Comparison between Tubular Discectomy and Open Microdiscectomy surgery for Symptomatic Lumbar Disk Herniation

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Abstract-
Objectives: There are many different minimally invasive procedures that can be used to treat lumbar disc herniation. In the management of lumbar disc herniation, Open microdiscectomy MD is the gold standard and is used as a benchmark for comparison with more recent techniques like tubular discectomy. The purpose of this study was to assess the complication rates of tubular discectomy and to compare the postoperative outcomes of individuals undergoing tubular discectomy with those undergoing MD.
Methods: A retrospective analysis of 250 patients who underwent single-level lumbar discectomy either by tubular TD or MD between JULY 2017- JUNE 2022 was performed. The differences in the 2 groups' demographics, surgical length, intraoperative blood loss, overall hospital stay, pain score on the visual analogue scale (VAS), Oswestry Disability Index (ODI) score both before and after the procedure, and complications were assessed.
Results: Out of the 250 patients, 130 patients were treated with MD and 120 by tubular disectomy TD. The mean age in MD and tubular TD group was 45.5 and 45.8 years. There was a improvement in VAS and ODI scores at 4 weeks in both the groups. There was a greater reduction of back pain in the TD group at 2 weeks compared to MD group but at 1 month both are comparable. Average surgical time was shorter in MD (71.6 min) as compared to TD group (80.2 min). the Average blood loss was higher (90.2 mL) in MD group as compared to TD group (35.8 mL) (Table 3). Length of incision as measured from the surgical scar was 1.7 cm in TD while it was 3.0 cm in MD group. Average hospital length of stay in TD (1.2 days) which was less than MD group (2.1 days). Likewise, MD group patients took 5.9 weeks to return to activity which was higher than the TD group (4.1 weeks).
There were 9 cases (6.9%) of dural tear in MD and 10 cases (8.3%) in TD group.
Conclusion: Sciatica caused by disc herniation can be effectively and safely treated with lumbar discectomy, whether it is TD or MD. In comparison to MD, the TD method for treating symptomatic lumbar radiculopathy is superior in that it causes less postoperative back pain, less blood loss, a shorter hospital stay, and a quicker return to work. Despite the learning curve, TD has been demonstrated to be a viable choice for treating lumbar disc herniation in patients who are carefully chosen.

INTRODUCTION

Sciatica is a common condition that is caused by a herniated disc. (1) Lumbar radiculopathy affects 12% to 43% of people. (2,3) Despite the fact that 75% of individuals recover within the first 4 weeks (4), surgical decompression is recommended for patients with radicular symptoms who do not respond to nonoperative therapy options.(5)

According to statistics, discectomy success range between 50 to 98%. (6)
Since Mixter and Barr(7) described the first lumbar disc surgery in 1934, a number of less invasive surgery have been developed. The initial laminectomy with the advent of the microscope refined into open microdiscectomy (MD), which is currently the most prevalent surgery. (7,8)

The Lumbar discectomy was first done in 1934, and little altered until 1978. The starting of microdiscectomy was aided by the introduction of surgical microscopes. This treatment claimed to reduce surgical site infections (SSI), blood loss, overall discomfort and pain, and provide an ambiguous recovery of neurological state and recurrent rate of disc herniation.(9)
The most often utilised procedure is conventional open microdiscectomy, as outlined by McCullough in 1992.(10)
Foley and Smith (1997) invented the less invasive procedure of transmuscular tubular diskectomy (TD) (11). In compared to subperiosteal muscle dissection, the muscle-splitting transmuscular method of tubular diskectomy generates less tissue injury, resulting in a faster healing rate but equivalent long-term results, according to numerous research.
Patients are likely to have less postoperative back discomfort, which will allow for speedier mobilisation and a shorter hospital stay, as well as a quicker return to work and everyday activities. (5,9)
Despite these studies, there was insufficient literature to suggest use of TD over standard MD and is still debatable.
The purpose of this study was to compare the results of TD patients with those of traditional MD patients in view of clinical efficacy, complication rate, and return to activity. We also intend to compare the complication and clinical outcomes of TD against MD.

MATERIALS AND METHODS

The research comprised patients between the ages of 18 and 80 with symptoms and having single-level lumbar disc herniation that lasted longer than 6-8 weeks and was unresponsive to conservative therapy.

