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The Improvement of Back Pain and Radicular Pain Following Endoscopic Versus Microscopic Lumbar Discectomy: A Randomized Clinical Trial in an Egyptian Tertiary Care Center

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Original Research Article

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ABSTRACT

Aims: To compare the results obtained from a cohort of patients with posterolateral lumbar disc prolapse regarding the postoperative improvement of back pain and radicular pain, in patients operated for endoscopic lumbar discectomy, with a group of patients operated for microscopic lumbar discectomy, in the Neurosurgery Department, Tanta University Hospitals, from November 2021 till the end of October 2022.
Methodology: A prospective analysis was performed on 40 patients operated for minimally invasive lumbar discectomy, 20 patients underwent microscopic discectomy and 20 patients underwent endoscopic discectomy. This randomized clinical trial took place in the Neurosurgery department, Tanta University Hospitals in Egypt.

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Results: 40 patients with posterolateral single level de novo lumbar disc herniations were included. 20 patients underwent microscopic discectomy, and 20 patients underwent endoscopic discectomy. Both groups exhibited significant improvements in radicular and back pain postoperatively ($P < 0.001$). Although there was no significant difference in radicular pain improvement between the groups, improvement in back pain was significantly higher in the endoscopic group than in the microscopy group (5.1 ± 1.5 vs. 2.7 ± 1.0, $P < 0.001$). The improvement in Oswestry Disability Index (ODI) postoperative was statistically significant in both groups ($P<0.001$). Although statistically insignificant ($P=0.072$), the improvement in ODI was higher in the endoscopic group than in the microscopic group.

Conclusion: This study revealed that endoscopic lumbar discectomy is superior to microdiscectomy in terms of improvement of postoperative back pain, reduced hospital stay and early return to daily activity, which can be justified by the maximal preservation of normal bony and myoligamentous anatomy. This allows for earlier recovery and avoid chronic back pain resulting from fibrosis in muscles, ligaments and also epidural fibrosis.

Keywords: Endoscopic lumbar discectomy; microscopic lumbar discectomy; minimally invasive spine surgery; lumbar disc herniation.

1. INTRODUCTION

"Low back pain is considered one of the most concerning health problems and the commonest type of musculoskeletal disorders. Frequently, back pain coexists with a radicular pain or radiculopathy, which occurs as a result of a dysfunction of spinal nerve root causing dermatomal pain and paraesthesias, myotomal weakness, and/or impaired deep tendon reflexes" [1].

"Lumbar disc herniation is the principal spine disorder causing low back pain and sciatic radiculopathy. Among the degenerative spine disorders category, disc herniation is the most common pathology encountered and managed by neurosurgeons. Lumbar disc herniation has to be managed surgically when severe and disabling radicular or back pain becomes refractory to conservative treatments or when neurologic deficits, including motor weakness or sensory loss, develop" [1].

"Upon introduction of microscopic discectomy in the literature in the late 70s by Yasargil, Caspar and others, it has become recognized as the gold standard technique for surgical management of disc prolapse. When compared to the historical exploratory laminectomy, it has been proven that microdiscectomy does not lead to operation time prolongation or a significantly higher number of wrong level explorations or missed disc fragments. Microdiscectomy is also suitable for all types of disc herniations regardless of any anatomical or technical restrictions" [3-7].

"The evolution of minimally invasive surgical techniques has led to the introduction of percutaneous endoscopic discectomy" [8]. Although microscopic discectomy is still the gold standard surgical technique for excision of prolapsed disc, percutaneous endoscopic discectomy is a reliable alternative with comparable results to microsurgery [9,10,11].

Since percutaneous endoscopic discectomy has been introduced in the literature, it has been classified as the least invasive procedure for lumbar disc prolapse [12,13]. That's why many studies have been published comparing endoscopic discectomy with the microscopically open surgeries and open lumbar discectomy.

Despite these results being promising, many authors still need more independent high-quality randomized clinical trials using sufficient sample sizes with cost-effectiveness analysis in different populations for more technical advances, and to establish Endoscopic discectomy as the standard procedure for the lumbar disc herniation.

2. MATERIALS AND METHODS

2.1 Study Design and Duration

This is a randomized clinical trial with a prospective analysis of the data of 40 patients with unilateral posterior lumbar disc prolapse admitted to the Neurosurgery Department, Tanta University Hospitals starting from November 2021 till the end of October 2022.

Randomization of the patients into the two group was made by blind selection of one of the two techniques by the head nurse of the department ward.

2.2 Study Population

A total of 40 patients with unilateral posterior lumbar disc prolapse admitted to the Neurosurgery Department, Tanta University Hospitals starting from November 2021 till the end of October 2022.

