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Mohammad Kaif,
Kuldeep Yadav,
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Deepak Kumar Singh

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Endoscopic lumbar discectomy using side viewing conical working tube. An institutional experience

Mohammad Kaif, Kuldeep Yadav, Rakesh Kumar, Deepak Kumar Singh

Department of Neurosurgery. "Dr Ram Manohar Lohia" Institute of Medical Sciences, Lucknow, INDIA

ABSTRACT

Objective: The paradigm of surgical therapy for spinal disease especially for lumbar disc herniation has gradually shifted from traditional open surgeries to minimally invasive spinal surgeries. Endoscopic discectomy has been performed widely using various devices and techniques. In this study, we present our experience of endoscopic discectomy using a unique device with separate side viewing channel.

Methods: 26 patients of lumbar disc herniation treated between March 2015 to April 2018 using the unique conical working tube with separate side-viewing endoscopic channel have been retrospectively analysed. Their preoperative and postoperative Oswestry Disability Index (ODI) and Macnab scores were used to evaluate the outcome with a mean follow up of 37.04 months.

Results: There were 18 males and 08 females with age ranging from 19-72 years (mean-38.4 years). The follow up ranged from 25 months to 60 months with a mean of 37.04 months. The mean preoperative ODI score was 72.4 which decreased to a mean of 7.6 and the outcome evaluated by Macnab criteria was 65.3% excellent, 19.2 % good, 11.5% fair, 3.8% poor. 1 patient underwent a second surgery. None of the patients had to change their occupation postoperatively. Complications occurred were dural tear in 1 patient and transient foot paresis in 1 which improved spontaneously.

Conclusion: Endoscopic discectomy using conical working tube is a safe and effective technique for lumbar disc prolapse. The long-term results are comparable to conventional techniques.

Keywords
lumbar disc herniation, endoscopic discectomy, side viewing endoscopic device

Corresponding author:
Mohammad Kaif

"Dr Ram Manohar Lohia" Institute of Medical Sciences, Lucknow, India

dr_kaifmohd@yahoo.co.in

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INTRODUCTION

Endoscopic lumbar discectomy for lumbar disc herniation (LDH) has been an ever-evolving procedure since its inception, because of the benefits it caters over open surgery. Open surgical procedures for LDH are associated with greater muscle, nerve roots and dural sac retraction, lamina and facet joint resection, etc. This leads to more muscular injury, epidural scarring, postoperative pain, longer hospital stays and greater blood loss.

Endoscopic lumbar discectomy overcomes these associated drawbacks of open surgery for LDH but is associated with its own

difficulties and complications. Steep learning curve, endoscopic approach related anatomical limitations and vague tissue differences are few problems associated with endoscopic procedures. Various devices have been developed to increase the ease of procedure and reduce the learning curve along with associated complications. Kambin and Gellman first introduced endoscopic lumbar discectomy in 1973.[11] Later various devices were introduced like Yeung endoscopic spine system (YESS), transforaminal endoscopic spine system (TESSYS), Destandau system etc.[18,7,4] Similarly various authors have reported their experience of endoscopic discectomy using different devices , although many of these lack the literature on long term results of endoscopic surgery.[4,5,12,2] In this article we present our institutional experience of endoscopic discectomy using the conical working tube with separate viewing channel.

Methods

Study setting: This study was conducted in the Department of Neurosurgery Dr Ram Manohar Lohia Institute of Medical Sciences, Lucknow, India.

Study Design and Period: It is a retrospective study based on follow up of 26 patients of LDH treated using the conical working tube with side viewing endoscopic channel.[9] The hospital records of 38 patients who underwent endoscopic lumbar discectomy using this device between March 2015 to April 2018 were retrieved. Only those patients were included in this study who could be contacted on telephone and responded to the ODI (Oswestry Disability Index) and Macnab score formats.

