



## A Two-year Outcome of Various Techniques of Discectomy On Complications: A Multicentric Retrospective Study

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**Objective:** Various techniques of performing lumbar discectomy are prevalent, each having its rationale and claimed benefits. The authors ventured to assess the total complication rate of lumbar discectomy as well as the complication rates of individual complications, namely CSF leaks, superficial wound infections, deep wound infections, recurrence rates, re-operation rates, and wrong level surgery.

**Methods:** This was a retrospective study of patients operated using open discectomy (OD), microdiscectomy (MD), microendoscopic discectomy (MED), interlaminar endoscopic lumbar discectomy (IELD), transforaminal endoscopic lumbar discectomy (TELD), and Destandau techniques (DT) with a minimum follow-up of 2 years. The inclusion criteria were age > 15 years, failed conservative treatment for 4-6 weeks, and the involvement of a single lumbar level.

**Results:** There is no statistically significant association between surgical technique and complications. The total complication rate was 12.89% in 946 operated cases. The most common complication was recurrence (5.81%), followed by re-operation (3.69%), CSF leak (1.90%), wrong level surgery (0.63%), superficial infection (0.52%) and deep infection (0.31%). There were minor differences in the incidence of complications between techniques.

**Conclusion:** This is the first study to compare the complication rates of all the prevalent discectomy techniques across the globe in 946 patients. Although there were minor differences in incidences of complications between individual techniques, there was no statistical significance. The various rates of individual complications provide a reference value for future studies related to complications following discectomy.

**Key Words:** Discectomy, Comparative study, Complications, Multicenter trials

## INTRODUCTION

Lumbar discectomy is one of the most commonly performed spinal surgeries. It was first reported by Mixter and Barr [1] in 1934, that has changed the management of lumbar disc herniations. In 1973, Kambin and Savitz [2] introduced the concept of endoscopic lumbar discectomy. In the late 1970s, Caspar [3] Yasargil [4] and Williams [5] independently reported microsurgical techniques for the treatment of lumbar radiculopathy. These techniques provided the surgeon with excellent magnification of the operative field, which enabled the use of a smaller incision and facilitated less traumatic procedures. Foley and Smith [6] in 1997 introduced an operative endoscope with the tubular system terming it “endoscopic discectomy” and later in 2003, Foleys modified the tubular retractors to include a microscope, which is termed “microtubular discectomy”. The full endoscopic procedures like transforaminal and interlaminar techniques, which use continuous water irrigation have been performed since the late 1990s. All these techniques of performing lumbar discectomy are prevalent, each having its rationale and claimed benefits [7-10]. The primary goal of each technique is to relieve symptoms without causing any complications. Although the level of evidence as well as data in the literature is low, there is a claim of ‘one technique being better than the other’. While each technique has its exclusivity and distinct flair, each technique also carries its unique set of complications [11]. While outcomes of all individual techniques are widely documented in the literature [12-14], along with a few comparative studies [8-10,15-19], as per the author’s knowledge, there is scarcity in the literature comparing complication rates of all the techniques that are commonly performed across the globe. The authors ventured to assess the total complication rate of lumbar discectomy as well as the complication rates of individual complications, namely CSF leaks, superficial wound infections, deep wound infections, recurrence rates, re-operation rates, and wrong level surgery.

## MATERIALS AND METHODS

This was a retrospective study of consecutive patients operated between May 2012 to April 2017 using various techniques, namely open discectomy (OD), microdiscectomy (MD), microendoscopic discectomy (MED), interlaminar endoscopic lumbar discectomy (IELD), transforaminal endoscopic lumbar discectomy (TELD), and Destandau techniques (DT) at ten centres with a follow-up period of minimum 2 years, with data collection initiated in July 2019 after approval from the ethical

and review committee. Each surgeon included in the study performed only a single surgical technique that they are familiar with and had a minimum experience of 5 years in performing the procedure. The different techniques used by different surgeons are based on their experience and the availability of infrastructure and are not randomised. The basic concept of performing lumbar discectomy i.e., removal of the herniated disc fragment and adequate decompression of the nerve root is the same in all the techniques, however, the armamentarium required and the approach for each technique is different and is explained briefly in Table 1). These surgical techniques are broadly divided into a minimally invasive group which includes TD, IELD, TELD and DT and open groups which includes OD and MD. The informed consent was taken from every patient included in the study. The inclusion criteria were age >15 years, symptoms and signs of radiculopathy with failed conservative treatment for at least 4-6 weeks in any form based on the surgeon’s criteria, the involvement of single lumbar level disc herniation, and exclusion criteria were the presence of associated instability in the form of translation and angulation in dynamic plain radiographs, spondylolisthesis, and stenosis with background claudication pain and the presence of radiological stenosis on MRI. Incidence of total and individual complications in the perioperative period and during the follow-up period was evaluated. Descriptive statistics were used to summarise data and categorical data was represented in frequency and percentage. Chi-square with Pearson’s test was used for comparative analysis. All analysis was performed with SPSS 25 version and a p-value <0.05 was considered as statistically significant.