Exclusion criteria were patients with,

1. central canal stenosis,
2. pregnancy, and
3. severe somatic or mental illness,
4. congenital narrow canal,
5. multilevel disc herniations,
6. cauda equina syndrome,
7. spondylolisthesis.

A review of records of patients hospitalised and operated on at U.P.U.M.S, a tertiary level centre, between July 2017 and June 2022 was included in the study.

MD and TD were done by a same surgeon who had prior expertise with the open microdiscectomy procedure.

Various Variables were assessed.

1. age,
2. gender,
3. smoking,
4. comorbidity,
5. BMI (body mass index),
6. signs and symptoms,
7. perioperative parameters (surgical time, blood loss, days of hospitalisation),
8. pre-op and post-op VAS and ODI scores,
9. complications
10. percentage of patients who required conversion to an open procedure,

Case records were used to collect data. Follow-up data were collected by follow-up OPD visits, physiotherapy records, and phone calls. The level and side of the procedure, Roland-Morris Disability Questionnaire score, and duration of stay were all documented and calculated in an Excel spreadsheet.

During TD under general anaesthesia (GA), the patient was positioned prone on a radiolucent table. An 18 G spinal needle placed at the spino-laminar junction using C arm. Under the C arm, a 1.5 cm incision was done at the needle site deep till the thoracolumbar fascia, and then the blunt end of the guide wire was introduced at the spino-laminar junction aiming at the centre of the disc under C arm guidance. The METRx Micro endoscopic system was used during the procedure (Fig.1-12).

Sequential dilators were put over the guide wire to separate the muscles before the last tubular retractor(18 mm or 20 mm) was docked. A surgical microscope was employed. To reveal the bone structures, the muscles above the lamina were removed. A drill used for laminotomy. Curettes and Kerrison rongeurs are used to remove the ligamentum until the dura and nerve roots are seen. The problematic herniated disc was removed after the thecal sac and nerve root are retracted. Adequate decompression was done . Subcutaneous tissue ,the thoracolumbar fascia and skin was closed.

FIGURE 1-12

Operative steps used in MD patient, The placement of the patient is the same as in TD. First, we use C-arm fluoroscopy to mark our incision. A 4-5 cm long midline incision made. Subperiosteal Dissection was performed. To keep the surgical access a bladed retractor (McCullough retractor) was introduced. an operational microscope was employed. The lamina can be thinned using a burr. Kerrison rongeurs were then used to remove bone and ligamentum flavum.

A nerve root retractor was used to gently retraction the dura and nerve root, and an irritating disc was removed. Fascia subcutaneous tissue skin are closed.The patients in both groups were mobilised out of bed the next morning. Suture removal was performed 10-12 days after surgery. Patients were followed up on two weeks and one month following surgery.

Table 1 Demographic variables, sign and symptoms of patients in groups

	MD	TD	
Number of patients	130	120	
Age (years) Mean	45.5	45.8	
Sex (M: F)	69:61	63:57	
Smoking Status n (%)	27 (20.7)	23 (19.1)	
Comorbidity	5	4	
Mean BMI	27.8	27.9	
LEFT SIDE DISC n (%)	70(53.8%)	64 (53.3%)	
RIGHT SIDE DISC	60	56	
Radicular pain right n(%)	70 (53.8)	64 (53.3)	
Radicular pain left n(%)	60 (46.2)	56 (46.7)	
Sensory symptom n(%)	99 (76.1)	91 (75.8)	
Motor weakness n(%)	72 (55.3)	65 (54.1)	
Urinary symptom n (%)	20 (15.3)	15 (12.5)	
Asymmetric DTR knee	25	22	
Asymmetric DTR Ankle	42	36	
SLR positive	121	114	
Crossed SLR positive	26	22	
Levels operated			
L3-4 level	8	7	
L4-5 level	50	47	
L5-S1 level	72 (55.3%)	66 (55%)	
Follow-up period Months	16.4	15.3	

Table 2 comparison in clinical and functional score between groups in preop and post op periods