Study Participants: Endoscopic surgery was conducted on patients who presented with low backache along with radicular pain in lower limbs with or without neurological deficit and failed conservative management. Patients with segmental instability, no clinico-radiological correlation or evidence of infection were excluded from this study. There were 18 males and 08 females with age ranging from 19 years-72 years (mean-38.4 years). The follow up ranged from 25 months to 60 months with mean of 37.04 months.

Instrument design: This device comprises of a conical working tube which is passed over coaxial dilators and secured in position by a holding device attached to the operating table. It has a separate side viewing channel for the telescope which is attached to a light source and camera. No special instruments are used for laminotomy and discectomy. **(Figure 1)**

Operative technique: Patient is positioned prone after general anaesthesia on a Wilson's frame or foam bolsters. Level is localised using fluoroscopy. Incision deep to fascia is given 1 cm lateral to midline. Firstly, a dilator is passed with a 5mm trocar up to the lamina and the trocar is removed. A gentle medial to lateral and cranial to caudal sweeping movements are done for the elevation of soft tissue. Serial dilators are passed over this first tube followed by the working tube over these dilators which is finally fixed to table after removal of serial dilators. Position of the working tube is confirmed under fluoroscopy. A cannula with trocar is passed from the separate side channel through a separate stab incision and locked in the working tube using the locking mechanism. A zero-degree telescope (4 mm diameter and 180 mm length) is passed through this separate channel. The tip of the telescope just reaches up to the inner part of the working tube. The light source and camera is attached to the cannula and the image orientation is done by rotating the camera on scope. **(Figure 1)**

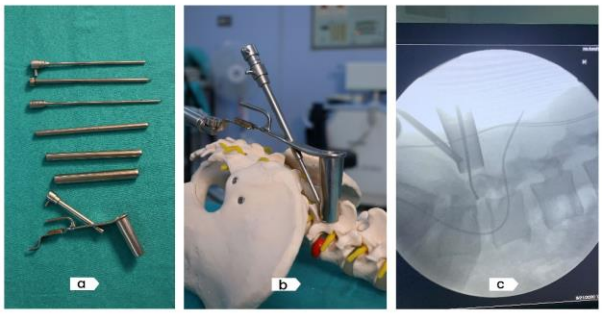

Figure 1. a - instrument design, b - Instrument setup with telescope and light source, c - fluoroscopic view with endoscopic device.

Medial part of the facet and contiguous lamina are identified. A small hemi-laminotomy and medial facetectomy were done using Kerrison rounger. The Ligamentum flavum is detached from the under surface of the lamina and removed. Traversing nerve root and thecal sac are identified using a ball probe. The nerve root is retracted medially and the disc is removed by entering the disc space through the annular tear or an annulotomy. The disc space is irrigated with normal saline to wash out the loose

disc fragments. The nerve root is inspected to ensure adequate decompression. **(Figure 2)** The entire assembly is removed and the fascia is closed with absorbable suture. Skin is closed using subcuticular sutures.

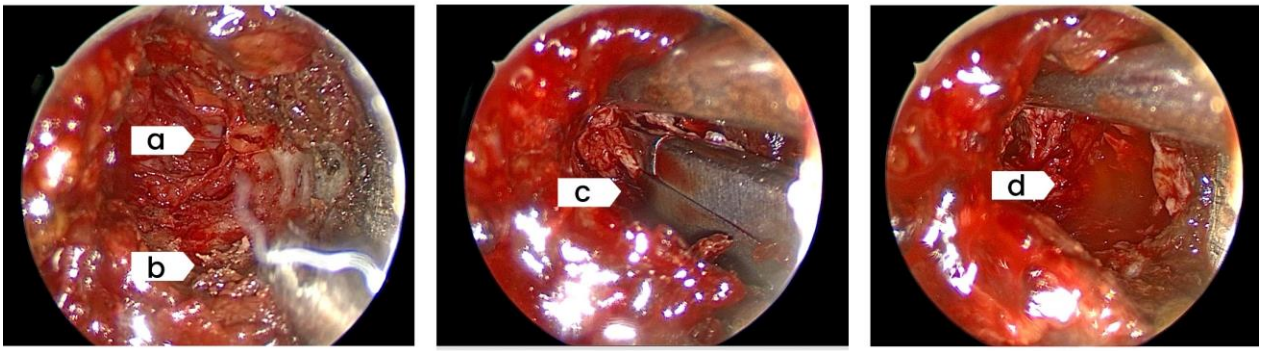

Figure 2. a - nerve root, b - medial of part facet joint, c - disc fragment being excised, d - disc space after discectomy.