2.3 Inclusion Criteria

All the patients who were included in this study had these criteria:

- De Novo posterolateral disc prolapses.
- Single level lumbar disc prolapses.
- Unilateral clinical manifestations: sciatic radicular pain or neurological deficit or both.
- Failed conservative treatment to control symptoms (from 4 to 8 weeks in absence of motor neurological deficit).

2.4 Exclusion Criteria

All patients who had one or more of these criteria were excluded from this study:

- Medically unfit patients.
- Recurrent lumbar disc prolapses.
- Central lumbar disc prolapses.
- Lumbar canal stenosis.
- Multiple levels disc prolapses causing symptoms.
- Patients with bilateral clinical manifestations of nerve root affection.
- Patients with lumbar spinal instability which needs fixation.

2.5 Methodology

Two pain scoring systems were used to record the patient pre-operative degree of pain in numerical fashion to be compared with post-operative state to evaluate surgical outcome:

- Visual Analogue Scale (VAS).
- The Oswestry Disability Index (ODI).

- **Visual Analogue Scale:** Visual analogue scales (VAS) are used to measure the intensity or frequency of various symptoms, particularly pain. They are generally completed by patients themselves but are sometimes used to elicit opinions from health professionals. VAS are more sensitive to small changes than are simple descriptive ordinary scales in which symptoms are rated, for example, as mild or slight, moderate, or severe to agonizing.
  The patient is asked to answer the following question "On a scale from 0 to 10 where 0 is no pain and 10 is the worst imaginable pain where does your current level of pain fall?.
- **Oswestry Disability Questionnaire:** This questionnaire has been designed to give us information as to how the back or leg pain is affecting the ability to manage in everyday life. It is done by checking one box in each section. The ODI is divided into 10 items designed to assess multiple aspects of disability with respect to pain, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and travelling.
- **Scoring:** Each ODI item is scored on a 0 to 5 scale, with 5 representing the greatest level of disability. If the first statement is marked the section score equals 0, and if the last statement is marked it equals 5.
- **For example:** If all ten sections are completed the score is calculated as follows:

  16 (total scored)
  50 (total possible score) x 100 = 32%
  If one section is missed or not applicable the score is calculated as follows:
  16 (total scored)
  45 (total possible score) x 100 = 35.5%

Interpretation:

- From 0% to 20% (minimal disability): Patient can cope with most living activities.
- From 21% to 40% (moderate disability): Patient experiences more pain and difficulty with sitting lifting and standing. Travel and social life are more difficult, and they may be disabled from work. Personal care sexual activity and sleeping are not grossly affected.
- From 41% to 60% (severe disability): Pain remains the main problem in this group, but activities of daily living are affected.
- From 61% to 80% (crippled): Back pain impinges on all aspects of the patient's life.
- From (81% to 100%): These patients are either bed-ridden or exaggerating their symptoms.

2.6 Outcome Measurements

Clinical variables included baseline patients' characteristics including age, body mass index (BMI) and full laboratory investigations were gathered, The Visual Analogue Score (VAS) [14], and the Oswestry Disability Index (ODI) [15]. Surgical Techniques utilized are endoscopic lumbar discectomy and microdiscectomy performed by expert surgeons (EM, AS, MB) in Tanta University Hospital.

2.7 Statistics

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**.** **(**Armonk, NY: IBM Corp**)**. Qualitative data were described using number and percent. The Shapiro-Wilk test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). Significance of the obtained results was judged at the 5% level.

The used tests were:

1 - Chi-square test: For categorical variables, to compare between different groups.

2 - Fisher's Exact or Monte Carlo correction: Correction for chi-square when more than 20% of the cells have expected count less than 5.

3 - Student t-test: For normally distributed quantitative variables, to compare between two studied groups.

4 - Mann Whitney test: For abnormally distributed quantitative variables, to compare between two studied groups.

5 –Wilcoxon signed ranks test: For abnormally distributed quantitative variables, to compare between two periods.

6- Marginal Homogeneity Test: Used to analyze the significance between the different stages.

3. RESULTS

3.1 Patient Characteristics

Table 1. The co relation test between male and female with microscopic and endoscopic

	Microscopic (n = 20)		Endoscopic (n = 20)		Test of Sig.	P
	No.	%	No.	%		
Sex						
Male	14	70.0	12	60.0	χ^2=	0.507
Female	6	30.0	8	40.0	0.440	
Age (years)						
Min. – Max.	21.0 – 53.0		20.0 – 49.0		t=	0.354
Mean ± SD.	37.0 ± 10.51		34.15 ± 8.58		0.939	
Median (IQR)	37.0 (27.50 – 47.0)		34.50 (26.50 – 39.50)			

Table 2. The correlation test of medical history and types of work with microscopic and endoscopic

