



# Comparative Study of Operation Times, Length of Hospital Stay and Complications between Open versus Minimally Invasive Lumbar Microdiscectomy

Dr.S.K.Aleem, Dr.U.Venkata Satyajith

*Postgraduate resident, Department of orthopedics Narayana medicalcollege, Nellore,Andhra pradesh*

*Assistant professor, Department of orthopedics ,Narayana medical college, Nellore,Andhra pradesh*

Submitted: 05-06-2021

Revised: 21-06-2021

Accepted: 24-06-2021

**ABSTRACT:** Microdiscectomy or open discectomy (MD/OD) are the standard procedures for symptomatic lumbar disc herniation and they involve removal of the portion of the intervertebral disc compressing the nerve root or spinal cord (or both) with or without the aid of a headlight loupe or microscope magnification. To determine if a minimally invasive approach to lumbar microdiscectomy reduces operative time, length of hospital stay, or frequency of complications we retrospectively compared medical records of single level microdiscectomy patients by a single surgeon performed using a open approach versus a minimally invasive approach 45 patients were in the open group: 68 % male, average age 43.2 years, and 41 patients were in the minimally invasive group 63 % male, average age 41.1 years. There was no difference in surgical time or blood loss between the open and minimally invasive groups: 83.4 versus 75.9minutes and 51.9versus 69.1 mL, respectively There were no significant complications intraoperatively or within the 30 day post-op period for either group. Operation times, blood loss, complications, and outcome were similar to open microdiscectomy while hospital stay was significantly less.

**KEYWORDS:**Microdiscectomy, Minimally invasive lumbar surgery

## I.INTRODUCTION

When the discs between vertebrae in the spine become damaged (herniated), the soft gel inside them pushes through the wall of the disc and presses against the nerves or the spinal cord, causing a burning pain in legs and pain in the back. When this happens in the lower back, it is known as lumbar disc herniation. The main treatment for this condition is lumbar discectomy, which involves removing the part of the disc pressing on the nerves.

There are two main types of discectomy. The first type is standard microdiscectomy, which

can be performed with the aid of microscope magnification or headlight loupe, or open discectomy where surgeons do not use a microscope or loupe (MD/OD). However, all steps of the operations are similar. The second type of operation is minimally invasive discectomy (MID) procedures. MID involves a smaller incision and less damage to the surrounding tissues

Minimally invasive surgical techniques for patients with herniated nucleus pulposus and radiculopathy include laser disk decompression, arthroscopic microdiscectomy, laparoscopic techniques, foraminal endoscopy, and microendoscopic discectomy. The concept of minimally invasive spine surgery is to provide surgical options that optimally address the disk pathology without producing the types of morbidity commonly associated with open surgical procedures.

The goal of minimally invasive techniques is either disk debulking or selective fragment removal to alter disk morphology and subsequently abate nerve root compression. Recently, the use of muscle dilating tubular retractor systems that place less stress on the paraspinous muscles than midline retractors have been used for lumbar discectomy procedures. Many surgeons find the two-dimensional fiber optic endoscopic visualization recommended during endoscopic discectomy inferior to the three-dimensional visualization achieved with the operating microscope. Secondly, some find rigid access tubes to be too narrow and overly confining. We have used the minimally invasive retractor and operating microscope to perform lumbar microdiscectomy under general anesthesia. The illuminated, flexible retractor has a skirt that expands distally near its interface with the spine to improve surgical freedom and working area beyond what is possible with rigid tubular retractors.

We have compared minimally invasive to



an open microdiscectomy performed by the same surgeon approximately one year prior to a changeover to minimally invasive access at a single institution and then for another one year after the changeover. We sought to determine whether the use of the minimally invasive access reduced patient pain and discomfort, length of hospital stay or frequency of complications.

