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COMPARING THE EXTENT OF TISSUE DAMAGE BETWEEN LUMBAR MICROENDOSCOPIC DISCECTOMY (MED) AND MICROSCOPIC DISCECTOMY(MD) USING BIOCHEMICAL MARKERS

Comparing the Extent of Tissue Damage between Lumbar Microendoscopic Discectomy (MED) and Microscopic Discectomy (MD) Using Biochemical Markers

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Abstract

Background Data: Discectomy through a limited laminotomy has remained the “gold standard” for lumbar disc surgery. Surgery for lumbar disc herniation can be classified into two broad categories;open (conventional) versus minimally invasive surgery, where the last category classified into microscopic, endoscopic and percutaneous procedures. Microendoscopic discectomy (MED) is unique in that it combines open surgical principles with endoscopic technology.

Purpose: To evaluate extent of tissue damage and pain relief after microendoscopic (MED) and microscopic lumbar discectomy (MD).

Study Design: A prospective randomized controlled study.

Patients and Methods: The study included 40 patients having lumbar disc prolapse, operated in Alexandria Main University Hospital. Twenty of them underwent MED (Group A) and the other twenty underwent MD (Group B). Clinical (VAS, ODI) and radiological and biochemical markers (CRP, CPK) for tissue inflammation data were collected preoperatively and postoperatively for comparison. Patients were followed up for 6 months.

Results: 26 patients were males and 14 were females. The mean age for group A was 40.8±1.34 years and for group B was 40.2±1.06 years. Clinically all patients had low back pain and radicular leg pain. There was no statistically significant difference between the duration of surgery in both groups. The length of hospital stay was significantly less in MED group. The length of the skin wound was significantly less in MED group. Reduction of back pain VAS immediate and 1 month postoperative was reported in both groups and was statistically significantly better in MED group, however, after 6 months there was no difference between both groups. There was significant improvement with no difference between both groups regarding radicular VAS and ODI all through the follow up. Postoperative CRP and CPK was statistically significantly higher in MD group ($P<0.001$).

Conclusion: Both techniques gave comparable clinical outcomes although early back pain score and tissue markers were in favor of MED technique. (2018ESJ153)

Key words: microscopic discectomy, microendoscopic discectomy, CRP, CPK

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Introduction

Discectomy is one of the most common elective spinal surgical procedures.[14] Critics of surgery have argued that since 60% of patients improve without surgery, the operation should not be performed so long as alternative treatment can provide equivalent outcome within an acceptable period of time. Open disc surgery has also been criticized because it can cause muscle scarring, epidural fibrosis and spinal instability.[36] Surgery should only be saved for cases that fail medical treatment after 4-6 weeks and/or develop neurological deficit. Surgery for lumbar disc herniation can be classified into two broad categories: open (conventional) versus minimally invasive surgery. Minimally invasive surgery can be classified into microscopic, endoscopic and percutaneous procedures.[2,20]

Nowadays, "Minimally Invasive Surgery" is a trend setting catchword, but in the seventies the application of microsurgical techniques derived from intracranial procedures to the lumbar spine was a breakthrough.[1] In 1997 Smith and Foley introduced the microendoscopic discectomy (MED) system, which allowed spinal surgeons to decompress a symptomatic lumbar nerve root reliably.[11,23]

In this study we compared between both the microscopic and microendoscopic techniques from the clinical and biochemical points of view; evaluating their results of clinical improvement, and the extent of tissue damage caused by the surgery; using specific biochemical markers.

Patients and Methods

This is a prospective randomized controlled clinical study including 40 consecutive patients having fresh single level lumbar disc prolapse (L4-L5 or L5-S1). All patients were operated in Alexandria Main University Hospital between July 2016 and December 2017. Patients with other level affection, more than one level, lumbar canal stenosis, instability, and bad comorbidity were excluded. Twenty patients underwent microscopic lumbar discectomy (Group A), and the other twenty underwent MED (Group B). Clinical and radiological data, in addition to biochemical markers for tissue inflammation, were collected preoperatively and postoperatively for comparison. Patients were followed up for 6 months.

Two biochemical markers were used in the evaluation. The first is Creatine Phosphokinase (CPK), which quantifies the amount of muscle damage; it is measured in serum and reaches a maximal value on day 1 after surgery. The second is C-reactive protein (CRP), which is produced in the liver and is released into the circulation in response to IL-1 produced at an inflammatory locus. The less the inflammatory response; the less is the invasive nature of the surgical procedure. Again, it is measured in serum and reaches a maximal value on day 1 after surgery. CPK was measured using Dimension RxL Max Integrated chemistry system, Siemens, by chemiluminescence method with normal value: 22 to 198 u/liter). CRP was measured using BN ProSpec system, Siemens, by nephelometry method wiyh normal value: up to 3 mg/l). Patients' demographic data and clinical data were reported as well as operative time, skin incision, operative morbidity, and hospital stay.