Medical history	Microscopic (n = 20)		Endoscopic (n = 20)		χ^2	^{MC}p
	No.	%	No.	%		
No	14	70.0	17	85.0	2.420	0.646
Rheumatoid arthritis	1	5.0	1	5.0		
HTN	1	5.0	1	5.0		
DM	4	20.0	1	5.0		
Type of work	**Microscopic (n = 20)**		**Endoscopic (n = 20)**		χ^2	^{MC}p
	No.	%	No.	%		
Mild physical work	10	50.0	11	55.0	0.358	1.000
Moderate physical work	7	35.0	7	35.0		
Strenuous physical work	3	15.0	2	10.0		

- The age of patients ranged from 21 to 53 years in Microscopic group, with a mean age of 37 years, while in Endoscopic it ranged from 20 to 49 years, with a mean age of 34.15. 14 patients (70%) were males and 6 (30%) were females in Microscopic group, while in Endoscopic group 12 (60%) were males and 8 (40%) were females.
- The majority of the patients (70%) in Microscopic group had no medical history. 4 Patients (20%) had Diabetes Mellitus, 1 patient (5%) had Rheumatoid arthritis and 1 patient had Hypertension in Microscopic group. In Endoscopic group also 17 patients (85%) had no medical history, 1 patient (5%) had Diabetes Mellitus, 1 patient (5%) had Rheumatoid arthritis and 1 patient (5%) had Hypertension.
- In Microscopic group, 10 patients (50%) had been doing a mild physical work, 7 patients (35%) had been doing a moderate physical work and only 3 patients (15%) had been doing a strenuous physical work.
- In Endoscopic group, 11 patients (55%) had been doing a mild physical work, 7 patients (35%) had been doing a moderate physical work and only 2 patients (10%) had been doing a strenuous physical work.

3.2 Presentation

Table 3. Test of significance

Symptoms	Microscopic Group (n = 20)		Endoscopic Group (n = 20)		Test of Sig.	P
	No.	%	No.	%		
Low back pain	20	100.0	20	100.0	–	–
Radiculopathy	20	100.0	20	100.0	–	–
Neurogenic claudication	6	30.0	3	15.0	χ^2=1.290	^{FE}p=0.451
Sense of weakness	5	25.0	10	50.0	χ^2= 2.667	0.102
Numbness	20	100.0	20	100.0	–	–
Duration of symptoms (months)						
Min. – Max.	1.0 – 22.0		1.0 – 20.0		U=	0.495
Mean ± SD.	9.05 ± 6.07		7.70 ± 5.89		174.50	
Median (IQR)	9.50 (3.50 – 12.0)		6.0(3.50 – 12.0)			

- Low back pain, radiculopathy and numbness were the most common presenting complaints occurring in all patients (100%) of both study groups. 6 patients in microscopic group (30%) were complaining of neurogenic claudication, while only 3 patients in endoscopy group (15%) had the same complaint. 5 patients in microscopy group (25%) were complaining of a sense of weakness, while half the patients in endoscopy group (50%) had this symptom.

Table 4. The chi-square test of positive sign with microscopic and endoscopic

Positive signs	Microscopic (n = 20)		Endoscopic (n = 20)		χ^2	P
	No.	%	No.	%		
Weakness	2	10.0	1	5.0	0.360	^{FE}p=1.000
Straight leg raising test	19	95.0	16	80.0	2.185	^{FE}p=0.342
Cross Straight leg raising test	12	60.0	16	80.0	1.905	0.168
Femoral stretch	1	5.0	1	5.0	0.0	^{FE}p=1.000

- On examination of the patients in microscopy group, Straight leg raising test was positive in almost all patients (95%), Cross straight leg raising test was positive in 12 patients (60%) and Femoral stretch was positive in 1 patient (5%). 2 patients (10%) had motor deficit. On examination of the patients in endoscopy group, both Straight leg raising test and Cross straight leg raising test were positive in 16 patients (80%), and Femoral stretch was positive in 1 patient (5%). Only 1 patient (5%) had motor deficit.

- The most common level of herniation in microscopic group was L5-S1 which occurred in 11 cases (55%) while L4-5 herniation occurred in 8 cases (40%) and 1 case only (5%) had L3-4 herniation.

In the endoscopy group, the predominant level of herniation was L4-5 occurring in 12 cases (60%), while L5-S1 herniation occurred in 7 cases (35%) and 1 case only (5%) had L3-4 herniation.