## II. PATIENTS AND METHODS

This is a retrospective study and was conducted in Narayana medical college and hospital after getting approval from institutional review board. Medical records of patients who underwent single level lumbar microdiscectomy by the same surgeon were obtained and included in the study. Patients who were included had radicular pain attributed to nerve root impingement from herniated disc material, no prior lumbar spine surgery and failed conservative therapy. Patients were separated into two groups; microdiscectomy performed using a traditional open approach (operated on consecutively from September 2018 to November 2019) versus a minimally invasive approach (operated on December 2019 to January 2021).

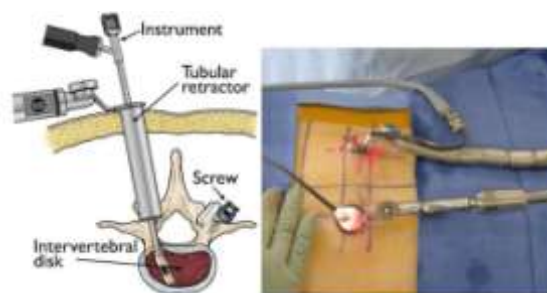
### Open technique

The traditional open lumbar microdiscectomy procedure consisted of a midline incision 2–4 cm long centered over the spinous process after the induction of general anesthesia. A curvilinear incision was made through the lumbar dorsal fascia and a subperiosteal plane was achieved over the spinous process and lamina on the appropriate side. A retractor allowed visualization of the lamina. A small laminotomy was performed to

allow access to the disc and to visualize the immediately caudal nerve root. The ligamentum flavum was removed over the area of exposure. The herniated disc fragment was removed with pituitary and Kerrison rongeurs, reverse angle curettes and ring curettes. Upon completion of the discectomy, the retractor was removed and closure of the subcutaneous layer and skin was performed.

### Minimally invasive technique:

Under sterile aseptic conditions and under general anesthesia, patient was placed in knee chest position, the paraspinous and subcutaneous tissue was infiltrated with approximately 10 mL of 0.25 % lignocaine. A stab wound was made with a #15 blade approximately one fingerbreadth from the midline at the appropriate spinal level on the symptomatic side. K wire was passed at about a 15 – 20 degree angle from vertical until any resistance was encountered. By AP and lateral fluoroscopy, the tip of the K wire was passed near the posterior margin of the lamina within 5mm of midline and parallel to the plane of the disc space. The stab wound was then lengthened to 2.5 cm in length and the lumbar dorsal fascia underneath was similarly incised. Lamina contact was confirmed both by feel and by fluoroscopy in order to reduce the risk of dural injury due to dilatation with the tip over the interspace. The K wire was removed and a series of sequential dilators was used to establish a cylindrical pathway to the surgical site. After removal of the last dilator, an expanding instrument was used to expand the distal end of the retractor at the point closest to the spine in order to optimize the surgical working area. (figure 1)



(Figure 1)

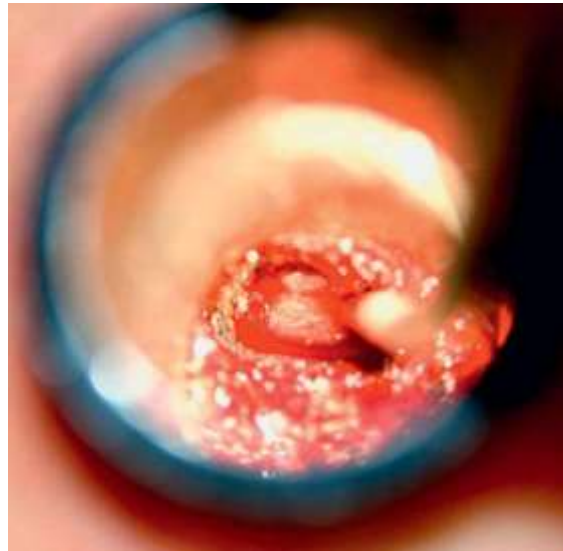
The retractor was secured with a low profile light source / stabilizer secured by a mechanical arm to the bedside. If needed, soft tissue was debrided over the surgical space with an automated debrider / bipolar device. Surgery then

proceeded with the operating microscope. A small laminotomy was performed as necessary to visualize the disc space and the immediate caudal nerve root



Enhanced intraoperative photograph demonstrating the thecal sac and nerve root at the completion of

discectomy as visualized through the operating microscope.