Postoperative management: Patients were mobilized in the evening of the day of surgery and were discharged on the next postoperative day. In this study the mean hospital stay was 1.6 days.

Complications: An incidental dural tear was observed in 1 patient. This was managed by sealing the defect by fibrin glue. No postoperative CSF leak or pseudomeningocele or any long-term sequelae were observed. The other postoperative complication was transient foot paresis in 1 patient which improved spontaneously.

Results

Patients were evaluated using ODI score. The score was interpreted as 0% to 20% (minimal disability), 21% to 40% (moderate disability), 41%to 60% (severe disability), 61% to 80% (crippled) and 81% to 100% (bed bound/ exaggerating their symptoms). Both the preoperative and postoperative ODI were compared and its differences were calculated. The mean preoperative ODI score was 72.4 which decreased to a mean of 7.6 postoperatively. The final outcome was evaluated using Macnab criteria which was divided into excellent, good, fair and poor categories. As per Macnab criteria 65.3% (n=17) had excellent outcome, 19.2 % (n=05) had good, 11.5% (n=03) had fair, 3.8% (n=01) had poor outcome. One patient experienced persistent radicular pain of same intensity and was diagnosed to have a residual disc fragment which was removed later by microsurgery. None of the patients had to change their occupation due to their lumbar disc disease. **(Table 1)**

S. No	Procedural characteristics	Value
1	**Outcome (Mac Nab)**	
	Excellent	n=17 (65.3%)
	Good	n=5 (19.2%)
	Fair	n=3 (11.5%)
	Poor	n=1 (3.8%)
	Oswestry Disability Index (ODI)	
	Mean Preoperative score	72.4
	Mean Postoperative score	7.6
2	**Complications**	
	Dural tear	n=1 (3.8%)
	Transient foot paresis	n=1 (3.8%)
3	**Repeated Surgery**	n=1 (3.8%)

Table 1. Summary of procedure related data.

Discussion

Lumbar intervertebral disc herniation, leading to various symptoms have been catered through multiple operative modalities. The classic discectomy described by Mixter and Barr[14] has undergone a series of modifications to develop into the present day discectomy procedure.[15] The classic discectomy required a larger incision, separation and retraction of paraspinal muscles that led to an increase in postoperative morbidity such as increased pain, a delay in resuming activities and a lengthy hospital stay with significant financial burden on patients especially in a developing nation. Moreover, the extensive surgery could lead to the instability of spine with due course of time.

To overcome the disadvantages and problems

associated with classic discectomy, various minimal invasive techniques have been developed. In 1978, Williams[17] described micro discectomy which established as a guide to a lesser invasive approach to lumbar spine. This was the mini variant of conventional discectomy through a much smaller incision as compared to the previous technique. Howe and Frymoyer[8] reported a success rate of 60%–97% with the micro discectomy but it still required the separation of paraspinal muscles from the lamina and spinous process leading to the denervation of the paraspinal muscle complex and causing a delay for the patient in resuming daily activities.

Endoscopic spinal surgery began as percutaneous endoscopic discectomy. Kambin (1973) and Hijikata et al. (1975) had attempted the earliest endoscopic surgery in 1970's.[16] Since then this technique has got modifications through generations[10], in order to improve the patient outcome and increase the domain of indications for endoscopic spine surgery **(Table 2)**. Various authors have described their results of Micro endoscopic discectomy (MED) some of which are mentioned in **Table 3**. Jensdottir et al in their retrospective study reported a good/excellent outcome of micro discectomy[10]. Casal Moro et al in their prospective study reported that MED is a safe technique with lesser tissue trauma and comparable results to that of conventional techniques[3]. Bhansare et al reported their experience using the Destandau technique with excellent short and long term results[1].

