

# Transtubular versus microsurgical approach for single lumbar disc herniation: a prospective study

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**Abstract** Earlier studies have compared transtubular discectomy with microsurgical discectomy in the treatment of lumbar disc herniations, but a few prospective studies with homogeneous groups of patients have been conducted. The aim of this study was to compare intraoperative and immediate postoperative results in a group of patients submitted to discectomy with the use of a tubular retractor (TTD) to the one operated with standard microdiscectomy as described by Caspar (MSD). A total of 83 patients were prospectively observed and reviewed. Two homogeneous groups of patients were compared. All patients were preoperatively examined by the operating surgeon and the anaesthesiologist. All surgical data and constataions were collected on the operative summary. Several parameters like operative time, morphinic consumption in recovery room, length of hospital stay and peri- and post-operative complications were compared. Results show that both procedures lead to excellent recovery and that TTD is a viable alternative to MSD. There was no statistically significant difference in most of the examined parameters between the two techniques.

**Keywords** Transtubular discectomy · Minimally invasive discectomy · Microdiscectomy · Lumbar disc herniation

## Introduction

Surgical treatment of lumbar disc herniation was first described in 1934 by Mixter and Barr [1]. Refinements in the procedure came from Love [2], who first reported an extradural approach of the disc. A major step in this type of surgery was the introduction of operative microscope by Caspar [3] and Yasargil [4] in 1977. This approach allowed better visualization, less invasiveness and reduction of perioperative morbidity, thus becoming “the gold standard” technique for open discectomy. Since then and along the years, perpetual seek of less traumatic lumbar disc surgery in order to improve clinical outcomes show adverts in the development of various minimally invasive techniques.

In 1997, Foley and Smith [5] reported on microendoscopic discectomy (MED). In this technique, percutaneous tubular retractors are used to create a 20 mm working channel by splitting muscular fibres, aiming to reduce paravertebral muscles injury. Originally, an endoscope was used through the retractors to visualize the operative field [6]. Currently, with the second generation of the Metrx system® (Medtronic Sofamor Danek), the procedure is more often performed with operative microscope or direct headlight source, thus allowing a 3D visualization.

Only few prospective randomized clinical studies have compared the use of a tubular retractor to standard microsurgical discectomy [7–9]. Even if adequate assessment of postoperative results is difficult because of many factors like patient subjectivity, psychological disorders, working compensations and association to chronic back pain [10], most of these studies failed to show any significant difference in short- and long-term clinical outcomes between the techniques. However, controversies still exist about potential intraoperative and immediate postoperative benefits of

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using tubular retractors, which could lead to reduced hospital stays and less early postoperative pain.

The purpose of this prospective study was to compare the Metrx tubular system (transtubular discectomy, TTD) with standard microsurgical discectomy (MSD) in patients with lumbar disc herniation.

The objectives were to assess the efficacy of TTD in reducing postoperative pain, opioids consumption and length of hospitalization.

## Materials and methods

Patients were recruited prospectively in a single-centre, between January and December 2007.

Indications for surgical treatment were a first or recurrent single lumbar disc herniation correlated to the symptomatology, confirmed by lumbar CT scan and/or MR imaging, minimal symptom's duration of 6 weeks, resistance to a well-conducted medical treatment, and/or recent neurological deficits (radicular deficit or cauda equina syndrome). Patients with lumbar canal stenosis, multilevel disc herniation, and disc protrusion either associated or not associated to foraminal stenosis, pregnancy or platelet ratio less than 100,000/mm<sup>3</sup> were excluded.

The series included 83 patients (46 males and 37 females) with a median age of 42.5 years (range 17–78). Median body mass index (BMI) was 23.5 (range 20–30). Thirty-six patients (43.3%) were overweight, presenting BMI of more than 25. Between them, six (7.2%) were obese, presenting a BMI of 30 or more.