	MD (MEAN)	TD (MEAN)		
VAS (Visual Analogue score) -leg pain				
Pre Op	6.9	7.2		
Post Op 2 Week	1.76	1.65		
Post Op 1 Month	1.65	1.51		
VAS (Visual Analogue score) -back pain				
Pre Op	2.97	3.06		
Post Op 2 Week	1.94	1.02		
Post Op 1 Month	1.54	1.01		
ODI (Oswestry Disability Index)				
Pre Op	41	38		
Post Op 2 Week	18	15		
Post Op 1 Month	15	12		
Roland-Morris Disability Questionnaire (RDQ) scored				
Pre Op	16.3	16		
Post Op 2 Week	6.4	5.5		
Post Op 1 Month	6.2	5.1		

Table 3 Comparison of perioperative parameters variables between groups

	MD (MEAN)	TD (MEAN)	
surgical time (mins)	71.6	80.2	
Blood loss (mL)	90.2	35.8	
Return to office (weeks)	5.9	4.1	
Duration of hospitalisation (days)	2.1	1.2	

Table 4 Comparing various complications between groups

	MD (n)	TD(n)	
Dural rent	9 (6.9%)	10 (8.3%)	
CSF leak	5	0	
Residual disc	1	5	

Haematoma	6	0	
Infection	12(9.23%)	0	
Postop-discitis	5	0	
Neurological deficit	2	2	
DVT	0	0	
Urinary problem catheter required	3	2	
Need to open		2	
Wrong level	0	0	
Resurgery	2 (1.53%)	5(4.1%)	

The obtained information was converted into variables, coded, and entered into Microsoft Excel. The SPSS-PC-20 version was used to analyse and statistically assess the data. Quantitative data were presented in the form of mean, standard deviation, or median with interquartile range.

RESULTS

Out of a total of 250 patients, 130 were treated with open microdiscectomy and 120 with Tubular diskectomy. The open microdisectomy group had a mean age of 45.5 years, whereas the Tubular diskectomy group had a mean age of 45.8 years. The mean follow-up length for the open microdiscectomy and Tubular diskectomy groups was 16.4 and 15.3 months, respectively (Table 1). Both groups improved their VAS and ODI scores after four weeks. At 2 weeks, the Tubular diskectomy group had a higher reduction in back pain than the open microdiscectomy group, but at 1 month, both groups were equivalent(Table 2).

Prolapsed intervertebral disc at L5 S1 was the most common level, affecting 55.3% of MD patients and 55% of TD patients. Disc herniation occurred on the left side in 53.8% of the MD group and 53.3% of the TD group. There was no difference between these groups in terms of the level and side of disc herniation.

After a 4-week follow-up, the mean RDQ score after tubular diskectomy was 5.1, compared to 6.2 for conventional microdiscectomy. There was no change in functional disability.

The pain score on the visual analogue scale for leg pain improved in both groups one month following surgery. Patients undergoing conventional microdiscectomy, on the other hand, reported more leg pain on the visual analogue scale (mean score, 1.65) than those undergoing tubular diskectomy (mean score, 1.51). Both groups improved on the visual analogue scale for back pain after surgery. On the visual analogue scale, patients who underwent conventional microdiscectomy reported more back pain(mean score, 1.51) than those who received tubular diskectomy (mean score, 1.01).

When compared, the mean operative time in open microdisectomy was 80.2 min against to the Tubular diskectomy group 71.6 minutes. On comparing the mean blood loss in the open microdiscectomy group was larger (90.2 mL) than in the Tubular diskectomy group (35.8 mL) (Table 3). On comparison of incision size measured from the surgical scar was 1.7 cm in the Tubular diskectomy group and 3.0 cm in the open microdisectomy group. On comparing mean days of hospitalisationin the Tubular diskectomy group was 1.2 days, which was smaller than the open microdisectomy group (2.1 days). Similarly, individuals in the open microdisectomy group required 5.9 weeks longer to return to office than those in the Tubular diskectomy group (4.1 weeks).

In the open microdisectomy group, there were 9 cases of dural rent (6.9%) and 10 cases (8.3%) in the Tubular diskectomy group. In contrast to the open microdisectomy group, where 5 patients experienced post-operative CSF wound leak, none of the patients in the Tubular diskectomy group did. Reoperation was necessary in 5 cases of residual disc in the Tubular diskectomy group and 1 case in the open microdisectomy group. In the open microdisectomy group, 12 patients suffered surgical site infections; out of them, 5 individuals had post-operative discitis. In all groups, there were two instances of nerve root injuries that resulted in postoperative extensor hallucis longus impairment, which subsequently fully recovered. (Table 4).