Surgical manipulation and visualization were optimized with the use of 60-degree angled instrument handles on reverse angle and ring curettes as well as bayoneted Kerrison and pituitary rongeurs. After discectomy was complete, the retractor was unlocked and rotated in a clockwise fashion such that the device collapsed as it was removed from the patient. Subsequent closure of the subcutaneous layer and skin was performed. Postoperative orders for pain relief remained standard through-out the period of the study such that all patients received the same orders for pain relief while on the ward.

Medical records, operative notes, and discharge summaries were reviewed by a study nurse without any knowledge of, or care history with the patients. Extracted data included patient age and gender, level and side of surgery, surgical time, blood loss, surgical complications, length of hospitalization.

Oswestry Disability Index (ODI) questionnaires were performed by phone more than 3 months after surgery. Statistical significance between the two groups was determined by using SAS version 9.1. Normally distributed continuous data (age, surgical time, and blood loss) were analysed by a Student's t test using an alpha level of 0.05 for significance. Hospitalization time categories were performed with a chi-square test also with an alpha level of 0.05.

### III.RESULTS

The open group consisted of 45 patients; 22 male and 13 female with an average age of 41.2 years old. 41 patients were in the minimally invasive group; 21 male and 10 female with average age 42.1 years old. In the open group, 4 (8.9%) microdiscectomies were performed at level L3 – 4, 21 (46.7%) at L4 – 5 and 20 (44.6%) at L5-S1. In the minimally invasive group, 3 (7.5%) microdiscectomies were at level L2 – 3, 3 (7.5%) at L3 – 4, 16 (39.2%) at L4 – 5, and 19 (46.5%) at L5-S1. The two groups were not considered statistically different.

Surgical times between the groups were not statistically different, although the minimally invasive procedures were performed slightly faster (75.9 minutes for minimally invasive and 83.4 minutes for open). Blood loss was also not statistically significantly different in the minimally invasive and open group (69.1 and 51.9mL) respectively.

Hospitalization times were significantly shorter in the minimally invasive group where 19 (46.4%) patients opted for discharge on the same day (less than 12 hours), 14 (34.2%) were discharged 12 – 24 hours after surgery and 8 (19.7%) were discharged after 24 hours. In the open group, 4 (8.9%) opted for same day discharge, 23 (51.2%) were discharged 12 – 24 hours postoperatively, and 18 (42.23%) were discharged after 24 hours. The differences in length of hospital



stay were highly statistically significant ( $P = 0.001$ )

Table – Length of hospital stay

Time category	Minimally invasive	Open	P value
<12 hours	19(46.4%)	4(8.9%)	
12 -24 hour	14(34.2%)	23(51.2%)	
>24 hour	8 (19.7%)	18(42.23%)	0.001

Complications included wound infection requiring hospitalization and antibiotics for 5 days in an open case and one minimally invasive case required a transfusion for a blood loss of 1 litre. There was no difference in the mean ODI scores obtained 3 months or more after the procedure. 15 % for the open group and 14 % for the minimally invasive group ( $P= 0.89$ ). There were no re-operations or second procedures performed in either group at the time of final follow-up.

## DISCUSSION

Lumbar discectomy is the most common procedure performed by most spinal surgeons. The procedure is generally a very effective treatment for lumbar radicular pain. Lumbar discectomy has been progressively refined through the years. Open microdiscectomy, the benchmark procedure with which percutaneous and minimally invasive techniques are compared, utilizes a small incision and a microscope or loupe magnification rather than an endoscope. The technique is similar to minimally invasive techniques in regard to patient selection and indications. Open discectomy allows the surgeon to visualize the pathology and neurovascular anatomy, but in this technique, the anatomic structures often must be gently manipulated (rather than avoided) for optimal access to the disknerve root compression interface.