Table 5. The correlation test level and side of herrniation with microscopic and endoscopic

	Microscopic Group (n = 20)		Endoscopic Group (n = 20)		χ^2	P
	No.	%	No.	%		
Level of herniation						
L3-4	1	5.0	1	5.0	1.895	$^{MC}p=$
L4-5	8	40.0	12	60.0		0.415
L5-S1	11	55.0	7	35.0		
Side of herniation						
Right	9	45.0	12	60.0	0.902	0.342
Left	11	55.0	8	40.0		

3.3 Preoperative Variables

Table 6. The preoperative Visual Analogue Score (VAS) of leg pain in the patients in microscopy group

Visual Analogue Scale (VAS) of leg pain	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	P
Min. – Max.	5.0 – 8.0	4.0 – 8.0	185.50	0.698
Mean ± SD.	6.15 ± 0.93	6.20 ± 0.95		
Median (IQR)	6.0 (5.50 – 7.0)	6.0 (6.0 – 7.0)		

- The preoperative Visual Analogue Score (VAS) of leg pain in the patients in microscopy group ranged from 5 to 8 with a mean value of 6.15 and the median was 6 while in endoscopy group it ranged from 4 to 8 with a mean value of 6.20 and the median was 6.

Table 7. The preoperative Visual Analogue Score (VAS) of back pain in the patients in microscopy group

Visual Analogue Scale (VAS) of back pain	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	P
Min. – Max.	3.0 – 7.0	3.0 – 8.0	185.50	0.698
Mean ± SD.	5.25 ± 0.83	5.20 ± 0.85		
Median (IQR)	5.0 (4.50 – 6.0)	6.0 (5.0 – 7.0)		

- The preoperative Visual Analogue Score (VAS) of back pain in the patients in microscopy group ranged from 3 to 7 with a mean value of 5.25 while in endoscopy group it ranged from 3 to 8 with a mean value of 5.20.

Table 8. Test of significance of Oswestry disability Index with microscopic and endoscopic

Oswestry disability Index (%)	Microscopic Group (n = 20)		Endoscopic Group (n = 20)		Test of Sig.	p
	No.	%	No.	%		
Minimal	0	0.0	0	0.0	$\chi^2=$	$^{MC}p=$
Moderate disability	6	30.0	9	45.0	1.590	0.435
Severe disability	11	55.0	10	50.0		
Crippled	3	15.0	1	5.0		
Min. – Max.	30.0 – 70.0		30.0 – 70.0		U=	0.583
Mean ± SD.	48.25 ± 12.59		44.75 ± 10.06		179.0	
Median (IQR)	45.0(40.0 – 55.0)		45.0(37.50 – 50.0)			

- In microscopy group, most of the patients (55%) had moderate disability before operation according to the Oswestry disability index (ODI). 6 patients (30%) had severe disability and 3 patients (15%) were crippled. No patients had minimal disability before surgery. In endoscopy group, half of the patients (50%) had severe disability before operation according to the Oswestry disability index (ODI). 9 patients (45%) had moderate disability and only 1 patient (5%) was crippled. No patients had minimal disability before surgery.

3.4 Postoperative Variables

Table 9. The postoperative Visual Analogue Score (VAS) of radicular pain in microscopy group and endoscopy group

Visual Analogue Scale (VAS) of leg pain	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	p
Min. – Max.	1.0 – 4.0	1.0 – 3.0	182.0	0.640
Mean ± SD.	1.70 ± 0.92	1.75 ± 0.72		
Median (IQR)	1.0 (1.0 – 2.0)	2.0 (1.0 – 2.0)		
Z(p0)	3.967* (<0.001*)	3.949* (<0.001*)		

- The postoperative Visual Analogue Score (VAS) of radicular pain in microscopy group patients ranged from 1 to 4 with a mean value of 1.70± 0.92.
- The postoperative Visual Analogue Score (VAS) of radicular pain in endoscopy group patients ranged from 1 to 3 with a mean value of 1.75± 0.72.

Table 10. The postoperative Visual Analogue Score (VAS) of back pain in microscopy group patients and endoscopy group patients

Visual Analogue Scale (VAS) of back pain	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	p
Min. – Max.	2.0 – 4.0	1.0 – 3.0	182.0	0.040
Mean ± SD.	3.20 ± 0.92	1.80 ± 0.65		
Median (IQR)	1.0 (1.0 – 2.0)	2.0 (1.0 – 2.0)		
Z(p0)	3.967* (<0.001*)	3.949* (<0.001*)		

- The postoperative Visual Analogue Score (VAS) of back pain in microscopy group patients ranged from 2 to 4 with a mean value of 3.20 ± 0.92.
- The postoperative Visual Analogue Score (VAS) of back pain in endoscopy group patients ranged from 1 to 3 with a mean value of 1.75 ± 0.72. The P values for comparing postoperative visual analogue scores of back pain in the patients in both groups are statistically significant. (p=0.040)