## RESULTS

A total of 946 patients were included in the study. Table 2 depicts the demographic data in terms of age, height, weight, body mass index (BMI), lumbar levels, and disc type. The mean age is 44.3 (15-82) years, average BMI is 26.3, average height is 5.2 feet and the average weight is 70kgs. The most common level operated is L4-5 (57.5%) followed by L5-S1 (34.46%), with no statistical difference between the level of disc operated.

The total number of complications accounted for is 122 (12.89%) and distribution is represented in Table 3. The highest complications are recurrence, which accounts for 5.81%, followed by re-operation (3.69%), and the least in deep infection that accounts for 0.31%. The distribution of individual complications within a particular technique is depicted in Table 4. The various causes of re-operation are depicted in Table 5. The

**Table 1.** Salient features of each surgical technique

Technique	Description
1 Open discectomy	General anaesthesia Midline posterior subperiosteal approach Mollison mastoid retractors Naked eye Laminectomy and flavectomy
2 Microdiscectomy	General anaesthesia Midline posterior subperiosteal approach Microscopic magnification McCullough retractors Hemilaminectomy and flavectomy
3 Microendoscopic discectomy	General anaesthesia Paramedian muscle splitting approach Microscopic magnification Use of METRx™ tubular retractor system (Medtronic Sofamor–Danek, Memphis, TN, USA) Laminotomy and flaval dissection
4 Interlaminar endoscopic lumbar discectomy	Local anaesthesia/general anaesthesia Endoscopic magnification Paramedian muscle splitting approach Constant irrigation for better visualisation Full-endoscopic surgical system "RiwoSpine (Spinendos, Munchen, Germany)" Laminotomy and flaval dissection
5 Transforaminal endoscopic lumbar discectomy	Local anaesthesia/general anaesthesia Endoscopic magnification Far lateral approach Constant irrigation for better visualisation Full-endoscopic surgical system "RiwoSpine (Spinendos, Munchen, Germany)" Foraminotomy Access through Kambins triangle
6 Destandau technique	General anaesthesia Endoscopic magnification Paramedian muscle splitting approach Destandau Endospine System (Karl Storz, Tuttlingen, Germany), which comprises an endospine tube, trocar, and working insert Laminotomy and flaval dissection

calculated chi-square statistics is  $\chi^2(25)=27.54$ ,  $p$ -value=0.329. This reveals that there is no statistically significant association between surgical technique and complications, the complications being equal in an open discectomy (OD), microdiscectomy (MD), microendoscopic discectomy (MED), interlaminar endoscopic lumbar discectomy (IELD), transforaminal endoscopic lumbar discectomy (TELD), and Destandau techniques (DT) (Table 4).

## DISCUSSION

Lumbar discectomy can be performed in various ways [19].

The leaders and followers of these various techniques claim certain merits of their technique over the others [7-10]. The merits include better surgical and functional outcomes and also minimized rates of complications. While outcomes of all individual techniques are widely documented in the literature [12-14], along with a few comparative studies of various techniques [8-10,15-18], there is no single study comparing all the techniques that are commonly performed across the globe, which adds credence to this study. A large volume of patients contributed by 10 centres and performed by surgeons with a minimum of 5 years experience, increases the external validity. This study helps in providing solid evidence regarding the out-