Transtubular discectomy group included 57 patients (28 males and 29 females) with a median age of 42 years (range 17–73). Median BMI was 24.2 (range 17.5–30). Affected intervertebral disc was located in L4–L5 for 23 patients and in L5–S1 for 34 patients, encompassing 51 nonoperated discs and 6 recurrent hernias.

Microsurgical discectomy group included 26 patients (17 males and 9 females) with a median age of 43 years (range 17–78). Median BMI was 25.5 (range 18.3–30.1). Intervertebral disc L4–L5 was affected in 12 patients and in L5–S1 in 14 patients. Recurrent hernia represented seven cases.

No statistically significant differences were shown between the two groups concerning age, BMI, localization of disc herniations and rate of recurrent hernias.

Three surgeons performed both procedures. Patients entered hospital 1 day before surgery. In three patients (3.6%) cauda equina syndrome needed emergently decompressive surgery. Therefore, to evaluate equally hospital stay duration, the day of intervention was marked as first

day of hospitalization for all patients. All patients were preoperatively examined by the operating surgeon and the anaesthesiologist. Surgery was cancelled if spontaneous improvement was reported between last examination and hospitalization.

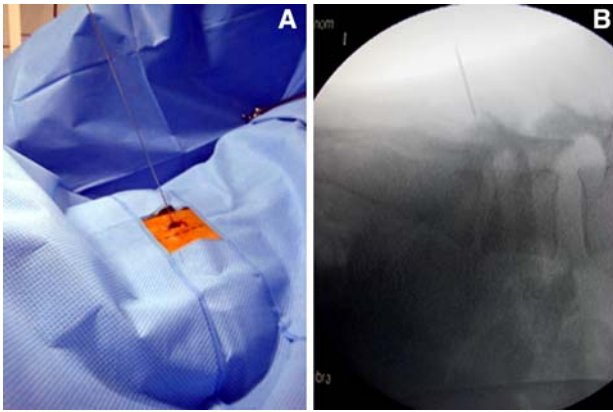
All intraoperative surgical data including operative time, blood loss and complications were noted on the operative summary. Blood loss inferior to 50 ml was considered non-significant. Furthermore, it was noted as <50 ml on this case, but encrypted if it was superior to this value.

The criteria assessed postoperatively were pain by a visual analog score (VAS), morphine consumption (mg) and postoperative complications. All patients were systematically reviewed by the operating surgeon at 3 weeks and 3 months, and at any other time if needed.

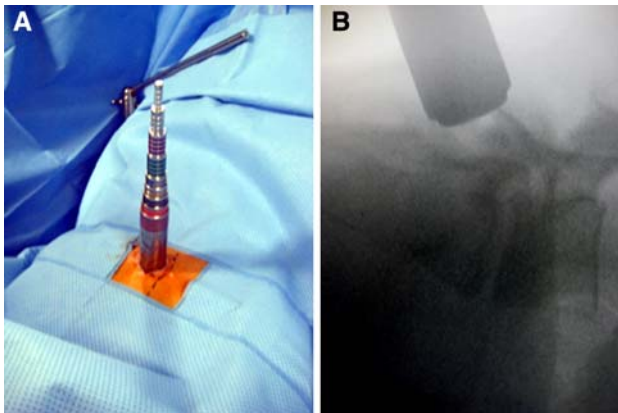
## Surgical technique

Transtubular discectomy was performed with the patient under general anaesthesia and in genupectoral position. After level identification by fluoroscopy, a 20 mm length incision was made on ipsilateral side, 10–15 mm laterally to the midline (represented by spinous processes), and fascia opened with Mayo scissors. A guidewire was then introduced through the incision, and angled to obtain a good trajectory toward the disc space. The trajectory was confirmed by fluoroscopic control (Fig. 1). The first Metrx dilator was used to detach muscle fibres from the lower aspect of the superior lamina. Following this dilators were introduced to complete the fibres splitting (Fig. 2) and adequate depth tubular retractor X-Tube (Medtronic Sofamor Danek) was placed and firmly fixed to the flexible arm (Fig. 3). The field was cleaned from few remaining muscular fibres by bipolar cauterization and disc rongeur. The yellow ligament was detached from the upper lamina by an angled curette. Laminotomy and partial excision of the ligamentum flavum were performed by Kerisson rongeur. Discectomy was associated to a foraminotomy if necessary for adequate decompression. After tube removal, closure was done in layers.