All patients were followed up after intervention by clinical evaluation (immediately postoperative (day 1), 1 month postoperative, and 6 months postoperative using both Visual Analogue Score (VAS) for both low back pain and radicular pain and Oswestry Disability Index (ODI). CPK and CRP were measured preoperatively and 24 hours postoperatively for comparison.

Results

This study included 40 patients with clinically manifest, fresh single level, lumbar disc prolapse, without radiological instability. Twenty patients had microscopic discectomy (Group A), and the other twenty patients had MED (Group B). 26 patients were males (65%) and 14 were females (35%).The mean age for group A was 40.8±1.34 (Range, 22-56) years, and for group B was 40.2±1.06 (Range, 19-56) years (Table 1).

There was no statistically significant difference between the duration of surgery in group A (87.0±26.87 minutes), and group B (79.55±24.99 minutes) ($P=0.3697$). There was a statistically significant difference between the length of hospital stay between both groups, 36.2±14.52 hours in group A, versus 11.1±4.82 hours in group B (P<0.001) (Table 2).

There was a statistically significant difference (using Two-sample t test with equal variances) between the lengths of the skin wounds between the two groups; 3.86±0.72 (Range 3-4) cm in group A, and 2.0±0.0 cm in group B (note that all the skin wounds had the same length, which represents the diameter of the working insert of the endoscope). (Table 3)

Low back pain VAS mean value was preoperatively 5.5 for group A, and 6.35 for group B. Immediately postoperative LBP VAS decreased to 3.9 for group A, and 3.05 for group B, that was statistically significantly less in endoscopic group . After 1 month, it was 2.98 for group A, and 2.13 for group B, again that was significantly less in endoscopic group. However, after 6 months, it was 1.85 for group A, and 1.95 for group B, with no statistically significant difference (Two-sample t test with equal variances was used) (Figure 1, Table 4).

Radicular VAS mean value was preoperatively 7.2 for group A, and 7.9 for group B. Immediately postoperative radicular VAS decreased to 2.66 for group A, and 2.65 for group B. After 1 month, it was 1.85 for group A, and 1.65 for group B. and after 6 months, it was 1.35 for group A, and 1.4 for group B, with no statistically significant difference in all periods (Two-sample t test with equal variances was used) (Figure 2, Table 4).

Regarding preoperative ODI, the mean value preoperatively was 84.5 for group A, and 83.8 for group B. Percentage of improvement of ODI has very close values in the 2 follow up periods between both groups with statistically insignificant differences. immediately postoperative it was 25.1 for group A, and 28.05 for group B. 6 months postoperatively it was 18.96 for group A, and 22.16 for group B (Student t-test was used: Statistically significant at p ≤ 0.05) (Figure 3).

Preoperative CRP mean value for group A was 0.92±0.32, and for group B was 1.03±0.51 (P=0.390). Postoperative increase of CRP in group A was 5.52±1.32, versus 3.13±0.92 in group B, that was statistically significantly less in group B (P<0.001). Preoperative CPK mean value for group A was 110.4±46.2, and for group B was 103.65±57.09 (P=0.683). Postoperative increase of CPK in group A had a mean value 468.40±87.67 versus 242.50±92.02 in group B that was statistically significantly more in group A (P< 0.001). (Tables 5, 6)

Table 1. Age and Sex Distribution of The Studied Patients in Both Groups

Parameters		Microscopic (N=20)	Endoscopic (N=20)	P
Age (years)		40.8±1.34 (22-56)	40.2±1.06 (19-56)	0.85*
Sex	Male	13(65.0%)	13(65.0%)	1.00**
	Female	7(35.0%)	7(35.0%)	

*t-test for equal variances

**P-value = 1.00 (Pearson Chi^2)

Table 2. Comparison between both Groups Regarding Duration of Surgery & Length of Hospital Stay

Parameters	Microscopic (N=20)	Endoscopic (N=20)	P
Duration of surgery/minutes	87.0±26.87 (60-90)	79.55±24.99 (55-85)	0.3697
Hospital Stay/hours	36.2±14.52 (24-48)	11.1±4.82 (9-36)	<0.001*

Table 3. Comparison between both Groups Regarding Wound Length (cm)