**Table 2.** Demographic data

SNO		MED	MD	DT	IELD	TELD	OD	p-value
1	Total patients	79	351	199	86	86	145	
2	Male	55	211	105	54	55	88	0.142
3	Female	24	140	94	32	31	57	(chi-sqaure)
4	Age (yr)	44.5 (14.12)	44.3 (12.76)	48.42 (14.57)	39.4 (10.23)	39.4 (12.38)	37.6 (7.39)	0.001 ANOVA
5	Age range	16–78	17–82	18–74	18–74	15–69	18–76	
6	Height (feet)	5.16 (0.51)	5.58 (0.43)	5.2 (1.28)	5.45 (0.68)	5.3 (0.42)	5.41(1.37)	0.001 ANOVA
7	Weight (kg)	71.8 (8.65)	72.32 (10.25)	69.35 (7.28)	71.85 (9.37)	71.35 (11.43)	73.6 (12.17)	0.003 ANOVA
8	Body mass index (kg/m <sup>2</sup> )	29.76 (6.70)	26.53 (5.82)	26.36 (4.32)	25.78 (6.28)	25.56 (5.49)	26.4 (4.25)	0.001 ANOVA
9	Lumbar levels							
	L1–I2	1 (1.3%)	0	0	0	1 (1.2%)	0	0.214 chi-square
	L2–I3	1 (1.3%)	11 (3.13%)	1 (0.5%)	0	6 (6.97%)	2 (1.4%)	
	L3–I4	8 (10.1%)	19 (5.41%)	11 (5.5%)	3 (3.48%)	8 (9.3%)	4 (2.8%)	
	L4–I5	43 (54.4%)	211 (60.13%)	101 (50.8%)	37 (43%)	66 (76.74%)	86 (59.3%)	
	L5–s1	26 (32.9%)	110 (31.33%)	86 (43.2%)	46 (53.48%)	5 (5.81%)	53 (36.6%)	
10	Disc type							
	Central	6 (7.6%)	39 (11.1%)	18 (9.1%)	2 (2.3%)	24 (27.9%)	26 (17.9%)	0.001–chi square
	Lateral recess	47 (59.49%)	243 (69.23%)	114 (57.28%)	79 (91.86%)	35 (40.69%)	77 (53.1%)	
	Foraminal	23 (29.11%)	91 (25.92%)	73 (36.68%)	5 (5.81%)	30 (34.88%)	54 (37.24%)	
	Extra foraminal	3 (3.79%)	17 (4.84%)	12 (6.03%)	2 (2.32%)	21 (24.41%)	14 (9.65%)	

MED: microendoscopic discectomy, MD: microdiscectomy, DT: destandau technique, IELD: interlaminar endoscopic discectomy, TELD: transforaminal endoscopic lumbar discectomy, OD: open discectomy.

**Table 3.** Total complications

Complication	Incidence
CSF leaks	18 (1.90%)
Superficial infection	5 (0.52%)
Deep infection	3 (0.31%)
Recurrence	55 (5.81%)
Re-operation rate	35 (3.69%)
Wrong level surgery	6 (0.63%)
Total complication rate	122/946 = 12.89%

comes and complications of different techniques.

There were some interesting findings that emerged from this study. There is no technique that is immune from complications. While there were minor differences in the incidence of various complications between the various techniques, there was a certain visible pattern noticed (Table 4). Recurrence was the most common complication across all the techniques. This probably means that irrespective of the invasiveness of the procedure, recurrence can manifest and is probably primarily related to the stability of the segment, previously described risk factors such as the size of the annular defect, the volume

of the disc, characteristics of the patient, etc [20]. Recurrence, although controversial, may also be related to the post-operative regimen, which could vary among surgeons and centres. Being a retrospective study, understandably, there was no control on this factor. The reoperation rate was the second most common complication following recurrence. Many causes like recurrence, instability, residual symptoms, wrong level surgery, and many other non-surgical factors like age of the patient, non-compliance to the postoperative protocol can lead to re-operation [21] (Table 5). Regardless of the technique, the re-operation rate was between 12%–20% [21]. Dural tears leading to CSF leaks were also a common set of complications, again across the board. Although the incidence was zero in the endoscopic interlaminar approach and highest in the open discectomy group and within this range in the other techniques there was no statistical significance. The statistical significance was not strong enough to suggest that magnification plays a pivotal role in preventing dural tears. The incidence of superficial infections (0.52%) and deep infections (0.31%) was relatively low. This could be related to the low morbidity of the approach, relatively a shorter duration of surgery translat-