Microsurgical discectomy was performed in the same position with level identification, using the technique described by Caspar [3] (Fig. 4). A 20–25 mm length skin and soft tissue incision was carried out on the midline. Paramedian C-shaped fascial incision and minimally subperiosteal muscular detachment from the hemilamina was performed, followed by retractor (Caspar or Markham) positioning. Laminotomy and excision of the ligamentum flavum were performed from medially to laterally. The following MSD operative steps were similar to that of TTD. Both techniques were performed either with microscope or direct view with halogen headlight.



**Fig. 1** Transtubular discectomy in a 35-year-old lady presenting with a left L5–S1 disc herniation: insertion of the guidewire through a 20 mm paramedian skin incision (a). The guidewire is angled toward the midline, and advanced under fluoroscopic control (b)



**Fig. 2** Introduction of sequential dilators through the paravertebral muscles (a). Position of the last dilator is verified by fluoroscopic control, and should be angled toward the disc space (b)

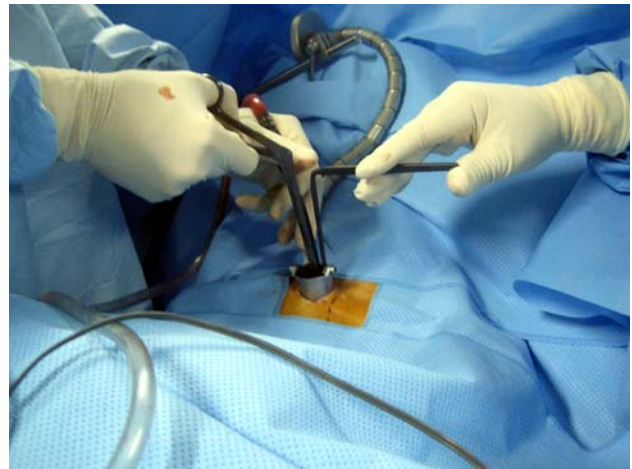
## Results

Mean operative time in TTD group was 55.3 min (range 30–100) and thus slightly shorter than in MSD group at 60 min (range 30–80) but nonsignificantly different ( $P = 0.18$ ). Blood loss was always inferior to 50 ml in both groups. No nerve root injury occurred in both groups.

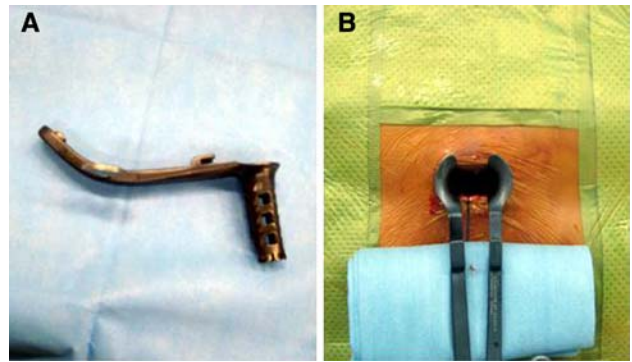
Mean immediate postoperative VAS in TTD group was 1.14 (median 1, range 0–6) while it was 1.55 (median 1, range 0–5) in MSD group, without any significant difference ( $P = 0.37$ ).

Mean morphine consumption was 5.11 mg (range 0–20) in TTD group and 5.10 mg (range 0–23) in MSD group, respectively, without significant difference between two groups ( $P = 0.99$ ).