DISCUSSION

Endoscopic lumbar discectomy was first proposed by Kambin and Savitz (12) in 1973. Yasargil(13) and Casper(8) invented the microsurgical discectomy in 1977, which has become the gold standard for lumbar disc symptoms .

A trans-muscular technique using dilators of increasing diameter and a tubular retractor to access the disc, and through a single portal, simultaneous visualisation and disc removal was performed, was described as "Endoscopic Discectomy" by Foley and Smith(11) in 1997 and "TD-micro-endoscopic discectomy" by the same authors in 2003 after the introduction of microscope. Numerous studies that evaluated the results of Tubular diskectomy with open microdisectomy found that Tubular diskectomy performed better in terms of infection, mean time to return to activity, and days of hospital stay.

However, there isn't much evidence to back up these claims in the literature to promote the use of Tubular diskectomy over open microdisectomy , and they remain debatable. Similar to prior research, we had seen a difference in the blood loss between the two groups, with the Tubular diskectomy group showed reduced blood loss (14,15,16). However, it would be unlikely that the observed variation in predicted blood loss across the groups would have an impact on the requirement for a transfusion because less likely blood required in lumbar disc surgery. The difference in operating time between the two groups was negligible. The study confirmed prior studies' findings that both methods had equivalent effectiveness in relieving leg pain (14,15,16,17). The Tubular diskectomy group, however, shows a higher decrease in back pain after 4-week.

According to Schick et al electromyography .'s study, which provides evidence of this phenomena, the cause may be reduced tissue trauma as a result of dilatation, which preserves the paraspinous muscles(17) (18). Brock(19) had also noted that patients who had trans-muscular surgery used less analgesia. According to Anderson(20) and Arts(21), the Tubular diskectomy group experienced more back pain than the open microdisectomy group. Tubular diskectomy and open microdisectomy did not vary in terms of postoperative back discomfort, according to Teli et al. (17). In our study, the days of hospitalisation in the Tubular diskectomy group was shorter than in the open microdisectomy group. The outcomes were different from those of the Teli et al.(17) research (2.3 days in Tubular diskectomy vs. 2.1 days in open microdisectomy).

In 2014 Cochrane review, 4 research on relieving leg pain were compared. (22) Despite the fact that both approaches considerably reduce low back pain, the open microdiscectomy cohort performed better postoperatively than the TD group. At 12 months, the MD group's leg pain score had decreased by 6.45 points against 5.8 points in the TD group. Overdest's findings, which demonstrated that postoperative lower back pain was 13% greater in the TD group, supported this. (23) In the MD group, prolonged hospital stays may be associated with a slower recovery from surgery because of deteriorating back pain.
In 2008 Ruetten reported that following tubular microdiscectomy had significantly less postoperative work days missed than open microdiscectomy.
Comparing the MD group to the TD group, the MD group had more than twice(49 days) as many days off from work as compared to TD group (24 days). (24)
In comparison to the MD group, the TD group returned to work more quickly and experienced lower hospital readmission rates. This may be explained by the TD group having no postoperative infection or CSF leaking. According to several studies, 4–20% of people experience a dural tear following TD (25,26), whereas the frequency in MD is significantly lower. Our 8.3% and 6.9% dural tear rates in TD and MD are comparable to those of other studies
Only two patients in the open microdisectomy group needed Dural repair because the rip was big and in the middle. Due to the fact that following the withdrawal of the tubular retractor within 5 minutes the tissues fall back and provide a physical barrier because of hydrostatic pressure due to the intradural space, the management of dural tears in Tubular diskectomy instances does not necessitate any repair or use of fibrin glue (27).
The MD group treated five instances with postoperative symptomatic CSF leak from the site with conservative measures, but none of them had pseudomeningoceles. None of the patients in the TD group experienced a deep infection because the tubular retractor is utilised in MIS surgery to decrease the potential dead area at risk for infection.
This lowering might help prevent seromas or hematomas that could lead to infection following surgery. Additionally, the tubular retractor only permits the use of surgical instruments while physically preventing surface skin microorganisms from locally contaminating deep tissue. We found that patients who received TD had similar results to those who received MD. The widespread use of the open method, however, avoids the difficult learning curve of MIS, which can be linked to undesirable results and an higher risk of problems, particularly when extension to open is required.