Table 11. Test of significance of Oswestry disability Index with Microscopic and Endoscopic Group

Oswestry disability Index (%)	Microscopic Group (n = 20)		Endoscopic Group (n = 20)		Test of Sig.	P
	No.	%	No.	%		
Minimal	14	70.0	18	90.0	χ^2=	^{FE}p=
Moderate disability	6	30.0	2	10.0	2.500	0.235
Severe disability	0	0.0	0	0.0		
Crippled	0	0.0	0	0.0		
Min. – Max.	5.0 – 20.0		5.0 – 20.0		U=	0.072
Mean ± SD.	13.50 ± 5.64		10.25 ± 4.72		133.0	
Median (IQR)	15.0(10.0 – 20.0)		10.0(5.0 – 12.50)			

- In microscopic group, most of the patients (70%) had minimal disability after surgery according to the Oswestry disability index (ODI). 6 patients (30%) had moderate disability and no patients had severe or crippling disability after surgery.

- In endoscopic group, most of the patients (90%) had minimal disability after surgery according to the Oswestry disability index (ODI). Only 2 patients (10%) had moderate disability and no patients had severe or crippling disability after surgery.
- The P value for comparing the two groups is insignificant (p=0.072).

Table 12. Test of significance of Oswestry disability Index between Group A and B

Oswestry disability Index (%)	Group A (n = 20)		Group B (n = 20)		Test of Sig.	p
	No.	%	No.	%		
Preoperative						
Minimal	0	0.0	0	0.0	χ^2= 4.175	^{MC}p= 0.123
Moderate disability	6	30.0	9	45.0		
Severe disability	11	55.0	10	50.0		
Crippled	3	15.0	1	5.0		
Min. – Max.	30.0 – 70.0		30.0 – 70.0		U= 179.0	0.583
Mean ± SD.	48.25 ± 12.59		44.75 ± 10.06			
Median (IQR)	45.0(40.0 – 55.0)		45.0(37.50 – 50.0)			
Postoperative						
Minimal	14	70.0	18	90.0	χ^2= 2.500	^{FE}p= 0.235
Moderate disability	6	30.0	2	10.0		
Severe disability	0	0.0	0	0.0		
Crippled	0	0.0	0	0.0		
Min. – Max.	5.0 – 20.0		5.0 – 20.0		U= 133.0	0.072
Mean ± SD.	13.50 ± 5.64		10.25 ± 4.72			
Median (IQR)	15.0(10.0 – 20.0)		10.0(5.0 – 12.50)			
Z(p0)	3.952* (<0.001*)		3.933* (<0.001*)			

- The P values for comparing the preoperative and postoperative Oswestry disability index for patients in both groups are statistically significant (p<0.001).

Table 13. Statistical Result of Postoperative Hospital Stay

	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	P
Hospital stay (days)				
Min. – Max.	1.0 – 3.0	1.0 – 3.0	98.50*	0.005*
Mean ± SD.	2.25 ± 0.72	1.55 ± 0.60		
Median (IQR)	2.0(2.0 – 3.0)	1.50(1.0 – 2.0)		

- Patients in both groups were discharged after 1 to 3 days of postoperative hospital stay.
- The mean value of postoperative hospital stay in microscopic group was 2.25 days, while in endoscopic group the mean value of postoperative hospital stay was 1.55 days.
- P value for comparing the two groups is statistically significant. (p=0.005)

Table 14. The statistical test of Return to daily activity (weeks)

	Microscopic Group (n = 20)	Endoscopic Group (n = 20)	U	P
Return to daily activity (weeks)				
Min. – Max.	1.0 – 8.0	1.0 – 4.0	116.0*	0.023*
Mean ± SD.	3.30 ± 1.56	2.34 ± 0.80		
Median (IQR)	3.0 (2.0 – 4.0)	2.0 (2.0 – 3.0)		

- For microscopic group patients, return to daily activity ranged from 1 to 8 weeks after the surgery, with a mean value of 3.30 weeks. As for endoscopic group patients, return to daily activity ranged from 1 to 4 weeks with a mean value of 2.34 weeks. (p=0.023)

4. DISCUSSION

"Microscope use was popularized, at first mainly among neurosurgeons, in the late 1970s and 1980s by, among others, Robert Williams who published very favorable results in 534 patients in 1979" [16]. "Microdiscectomy was further refined in the early 1990s by orthopaedic spine surgeon John McCulloch" [17]. "In the 1990s, the combination of better retractors, lighting, and magnification led to an increasingly standardized technique performed through 2.5-cm or smaller incisions. Since then, microscopic discectomy has been defined as the gold standard for lumbar disc herniation" [18,3,19,20].

