21], and lower than outcome results of Rutten et al., (96% good the excellent nearly the same microdiscectomy), Chae et al., (94.77% satisfactory results) and Mahesha 2017 (96% satisfactory results) [4,20,26].

Many randomized control studies concluded that the results of transforaminal endoscopic discectomy are at least equal or slightly better than those of microdiscectomy plus the advantages of less use of narcotic analgesics, rapid recovery and short hospital stay in cases of endoscopic procedures [11,21,26,34]. They also noted that the revision of surgery itself after TED is easier due to less scarring and relative preserved anatomy [11,34,35]. The same results confirmed by the meta analysis done by Zhang et al., which concluded that the length of hospital stay is significantly shorter in TED than microdiscectomy but there were no significant differences in sciatica VAS,ODI, incidence of complication, and rate of recurrence [38]. Although the microdiscectomy has many advantages over the conventional open one due to the minimal invasive nature of the procedure but we can't ignore the paraspinal muscle denervation, blood loss, bone resection, scarring and postoperative pain which also noticed even with microdiscectomy. Since the introduction of percutaneous posterolateral approach by Kambin and Gellman for treatment of herniated LDP, the procedure has advanced over the last decades and becoming more popular as the treatment of choice for treatment of herniated lumbar disc in selected cases [15,35]. Nowadays, about 30% of all spinal surgery done endoscopically in Far east and it is only a time factor and the spinal endoscopic approach will be the gold standard worldwide [9,38].

Recommendation: (1) Good selection of the patients is very important; (2) Patience in learning, because the learning curve is relatively long, (3) X-ray pelvis is recommended in cases of L5-S 1 disc prolapsed to exclude cases of high iliac crest. (4) CT lumbosacral is advised, when disc calcification is suspected. (5) Obesity is not a contraindication. (6) Doing the procedure under local anesthesia (awake-aware surgery) is vital issue with surgeon-patient communication during the procedure which allow the patient to report any nerve harm. (7) High quality multicentric randomized controlled trials are needed to discuss the issue in detail. Limitations of this study are limited number of patients, it is a retrospective study, don’t include the entire lumber disc levels.

Conclusion:

Although transforaminal endoscopic disccectomy has become wellknown, relatively safe, effective and popular approach over the past years, microdiscectomy is still nowadays the gold standard surgical approach for treatment of lumbar disc prolapse and sciatica. Advances in optics and instrumentation with good learning curve will make the
transforaminal endoscopic approach the gold standard in the near future.

**Compliance with Ethical Standards:**
- **Funding:** No funding received.
- **Conflict of Interest:** The authors declare no conflict of interest.
- **Ethical approval:** Approval from the Zagazig University review board (IRB) was taken and all procedures performed in studies were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.
- **Informed consent:** Informed written consents were obtained from the included patients.

**References**