Originally the open procedure described by Mixter and Barr in 1934 involved a lengthy midline incision, extensive muscle retraction with full laminectomy before disc herniation removal was accomplished. Since the 1960s, the procedure was frequently performed from a unilateral approach. Scoville and others developed retractor systems to facilitate unilateral exposure and thus, less paraspinal muscle damage and less facet damage leading to less perioperative pain. However, incisions were generally several inches long, and patients were hospitalized several days for incisional pain.

Lyman Smith introduced chemonucleolysis in 1964, as an alternative to

surgery, for the treatment of sciatica and mechanical back conditions. When compared to open surgical procedures in use at that time, this was a far less invasive alternative, and developed many adherents. This procedure was used fairly widely throughout the world for the next two decades with documented effectiveness. However, the use of chemonucleolysis waned when studies repeatedly showed chymopapain injections had less successful outcomes than open discectomy procedures.

The relative success of chemonucleolysis, along with the drawbacks described, led to other posterolateral minimally invasive approaches including mechanical techniques by Kambin and Hijikata. Percutaneous nucleotomy and automated percutaneous nucleotomy involved a percutaneous posterolateral portal to the disc nucleus with suction removal of disc without visualization of the disc space. Early reports demonstrated some efficacy, but when compared to open methods, results were inferior. Others reported the use of the Nd:YAG laser to vaporize central nucleus contents with quite variable results. In the 1990s posterolateral transforaminal methods were developed to include the possibility of directly visualizing and removing disc fragments not possible before while maintaining a minimally invasive access.

Posterolateral endoscopic discectomy relied on a narrow tube containing a fiber-optic camera and a working channel generally narrower than 5 mm. The narrow working channel and the need to move a single flexible instrument at sharp angles to visualize the disc hernia increased technical demands. This seems to have tempered enthusiasm for this approach despite its minimally invasive nature and outcomes for this procedure have never been directly compared to much more commonly performed open approaches



Ya argil and others refined the open posterior technique through the use of the operating microscope. With the advantages of direct exposure and the improved magnification and illumination, smaller incisions could be used, less muscle retraction was needed, and smaller laminotomies and facetectomies could be performed. Lumbar microdiscectomy has become a very widespread technique. Many series have demonstrated the effectiveness of the technique. Hospital stays have generally been less than 2 days after this procedure, and incisional pain diminished compared to surgeries without magnification with the smaller incisions and less retraction.

In 1994, Smith and Foley introduced the microendoscopic lumbar discectomy (MED). This modification of lumbar microdiscectomy reintroduced the use of fiber-optic visualization and lighting used in posterolateral techniques, but the working channel was a much wider tube introduced posteriorly through the paraspinous muscles after dilators had spread the muscle. The main advantage attributed to this procedure over microdiscectomy was less perioperative discomfort due to the minimally invasive nature of the access compared with traditional forms of muscle retraction. Two dimensional visualization and blood spattering of the fiber-optic lens must be accommodated for and dealt with during the operation. Most of the learning curve comes from learning to work with the two-dimensional visualization system, which by nature is not as informative as three-dimensional visualization, and getting used to restrictions in instrument utilization created by rigid tubular access.

The methods described within this paper were used to take advantage of the pain reduction afforded by minimally invasive access tubes, while performing the discectomy with the very best visualization and lighting that the operating microscope provides. In this study, for the minimally invasive approach, we chose to use a retractor for its specific advantages related to muscle retraction, visualization, and instrumentation. The retractor minimizes paraspinal injury by using a paramedial approach and an initial cylindrical diameter of 24 mm with the capability to expand distally to maximize exposure of the spine surface. The maximum intramuscular pressure generated by this retractor has been shown to be significantly less compared to that of an open retractor. Additionally, a study using MRI techniques showed that there was a significant

difference in the T<sub>2</sub> relaxation time in the multifidus muscle between minimally invasive and open posterolateral fusion groups 6 months after surgery, thus suggesting that less muscle damage occurs using the minimally invasive retractor.