Mean hospital stay in TTD group was 3.25 days (median 3, range 2–11). One elderly patient spent 11 days in the unit, due to difficulties returning at home and obtaining a



**Fig. 3** X-Tube® (Medtronic Sofamor Danek) has been placed and firmly fixed to the flexible arm. Intervention is then carried on in the usual way, either with the microscope or using halogen headlight (as in this case)



**Fig. 4** a Caspar retractor. b Positioning of the retractor through a 20–25 mm midline incision

bed in a rehabilitation centre. In MSD group, mean hospital stay was 3.43 days (median 3, range 2–9). No statistical difference was noted ( $P = 0.76$ ).

There were five dural tears in TTD group (8.7%) and three in MSD group (11.5%), without statistically significant difference. In both groups, dural tears were more frequent in patients operated for recurrent discs than in those operated for the first time (33 vs. 5.8% in TTD group and 28.6 vs. 5.6% in MSD group). All dural tears had a punctiform aspect, and in two there was a respect of arachnoids, without CSF leakage. They have been watertightly closed by fibrin glue without any consequence.

Overall, comparison of assessed parameters (Table 1) failed to show any significant difference.

## Discussion

In this prospective study, we compared standard microsurgical treatment of single lumbar disc herniation with

**Table 1** Comparison of intraoperative and postoperative results between TTD and MSD

Items	TTD	MSD	P value	
No. of patients	57	26	–	
Median age	42	43	0.74	NS
Median BMI	24.2	25.5	0.12	NS
Intraoperative results				
Operative time (min)	55.3	60	0.18	NS
Blood loss (ml)	<50	<50	–	
Dural tears	5	3	NS	
Nerve root injury	0	0	–	
Postoperative results				
Mean morphine consumption (mg)	5.11	5.10	0.99	NS
Postoperative VAS	1.14	1.55	0.37	NS
Mean hospital stay duration (days)	3.25	3.43	0.76	NS
Early recurrence	2/57	1/26	–	

NS Not significant

transmuscular approach using tubular retractors. Since many years, we adopted the surgical technique described by Caspar [3] and Yasargil [4], that is still considered as the gold standard in the treatment of lumbar disc herniations deserving surgery [11]. This technique has been shown to reduce hospital stay duration when compared to standard open discectomy, even if several prospective randomized studies failed to show any difference in clinical long-term results between the two techniques [11]. The main objective of our study was to compare results obtained with microsurgical approach with those obtained with transmuscular approach.

Main limitations of our study were sample size and absence of randomization, which may have been sources of potential confounding factors and may account for our results.

The main objective of current minimally invasive techniques for lumbar disc surgery is to reduce paravertebral muscles injury [10]. Several biological and histological studies have tried to measure degree of muscular trauma after lumbar disc surgery. In these studies, muscular injury has been assessed by measuring blood levels of biological markers of rhabdomyolysis, showing correlation between creatine phosphokinase (CPK), lactic dehydrogenase 5 (LDH-5) ratios and surgical invasiveness [12–15]. Some authors [12–14] also correlated CPK and LDH-5 serum levels to pain scores in different groups of patients who experienced MED or open discectomy. Results showed that MED was less invasive on serum levels ratios [12], but correlation to postoperative pain scores remained controversial [13, 14] because increasing serum levels being multifactorial (size of incision, type of retractor). However, results of these studies suggest that muscle's retraction modalities

and invasiveness of surgical approach should be considered in the field of lumbar discectomy and may have an impact on early clinical results.

To our knowledge, only three clinical prospective studies have compared clinical results of MED [7, 9] or transtubarular microdiscectomy [8] with MSD. In terms of long-term clinical outcomes and return to work, these studies failed to show significant differences at different steps of follow-up. On the other hand, very early postoperative VAS [7], operative time [7] and postoperative analgesia consumption [9] have been found significantly different between MSD and MED.