"The first attempts of endoscopic lumbar spine surgery date back to the early 1980s. However, only in the last decade this technology has substantially developed with a potential to replace microsurgical techniques especially for degenerative lumbar spine disorders. The endoscopic approach permits smaller incisions and less tissue trauma, compared with standard open microdiscectomy. Because the endoscopic procedure causes significantly less iatrogenic injury to the paraspinal musculature, it potentially provides additional long-term benefits over more aggressive procedures" [21].

In this study the age of the patients ranged from 21 to 53 years in microscopy group (mean 37± 10.51 years), while in endoscopy group it ranged from 20 to 49 years (mean 34.15± 8.58 years). "These results, agree well with all published data, and confirm that the majority of lumbar disc herniations occur between the ages of 30 and 50 and result in back pain and sciatica in the distribution of the affected nerve roots" [22] [23] [21] [24].

In this work 70% of the patients of microscopic group were males and 30% of the group were females while endoscopy group had 60% male patients and 40% female patients. Male predominance was a mutual characteristic of many similar studies [25] [22] [23] [21] [24]. Female predominance was only found in Hanaoka et al. series [26], 57% were females and 43% were males and in Nowitzke series [27], 54% were females and 46% were males. The relationship of sex to lumbar disc herniation is complicated. According to Miller et al. [28] discs in men start to degenerate a decade earlier than discs in women and were more degenerated than age-matched discs in women.

In the current study, sciatica, back pain and sensory affection in the form of paraesthesia or hypoesthesia were present in all patients of both groups (100%). 7.5% of patients had motor weakness (2 patients in microscopic group and 1 patient in endoscopic group). This is in concordance with the data from the literature [25] [29].

In the study in hand, the preoperative Visual Analogue Score (VAS) of radicular pain of the patients in microscopy group ranged from 5 to 8 (mean 6.15 ± 0.93), and the preoperative Visual Analogue Score (VAS) of radicular pain of the patients in endoscopy group ranged from 4 to 8 (mean 6.20 ± 0.95). The P value for comparing the two groups is insignificant (P=0.698). The postoperative Visual Analogue Score (VAS) of radicular pain of the patients in microscopy group ranged from 1 to 4 (mean 1.70 ± 0.92). The postoperative Visual Analogue Score (VAS) of radicular pain of the patients in endoscopy group ranged from 1 to 3 (mean 1.75 ± 0.72). P value for comparing between preoperative and postoperative VAS was statistically significant in both groups (P<0.001), but the P value for comparing postoperative VAS in the two groups was insignificant (P=0.640). Although the results are statistically insignificant, the improvement in VAS was slightly higher in the endoscopic group than in the microscopic group.

The preoperative Visual Analogue Score (VAS) of back pain in the patients in microscopy group ranged from 3 to 7 (mean 5.25± 0.83) while in endoscopy group it ranged from 3 to 8 (mean 5.20± 0.85). The postoperative Visual Analogue Score (VAS) of back pain in microscopy group patients ranged from 2 to 4 (mean 3.20 ± 0.92). The postoperative Visual Analogue Score (VAS) of back pain in endoscopy group patients ranged from 1 to 3 (mean 1.75 ± 0.72). The P values for comparing postoperative visual analogue scores of back pain in the patients in both groups are statistically significant. (p=0.040)

The preoperative Oswestry Disability Index (ODI) of the patients in microscopy group ranged from 30% to 70% (mean 43.0 ± 10.05%), and the preoperative Oswestry Disability Index (ODI) of the patients in endoscopy group ranged from 30% to 70% (mean 44.75 ± 10.06%). The P value for comparing the two groups is insignificant (P=0.445). The postoperative Oswestry Disability Index (ODI) of the patients in microscopy group ranged from 5% to 20% (mean 10.25 ± 5.25%). The postoperative Oswestry Disability Index (ODI) of the patients in endoscopy group ranged from 5% to 20% (mean 10.25 ± 4.72%). P value for comparing between

preoperative and postoperative ODI was statistically significant in both groups (P<0.001), but the P value for comparing postoperative ODI in the two groups was insignificant (P=0.072). Although statistically insignificant as well, the improvement in ODI was slightly higher in the endoscopic group than in the microscopic group.