The changeover to the use of the minimally invasive retractor, microscope and bayoneted and angled instruments was performed without objective evidence of a learning curve. However, understanding optimal retractor placement, living easily with limitations in hand position dictated by the minimally invasive retractor, and comfort with modified instruments improves with experience. Suboptimal placement of the retractor will occur less often with experience but should never be tolerated; removal and reinsertion can be performed easily and rapidly. Surgical times, blood loss, complication rates and outcomes were no different from the open microdiscectomy cases and length of hospitalization were significantly less. It would appear that there is very little risk in changing over to this method while there is real benefit for patients.

## REFERENCES

- [1]. Mixer WJ, Barr JS: Rupture of intervertebral disc with involvement of spinal canal. *N Engl J Med* 1934;211: 210-215.
- [2]. Nygaard OP, Mellgren SI: The function of sensory nerve fibers in lumbar radiculopathy: Use of quantitative sensory testing in the exploration of different populations of nerve fibers and dermatomes. *Spine* 1998;23:348-353.
- [3]. Saifuddin A, Mitchell R, Taylor BA: Extradural inflammation associated with annular tears: Demonstration with gadolinium-enhanced lumbar spine MRI. *Eur Spine J* 1999;8:34-3
- [4]. Kawakami M, Tamaki T, Hayashi N, Hashizume H, Nishi H: Possible mechanism of painful radiculopathy in lumbar disc herniation. *Clin Orthop* 1998;351:241-251.
- [5]. Wenger M, Mariani, Kalbarczyk A et al. Long term outcome of 104 patients after lumbar sequestrectomy according to Williams. *Neuro-surgery* 2001;19 :329 - 331
- [6]. Williams RW. Lumbar disc disease. Microdiscectomy. *Neurosurg Clin N Am* 1993 ;4 : 101 -108
- [7]. Mixer WJ, Barr JS. Rupture of the intervertebral disc with involvement of the spinal canal. *N Engl J Med* 1934 ;5: 210-215



- [8]. Koebbe CJ , Maroon JC,Abla A et al . Lumbar microdiscectomy: a historical perspective and current technical considerations .Neurosurg Focus 2002 ;13:E3
- [9]. Smith L,Garvin PJ ,Gesler RM et al .Enzyme dissolution of nucleus pulposus .Nature 1963 ; 198 :1311-1312
- [10]. Nordby EJ,Fraser RD ,Javid MJ .Chemonucleolysis .Spine 1996 ; 21 : 1102-1105
- [11]. Sutton JC .Chemonucleolysis in the management of lumbar disc dis-ease: a minimum six year follow up evaluation .Clin Orthop Relat Res 1986 ; 206 : 46-60
- [12]. Wittenberg RH,oppel S,Rubenthaler FA et al . Five year results from chemonucleolysis with chymopapain or collagenase: a prospective randomized study .Spine2001 ;26 :1835 -1841
- [13]. Guyer RD ,Corbin TP .Minimally invasive posterior fusion and internal fixation with the Atavi system. In: Kambin P (ed.) Arthroscopic and Endoscopic Spinal Surgery .New Jersey: Humana Press , 2005 ; 227-237
- [14]. Kotilainin E .Microinvasive lumbar disc surgery. A study on patients treated with microdiscectomy or percutaneous nucleotomy for disc herniation .Ann Chir Gynaecol 1994 ; 209 : 1-50
- [15]. Mochida J,Toh E , Nomura T ,Nishimua K.The risks and benefits of percutaneous nucleotomy for lumbar disc herniation. A 10 year longitudinal study . Bone Joint Surg [Br] 2001; 83: 501 -505
- [16]. Mathews HH , Long BH .Minimally invasive techniques for treatment of intervertebral disk herniation .A Am Acad Orthop Surg 2002 ;10:80 -85