Transtubarular discectomy and MSD seem to give similar perioperative results in our study. As in the abovementioned papers (Table 2), we could not find any differences in operative time and blood loss, while intraoperative complications such as dural tears were identical in the two groups. However, differently from previous studies [7, 9], we could not demonstrate any advantage for TTD in reducing immediate postoperative pain and improving early clinical outcome, as showed by our postoperative results on morphine consumption and hospital stay duration. The similar outcomes in the two groups of patients in our series may be explained by the technique we used for MSD (paramedian fascial incision with partial detachment of the muscles from the hemilamina), which differs significantly from a more invasive midline fascial incision and complete exposure of the vertebral arch [7, 16].

Our results appear to be similar to those published recently by Wu et al. [16], who did not show any statistically significant difference on postoperative pain in a retrospective study of 873 patients' comparing MED with open discectomy. Interestingly, in this study, complications as well as operative time diminished significantly between early MED groups and late MED groups, explained by learning curve.

Like other previous reports [17, 18] we found TTD and MSD to be extremely useful in obese patients in reducing incision length and tissue detachment. Cole et al. [17] report a series of 42 consecutive patients with a mean BMI of 35.9 kg/m<sup>2</sup> who underwent a lumbar discectomy through an 18–20 mm length incision. Main complications were as similar as in slim patients. Moreover, we noted absence of postoperative infection in this group of patients in our series. That has to be put in balance, considering overweight as significant risk factor for postoperative infection. This result has recently been confirmed by Park et al. [18] who reported a series of 77 overweight or obese patients involved in minimally invasive spine procedures encompassing lumbar discectomy, laminotomy for stenosis and TLIF.

We also found TTD to be more advantageous than MSD in previously operated patients to avoid crossing previous



**Table 2** Results of randomized studies comparing both techniques

Year	Authors (references)	No. of patients		Mean operative time (min)		Mean blood loss (ml)		Dural tear		Analgesic consumption (doses)		Hospital stay duration	
		TTD	MSD	TTD	MSD	TTD	MSD	TTD	MSD	TTD	MSD	TTD	MSD
2007	Righesso [7]	21	19	82.6*	63.7*	50	40	1	0	NA	NA	24 h*	26 h*
2007	Ryang [8]	30	30	82	92	26.2	63.8	0	2	NA	NA	4 days	4.4 days
2005	Schizas [9]	14	14	NA	NA	NA	NA	1	0	12 doses*	8.8 doses*	1.83 days	2 days
2008	This series	57	26	55.3	60	<50	<50	5	3	5.1 mg	5.1 mg	3.2 days	3.43 days

NA Not available

\* Statistically significant difference

approach fibrosis. In fact, the more angled approach to the interlaminar space allows to work in virgin tissues and to use virgin bone as a landmark. For these reasons, surgery of recurrent disc herniations can safely be performed without increasing risks, as recently shown by Isaacs et al. [19]. The small number of recurrent herniations in our series, however, did not allow us to validate these results.

Finally, it seems important to us to note that minimally invasive lumbar fusion-like TLIF as described by Holly et al. [20] or Mummaneni [21] are performed through the same retractors and therefore followed the same principles. Schwender et al. [22] reports a 45 minimally invasive TLIF series with a 100% fusion rate and significant patient's improvement. Previous data imply that discectomy through a tubular retractor could represent the first step in learning curve before arthrodesis.

## Conclusion

Transtubular discectomy is as effective and safe as MSD for the treatment of single-level lumbar disc herniation. Both techniques represent a minimally invasive approach to the spine, reducing postoperative pain and hospital stay duration. No statistically significant differences between the techniques were found comparing intraoperative complications, postoperative VAS and morphine consumption, and postoperative stay length. Giving these data, TTD does not appear to be more effective than MSD in reducing muscular trauma during surgery.