	N	Mean	SD.	[95% conf. interval]	
Endoscopic	20	2.0	0	2.0	2.0
Microscopic	20	3.86	0.72	3.54	4.21

Pr(|T| > |t|) = 0.0000 (Two-sample t test with equal variances)

Table 4. Low Back Pain and Root Pain VAS (Endoscopic vs Microscopic Group) Through the Follow up Period

Parameters	Time	Technique	Mean	SD	[95% conf. interval]		Test
LBP VAS	Immediate PostOp	Endoscopic	3.05	1.39	2.29	4.06	Pr(T>t) = 0.0413
		Microscopic	3.9	1.07	3.39	4.4	
	1 month PostOp	Endoscopic	2.13	0.68	1.13	2.87	Pr(T>t) = 0.0370
		Microscopic	2.98	1.47	2.11	3.49	
	6 months PostOp	Endoscopic	1.95	0.69	1.63	2.27	Pr(T>t) = 0.6766
		Microscopic	1.85	0.81	1.47	2.23	
Root pain VAS	Immediate PostOp	Endoscopic	2.65	1.18	2.09	3.2	Pr(T>t) = 1.0000
		Microscopic	2.66	1.22	2.08	3.22	
	1 month PostOp	Endoscopic	1.65	0.75	1.3	1.99	Pr(T>t) = 0.4223
		Microscopic	1.85	0.81	1.47	2.23	
	6 months PostOp	Endoscopic	1.4	0.88	0.98	1.81	Pr(T>t) = 0.8412
		Microscopic	1.35	0.67	1.03	1.66	

Table 5. Comparison between the Two Studied Groups According to CRP

CRP	Microscopic (N=20)	Endoscopic (N=20)	T	P
Pre-operative	0.92±0.32 (0.43–1.54)	1.03±0.51 (0.08–2.20)	0.869	0.390
Post-operative	5.52±1.32 (3.66 – 8.65)	3.13±0.92 (1.25–4.90)	6.639*	<0.001*
p_1	<0.001*	<0.001*		

t: Student t-test

p_1: p value for Paired t-test for comparing between pre and postoperative

*: Statistically significant at p ≤ 0.05

Table 6. Comparison between the Two Studied Groups According to CPK

CPK	Endoscopic (N=20)	Microscopic (N=20)		
Pre-operative	103.65±57.09 (43.0–281.0)	110.40±46.20 (60.0–244.0)	0.411	0.683
Median	85.50	96.0		
Post-operative	242.50±92.02 (75.0–433.0)	468.40±87.67 (293.0–642.0)	7.949*	<0.001*
Median	229.50	463.0		
p_1	<0.001*	<0.001*		

t: Student t-test

p_1: p value for Paired t-test for comparing between pre and postoperative

*: Statistically significant at p ≤ 0.05

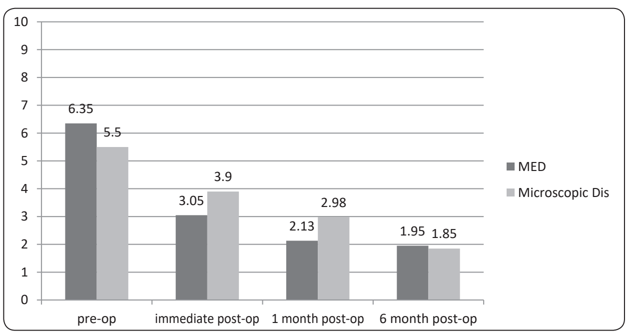

Figure 1. VAS of LBP for both groups in the follow up period.

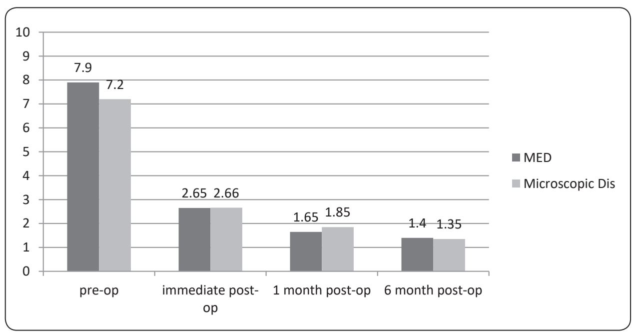

Figure 2. VAS of Leg pain for both groups in the follow up period.