MD procedures were found to have a 9.23% lower risk of surgical-site infection. The tubular group's incision size is likewise much reduced (1.7 cm). Significantly less retraction and damage to the paraspinal muscles result from the impact to the surrounding soft tissue. The reduced risk of deep infection of 0.1%, which is advantageous. There is less dead space and less devascularized tissue due to the small incision and restricted approach. This, together with the devices hardly ever making contact with the skin, helps explain the rarity of deep infections.

The learning curve for minimally invasive discectomies TD was rather steep. During this point of the learning curve, Sclafani and Kim(28) demonstrated longer operating times and higher incidence of surgical problems. The danger of dural tears with this kind of surgery, which is carried out through a tiny surgical window, is frequently very high. This treatment is more technically challenging due to less depth perception and restricted vision. A TD group had a noticeably higher risk of accidental dural tears than an MD group, according to research by Dasenbrock et al (29)

According to 2017 study from the Netherlands,(23) showed a minimally invasive group had higher reoperation rate than the open group at 5 years follow up (18% vs. 13%). According to Rasouli,(22) in minimally invasive postoperative lower back pain was worse than open microdiscectomy patients, with a and a minimally invasive technique had demonstrable increased rehospitalization rate due to disk reherniation. In addition, there was no significant difference in persistent motor deficit at 6 months in both group (22) Minimally invasive discectomy is often showed as having superior outcomes in terms of general complications, postoperative pain, and nerve root injury.Shriver(30) found no statistically significant difference between open and minimally invasive techniques. A 2017 research from the Netherlands(23) revealed that during the 5-year follow-up, the TD group had a higher reoperation than the open group (18% vs. 13%). As per Rasouli(22), a TD method had a demonstrably higher rehospitalization risk for disc reherniation and postoperative lower back pain that was worse than it was in open microdiscectomy patients. Additionally, there was no significant difference between the two groups' chronic motor deficits at 6 months (22). Studies frequently demonstrate that minimally invasive discectomy produces better results in terms of general problems, postoperative pain, and nerve root damage. No significant difference between MD and TD group was discovered by Shriver(30). Despite the assertion that tubular procedures maintain mechanical stability, a comparison of open and tubular approaches revealed that the tubular group used instrumented fusion more frequently. (23)

After follow-up period, the reoperation rate progressively increased, from 1.5% in the microdiscectomy group to 4.1% in the tubular discectomy group. The most frequent reason for a second procedure was recurrence. In comparison to patients who received conventional microdiscectomy, participants in the tubular discectomy group underwent instrumented fusion substantially more frequently. The most often cited justification for instrumented fusion was a loss of disc height leading in foraminal stenosis. Since instrumented fusion was a rare reoperation, this discovery also contradicts the idea that tubular discectomy would preserve spinal integrity. Our reoperation rate was close to the reoperation rates seen in other sizable population studies, which found that reoperation rates ranged from 12.3% to 13.8% over the course of a 4- to 5-year period. (31-33)
It is important to compare the long-term effects of TD to MD because the instability of the lower back muscles and tissue trauma brought on by the surgical operation may affect spinal integrity and cause chronic pain or necessitate a second surgery due to surgically induced instability and increased degeneration. In place of spinal integrity loss, postoperative lumbar pain, muscle injury, and tissue damage may be employed. Postoperative low back pain was expected to be lower with TD than after MD, however a prior study found equivalent or even greater postoperative lumbar pain levels in the TD group than in the MD group. (17,21,34,35)

CONCLUSION

Sciatica caused by disc herniation can be effectively and safely treated with lumbar discectomy, whether it is TD or MD. In comparison to MD, the TD method for treating symptomatic lumbar radiculopathy is superior in that it causes less postoperative back pain, less blood loss, a lesser hospital stay, and a faster return to work. Although the learning curve, TD has been demonstrated to be a viable choice for treating lumbar disc herniation in patients who are carefully chosen. Accurate anatomic alignment, meticulous dissection, handling of the nerve root and disc , and haemostasis all require close attention.

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