**Conflict of interest statement** No funds were received in support of this study. No benefits of any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

## References

- Mixer WJ, Barr JS (1934) Rupture of intervertebral disc with involvement of the spinal canal. *N Engl J Med*: 210–215
- Love J (1939) Removal of protruded intervertebral disc without laminectomy. *Proc Staff Meet Mayo Clinic* 14:800
- Caspar W (1977) A new surgical procedure for lumbar disc herniation causing less tissue damage through a microsurgical approach. In: Wullenweber R, Brock M, Hamer J (eds) *Advances in neurosurgery*. Springer, Berlin, pp 74–77
- Yasargil MG (1977) Microsurgical operation of herniated disc. In: Wullenweber R, Brock M, Hamer J (eds) *Advances in neurosurgery*. Springer, Berlin, p 81
- Foley KT, Smith MM (1999) Microendoscopic discectomy. *Tech Neurosurg* 3:301–307
- Perez-Cruet MJ, Foley KT, Isaacs RE et al (2002) Microendoscopic lumbar discectomy: technical note. *Neurosurgery* 51(Suppl 2):129–136
- Righesso O, Falavigna A, Avanzi O (2007) Comparison of open discectomy with microendoscopic discectomy in lumbar disc herniations: results of a randomized controlled trial. *Neurosurgery* 6:545–549
- Ryang YM, Oertel MF, Mayfrank L et al (2007) Standard open microdiscectomy versus minimal access trocar microdiscectomy: results of a prospective randomized study. *Neurosurgery* 61:174–182
- Schizas C, Tsiridis E, Saksena J (2005) Microendoscopic discectomy compared with standard microsurgical discectomy for the treatment of uncontained or large contained disc herniations. *Neurosurgery* 57(ONS suppl 3):357–360
- Toyone T, Tanaka T, Kato D et al (2004) Low-back pain following surgery for lumbar disc herniation. A prospective study. *J Bone Joint Surg Am* 86:893–896
- Awad JN, Moskovich R (2006) Lumbar disc herniations. Surgical versus nonsurgical treatment. *Clin Orth Rel Res* 443:183–197
- Arts MP, Nieborg A, Brand R et al (2007) Serum creatine phosphokinase as an indicator of muscle injury after various spinal and non-spinal surgical procedures. *J Neurosurg Spine* 7:282–286
- Kotil K, Tunckale T, Tatar Z et al (2007) Serum creatine phosphokinase activity and histological changes in multifidus muscle: a prospective randomized controlled comparative study of discectomy with or without retraction. *J Neurosurg Spine* 7(3):121–125
- Sasaoka R, Nakamura H, Konishi S et al (2006) Objective assessment of reduced invasiveness in MED compared with one level laminotomy. *Eur Spine J* 15:577–582
- Kawagushi Y, Matsui H, Tsuji H (1996) Back muscle injury after posterior lumbar spine surgery. A histologic and enzymatic analysis. *Spine* 21:941–944
- Wu X, Zhuang S, Mao Z et al (2006) Microendoscopic discectomy for lumbar disc herniation. Surgical technique and outcome. *Spine* 31(23):2689–2694
- Cole JSIV, Jackson TR (2007) Minimally invasive lumbar discectomy in obese patients. *Neurosurgery* 61:539–544

18. Park P, Upadhyaya C, Garton HJL et al (2008) The impact of minimally invasive spine surgery on perioperative complications in overweight or obese patients. *Neurosurgery* 62:693–699
19. Isaacs RE, Podichetty V, Fessler RG (2003) Microendoscopic discectomy for recurrent disc herniations. *Neurosurg Focus* 15(3):E11
20. Holly LT, Schwender JD, Rouben DP et al (2006) Minimally invasive transforaminal lumbar interbody fusion: indications, technique, and complications. *Neurosurg Focus* 20(3):E6
21. Mummaneni P, Rodts GE Jr (2005) The mini-open transforaminal lumbar interbody fusion. *Neurosurgery* 57:256–261
22. Schwender JD, Holly LT, Rouben DP et al (2005) Minimally invasive transforaminal lumbar interbody fusion (TLIF): technical feasibility and initial results. *J Spinal Disord Tech* 18 Suppl:1–6