The obtained results are consistent with the results of Choi, K. C. et al series [22], in which mean preoperative VAS was 7.3 ± 1.1 and mean postoperative VAS was 2.3 ± 0.8 in microscopic group, mean preoperative VAS was 7.5 ± 1.1 and mean postoperative VAS was 1.7 ± 1.2 in endoscopic group, with p value for comparison between the two groups preoperatively and postoperatively statistically insignificant and p value for comparison between preoperative and postoperative VAS in both groups statistically significant (p<0.001). Moreover, mean preoperative ODI in microscopic group was 66.1 ± 11.1 and mean postoperative ODI in the same group was 20.2 ± 7.2, and in the endoscopic group mean preoperative ODI was 61.6 ± 13.9 and mean postoperative ODI was 12.5 ± 7.5. P value for comparing preoperative ODI in both groups is insignificant and p value for comparing postoperative ODI in both groups is also insignificant, but p value for comparing preoperative ODI to postoperative ODI is statistically significant for both groups (p<0.001). As in our results, a slightly higher improvement in VAS and ODI is noted in the endoscopic group than the microscopic group.

In Ahn, S.-S. et al. series [30], preoperatively the back and leg VAS scores were 4.41 ± 0.98 and 7.53 ± 0.92, respectively, in endoscopic group, and 4.74 ± 1.08 and 7.50 ± 0.93, respectively, in microscopic group. These results revealed no significant differences. After surgery, the VAS scores for the back and leg decreased significantly in both groups. At 12 months after surgery, the back and leg VAS scores were 2.50 ± 0.62 and 2.06 ± 0.84, respectively, in the endoscopic group, and 2.91 ± 0.67 and 2.32 ± 1.01, respectively, in the microscopic group. There were significant differences between the groups for back VAS score at 6 months and 12 months after surgery (p < 0.001, p = 0.012, respectively). However, there was no significant difference between the groups for leg VAS score after surgery.

Similar results were obtained in Hsu, H.T. et al. study [21], after endoscopic discectomy, VAS and ODI scores decreased from 7.65 ± 2.82 and 35.6 ± 10.1% to 1.56 ± 2.18 and 6.42 ± 9.82%, respectively, while after microdiscectomy VAS and ODI scores decreased from 8.98 ± 1.35 and 31.9 ± 10.1% to 1.29 ± 1.84 and 3.29 ± 6.94%, respectively. No significant differences were noted in a comparison of the functional outcomes between endoscopic discectomy and microdiscectomy.

Lee, D. Y. et al. series [24] had comparable results, “as in microscopic group the mean VAS score for back pain was 5.4 ± 3.7 before surgery and improved to 3.1 ± 2.5 after surgery (p = 0.009). The mean VAS score for leg pain was 8.6 ± 1.7 before surgery and improved to 3.5 ± 3.1 after surgery (p < 0.001). The mean ODI score was 63.1 ± 22.3% before surgery and improved to 18.2 ± 15.4% after surgery (p < 0.001)” . In the endoscopic group, the mean VAS score for back pain was 7.0 ± 2.8 before surgery and improved to 2.9 ± 2.4 after surgery (p < 0.001). The mean VAS score for leg pain was 8.4 ± 1.7 before surgery and improved to 2.9 ± 2.5 after surgery (p < 0.001). The mean ODI score was 61.6 ± 22.1% before surgery and improved to 20.7 ± 15.9% after surgery (p < 0.001). There was no significant intergroup difference in improvement of VAS and ODI scores.

Ruetten, S [31] in his study stated that constant and significant (p < 0.001) improvement in leg pain and daily activities in both groups. After 2 years; 73% in the microscopic group and 76.5% in the endoscopic group no longer had pain at all, 20% in the microscopic group and 21% in the endoscopic group had pain occasionally or the pain was greatly reduced; and 7% in the microscopic group and 2.5% in the endoscopic group experienced no essential improvement. According to Ruetten, S [31], “the clinical results with the endoscopic technique were equal after 2 years to those obtained with the microsurgical technique. Significantly more patients in the microscopic group suffered progredient back pain. Postoperative pain and pain medication were significantly reduced in the endoscopic group. The results of these parameters in a literature comparison also favor the endoscopic group”.

The advantage of endoscopic discectomy over microscopic technique, especially in the improvement of back pain postoperatively, can be justified by the maximal preservation of normal bony and myoligamentous anatomy. This allows for earlier recovery and avoid chronic back pain resulting from fibrosis in muscles, ligaments and also epidural fibrosis [30].

In this study, patients in both microscopic and endoscopic groups were discharged after 1 to 3

days of postoperative hospital stay. The mean value of postoperative hospital stay in microscopic group was 2.25 ± 0.72 days, while in the endoscopic group the mean value of postoperative hospital stay was 1.55 ± 0.60 days. P value for comparing the two groups is statistically significant (P = 0.005).

In this study, the minimal time before discharge was 24 hours postoperatively, and the patient was examined thoroughly, local examination of the wound to exclude signs of hematoma collection and neurological examination to detect any sign of postoperative deficit, and then if the patient is feeling no or mild pain, and is not high risk of infection (e.g diabetic), he was discharged 1 day after surgery. Patients that took longer period in hospital were those suffering from moderate to severe back pain or paraesthesia after 24 hours, and those who are susceptible to infection.