First Generation	Second Generation	Third Generation	Newer Innovation
Yeung endoscopic spine system	Interlaminar uniportal endoscopic spine surgery	Endoscopic decompression	Endoscopic lumbar interbody fusion surgery
Percutaneous endoscopic lumbar discectomy	Interlaminar biportal endoscopic spine surgery	Endoscopic foraminotomy	
Transforaminal endoscopic lumbar discectomy			

Table 2. Generations of endoscopic spinal surgery.

Author/year	Number of patients	Outcome measures	Outcome	Recurrence	Complication
Kulkarni et al. 2014	188	VAS, ODI	Statistically significant pain relief	3 (1.5%)	11 (5%) dural tears, 1(0.5%)infection, 1(0.5%) wrong level
Hussein et al. 2014	185	NRS, Mcnab ODI	Statistically significant pain relief	2 converted to open	3 dural tears
Li et al. 2015	72	VAS, ODI, Mcnab	97% good to excellent	1	No complications
Kyung Chul Choi et al. 2016	20	VAS, ODI	91.3% good to excellent	1	1 transient neurological deficit
Sung Soo Eun et al. 2016	62	VAS, Mac Nab	Significant pain relief	06	2 dural tears
Kyung Chul Choi et al. 2017	149	VAS, ODI	90.6% good improvement	04	1 transient neurological deficit
Kaif et al 2017	66	VAS, ODI, Mac Nab	86.36% good to excellent	02	Discitis 1, dural tear 2, transient foot paresis 1
Hyung Sun Kim et al. 2018	98	VAS, ODI	96.1% good to excellent	03	2 Neurological deficit
Ziquan Li et al. 2019	21	VAS, ODI	Significant improvement	00	2 dural tear 1 dysesthesia
Chao Li et al. 2019	184	VAS, ODI, Mac Nab	89.3% good to excellent	14	4 dural tear 1 neurological deficit

***** VAS: Visual analogue scale, ODI: Oswestry disability index.

Table 2. Studies of endoscopic discectomy.

Our study also reveals the similar results regarding the excellent/good outcome of the patients using our specific side viewing conical working tube. The results with this device were excellent to good in 84.5% of cases after a mean follow up of 37.04 months which is comparable with other studies of all the minimally invasive lumbar discectomy techniques practiced worldwide. Casalmoro reported surgical complication rate of 3 to 10 % in various techniques whereas Destandau in his series reported 3.5% and 4 of his patients required reoperation[18]. In our series we experienced 7.7% (n=2) of such complications and 3.8% (n=1) required reoperation.

The popular device used for MED is the METRx system, which is a serial dilator system utilizing the interlaminar corridor. It has a telescope mounted at the top end edge of the working channel, but as experienced by the senior surgeons this technique causes clutter while working bimanually through the working tube. The other disadvantage is the high cost of the specialized hardware. The Destandau system is another popular device with excellent to good long-term results but it has the disadvantage that direct visualization using naked eye or microscope is not possible and also minimally invasive inter-body fusion cannot be performed through this device. The cost of these devices are very high which is one of the major hindrance in expansion of this technique. Our system is an indigenous innovation with a very low cost. The freedom of surgical maneuverability is the advantage[9]. The hardware cost is further reduced as it utilizes the conventional discectomy instruments and same telescope which is used in transcranial endoscopic surgeries.

Conclusions

Endoscopic discectomy using this conical working tube is a safe, effective and low cost technique for lumbar disc prolapse. It has the advantage for early mobilization, short hospital stays and lower financial burden. Overall outcome is comparable to the conventional techniques.

Limitation

Our study has limitations with the retrospective nature of the data collection. Small sample size is also a limitation of this study.

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