**Table 4.** Individual complications

Complications	Technique						p-value
	TD (n = 71)	DT (n = 199)	MD (n = 238)	OD (n = 122)	ILD (n = 86)	TFD (n = 86)	
CSF leak	2 (20%)	2 (22.23%)	3 (8.34%)	10 (20.83%)	0 (0.00%)	1 (11.13%)	0.088
Superficial infection	2 (20%)	1 (11.13%)	1 (2.78%)	1 (2.083%)	0 (0.00%)	0 (0.00%)	
Deep infection	0 (0.00%)	1 (11.13%)	2 (5.56%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	
Recurrence	3 (30%)	2 (22.23%)	17 (47.23%)	19 (39.58%)	8 (80.00%)	6 (66.67%)	
Re-operation	3 (30%)	2 (22.23%)	11 (30.56%)	15 (31.25%)	2 (20%)	2 (22.23%)	
Wrong level surgery	0 (0.00%)	1 (11.13%)	2 (5.56%)	3 (6.25%)	0 (0.00%)	0 (0.00%)	
Total	10 (100.00%)	9 (100.00%)	36 (100.00%)	48 (100.00%)	10 (100.00%)	9 (100.00%)	

CSF: cerebrospinal fluid, TD: tubular microdiscectomy, MD: microdiscectomy, DT: destandau technique, ILD: endoscopic interlaminar discectomy, TFD: endoscopic transforaminal discectomy, OD: open discectomy.

**Table 5.** Causes of reoperation

	Technique					
	TD	DT	MD	OD	ILD	TFD
Recurrence	2	0	5	7	1	1
Instability	1	0	3	4	0	0
Residual symptoms	0	1	2	2	1	1
Wrong level surgery	0	1	1	2	0	0

TD: tubular microdiscectomy, MD: microdiscectomy, DT: destandau technique, ILD: endoscopic interlaminar discectomy, TFD: endoscopic transforaminal discectomy, OD: open discectomy.

ing into lower retraction time, and the non-implant nature of the surgery. However, on one hand, there is a potential risk of infection as a result of contamination from the drapes/image intensifier and procedural equipments [22] in minimal access surgeries using microscope or endoscope, while on the other hand there is a potential risk of infection from a relatively larger dead space and wider tissue exposure in open surgeries [22,23]. Wrong-level surgery is an unfortunate event that has far-reaching medico-legal implications. Although it was more evident in certain techniques, the comparison did not reach any statistical level of significance. This unfortunate event was mostly witnessed in open and micro discectomies which generally need surgical exposure and verification of the level, even after marking and verifying the level before incising the skin. One of the distinct advantages of minimal access surgeries relates to the low to nil risk of performing a wrong level surgery since imaging is required till the endoscope or the tubular retractor is positioned over the segment of interest [24].

The study also brings to light the overall complication rate of lumbar discectomy, which is generally considered as one of the most common and seamless surgeries, irrespective of the technique. A complication rate of as high as 12.89% in 946 cases is an eventuality even with a procedure that is considered to

be one of the simplest of spine surgeries. This high incidence was noted amongst established surgeons with a minimum of five years of experience since that was the inclusion criteria in this study. This criterion was necessary to have a level playing field since it is well known that minimal access surgeries have a steep learning curve [25,26]. It will be interesting to note and compare the complication rates of various techniques amongst a group of surgeons that have recently started spine practice.

The other important limitation of the current study pertains to the anatomical location of the disc herniation. This aspect was not considered and the study was a mixed bag of all locations such as posterolateral, central, cranially, and caudally migrated as well as foraminal and extra-foraminal. One of the main reasons to include this mixed bag was to have a large volume of cases. There is some merit in segregating foraminal and extraforaminal herniations as a separate group since the transforaminal endoscopic route is an extremely simple procedure to treat this particular location of disc herniation. Nevertheless, this study provided a comprehensive comparison of all the techniques irrespective of the anatomical location.

The study has certain limitations. The main limitation is the retrospective nature of the study. All the limitations of the retrospective study apply to this study. While the study period extended to a two-year follow-up, a longer study would reveal events happening at longer follow-ups. The other important limitation of the current study pertains to the anatomical location of the disc herniation. This aspect was not considered, and the study was a mixed bag of all locations such as posterolateral, central, cranially, and caudally migrated as well as foraminal and extra-foraminal. One of the main reasons to include this mixed bag was to have a large volume of cases. There is some merit in segregating foraminal and extraforaminal herniations as a separate group since the transforaminal endoscopic route is an extremely simple procedure to treat this particular loca-



tion of disc herniation. The other drawback is that the study doesn't reflect the incidence of disc prolapse at different lumbar levels, because fusion sometimes resorts to the management of disc herniations at the upper lumbar levels.

## CONCLUSION

This is the first study to compare the complication rates of all the prevalent discectomy techniques across the globe in 946 patients. Although there were minor differences in incidences of complications between individual techniques, there was no statistical significance. The various rates of individual complications provide a reference value for future studies related to complications following discectomy.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article.

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