Time needed to return to daily activity ranged from 1 to 8 weeks after the microscopic discectomy surgery, with a mean value of 3.30 ± 1.56 weeks. As for the endoscopic group, return to daily activity ranged from 1 to 4 weeks with a mean value of 2.34 ± 0.80 weeks. P value is statistically significant. (p=0.023)

The obtained results are consistent with the results of Choi, K. C. et al series [22], which mentioned that mean hospital stay was significantly shorter in the endoscopic group (1.5 ± 1.1 days, range: 0.5 – 3 days) than the microscopic group (7.2 ± 3.5 days, range: 3 – 14 days, P < 0.001). The mean time to return to work was also significantly shorter in the endoscopic group (4.2 ± 1.4 weeks), than in the microscopic group (8.6 ± 8.8 weeks) (P = 0.002).

In Ahn, S.-S. et al series [30], the mean hospital stay was significantly shorter endoscopic group (7.50 ± 2.63 days) as compared to microscopic group (15.65 ± 4.80 days) (p < 0.001). The mean return-to-work time was significantly shorter in endoscopic group (13.94 ± 3.72 days) as compared to microscopic group (29.26 ± 5.80 days) (p < 0.001).

Kim, M.J. [23] spoke in his series “in terms of the cost/benefit ratio mentioning that the endoscopic discectomy cost less with a ratio of 0.89 compared with microdiscectomy, and the number of days of hospitalization was fewer in full-endoscopic discectomy with a ratio of 0.31 compared with open microdiscectomy”.

In Hsu, H.-T. et al. series [21], mean hospital stay was significantly shorter in endoscopic group (0.9 ± 0.5 days) compared to microscopic group (3.8 ± 1.4 days) (p < 0.001).

In Mayer, H. M. et al. series [25], postoperative disability lasted significantly longer after microdiscectomy than after endoscopic discectomy (mean value was 22.9 vs. 7.7 weeks respectively).

In Rutten, S et al. series [31-34], the maximum time in hospital was 6 days in the microscopic group and 3 days in the endoscopic group.

This significant advantage of the endoscopic discectomy over microscopic discectomy in terms of postoperative hospital stay and return to work and daily activity can be explained by the lower intensity of pain, especially back pain presented by the endoscopic group allowing early hospital discharge with oral analgesia. The shorter period of postoperative disability and early return to daily activity may be attributed to the absence of the epidural fibrosis and tethering of nerve roots that commonly ensue after laminotomy. The epidural venous systems are less commonly disturbed during endoscopic discectomy, which helps to prevent venous stasis and chronic nerve-root edema. It also does not entail traumatic nerve root dissection, extra bone removal or large skin incisions. The risk of complications from scarring, blood loss, infection and anesthesia is considerably reduced or eliminated. Minimal instrumentation and injury to the ligamentum flavum is a benefit of endoscopic discectomy. About 5–12 % of failed back syndrome is caused by epidural fibrosis in patients who underwent lumbar disk surgery. Reduced trauma to the ligamentum flavum appears to limit epidural fibrosis, thus decreasing postoperative back pain and also facilitates rapid recovery. The studies also point that patients benefit from a surgeon that have gone through his learning curve. Better clinical outcome is correlated with a higher experience of the surgeon.

5. STUDY LIMITATIONS

The main limitation of the present study was the relatively small number of patients, which could limit the generalizability of our results. However, we performed a sample size and power analysis before enrolling patients to ensure that our study could find a statistically significant difference between the two groups in comparison. The other limitation was the short follow up period (1 year), which was not adequate enough to detect

the long-term sequel of the two techniques. Another factor that lacks this study is the postoperative radiological evidence, MRI in particular, to compare the impact of both techniques on the paraspinal musculature and the adequacy of decompression of the spinal canal, lateral recesses and foramina. Another limitation was the unavailability of transforaminal lumbar endoscopy system in the hospital.

6. CONCLUSION

Minimally invasive spine techniques for lumbar discectomy provide the advantage of direct attack of the pathology with maximal preservation of the normal anatomical structures, improving the clinical outcome and reducing the complications of lumbar discectomy. Similar to many of the recent studies, our randomized clinical trial showed that endoscopic lumbar discectomy showed similar functional outcome as microscopic discectomy. In addition, the endoscopic approach permits smaller incisions and less tissue trauma. Moreover, endoscopic lumbar discectomy is superior to microdiscectomy, especially in terms of improvement of postoperative back pain, reduced hospital stay and early return to daily activity, provided that surgeon undergoes many years of learning curves and experiences.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

This study was approved after the review by the Research Ethics Committee in Tanta University.

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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