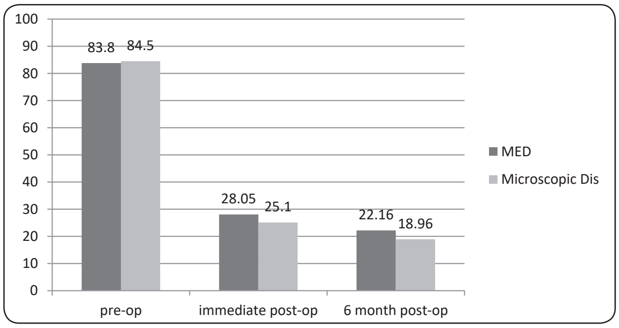

Figure 3. Percentage of improvement for ODI for both groups in the follow up period.

Discussion

Conventional (open) discectomy was considered as the gold standard for the treatment of lumbar disc prolapse by many authors, and the majority of series publish satisfactory results of improvement ranging from 75% to 95% of cases.[5,15,17,19,34,38] Microdiscectomy (MD) introduced by Yasargil and Caspar (1977) is now considered the gold standard. The satisfactory results of MD also range from 88% to 98.5%.[12,13,17,18] Both procedures are time-tested giving good surgical results in patients having disc prolapse. Microendoscopic discectomy (MED) introduced by Foley et al,[13] (1997), combines lumbar microsurgical techniques with endoscopic technology, enabling surgeons to successfully address different pathological variants of disc prolapse. MED also allows smaller incisions and less tissue trauma, compared with MD. There are many reports proving the efficacy of MED with overall comparable results.[8,11,24,28,29,32,37]

In our study, the mean age was 40.2 years for MED group, and 40.8 years for MD group and both were comparable. Those results agree well with all published data, and confirm that the majority of lumbar disc herniation occur between the ages of 30 and 50 years; the years of most muscular activity, and result in back pain and sciatica in the distribution of the affected nerve roots.[10,16,28] In this study, we had 26 male (65%) and 14 female (35%). These results have similar values with male predominance in many series. In the study by Nakagawa et al,[25] 73% were males and 27% were females, where in the series of Perez-Cruet et al,[28] 62% of their patients were males and 38% were females, in Oertel et al, series,[26] 55% were males and 45% were females, and in Schizas et al. series,[32] 64.3% were males and 35.7% were females. Male predominance is usually attributed to environmental factors. Historically, they were believed to be the strongest risks for the development of lumbar disc prolapse, such as smoking, occupations involving heavy manual labor, and exposure to vibrations. However, the recent work by Batie et al,[6] Batie and Videman[7] Videman et al,[35] and others[3,30] they provided convincing evidence that, although environmental factors contribute to the incidence and progression of disc degeneration, the strongest predictors are the genetic factors which influence the size and shape of spinal structures, as well as the synthesis and breakdown of intervertebral disc structural components. They compared lumbar MRI findings to lifestyle factors in a large sample of identical twins; and reported a hereditability estimate of 74 %.

This study shows mean value for operative duration to be 79.55 minutes for MED group, and 87 minutes for MD group. MED surgery duration was less than microscopic surgery; however that did not show a statistically significant impact. Huang et al,[18] in his series reported an average of 109 minutes for MED cases, and 72.1minutes for MD cases. The mean operative time in his series might be longer for MED presuming it was early in their learning curve.

The mean value for skin incision in our study was 2.0 cm for MED cases, and 3.86 cm for MD cases. Endoscopic wound was markedly smaller than microscopic wound. This difference is due to fixed endoscopic sheath diameter used 2.0 cm, compared to the need in microscopic technique to open a little bit wider for better illumination. Huang et al,[18] had similar values; which were 1.86cm for MED group, and 4.0 cm for MD group.

In both groups the patients had moderate and severe back pain and radicular pain preoperatively;

we had no significant difference between the 2 groups regarding both preoperative VAS of LBP and VAS of RP in our study. This matches with other series as Bydon A et al,[9] that had mean values comparable to our results. In this study, results show better low back pain relief for endoscopic surgery in short term follow up and no difference in long term follow up, that may be due to minimal invasive work of endoscopic technique. Arts et al,[4] had similar results. Regarding VAS for RP, both groups give similar results in radicular pain relief due to good decompression in both techniques. Bydon et al,[9] had similar values; there was no significant difference between both techniques, both in our study and other studies in radicular pain relief.

Our preoperative mean Oswestry Disability Index for MED group was 83.80, and for MD group was 84.50, similarly Arts et al,[4] had in their study mean preoperative ODI of 80.0 in endoscopic, and 81.5 in microscopic discectomy group, and these results are close to those of our study. There was no significant statistical difference in our study or other studies between preoperative ODI of both groups. One month postoperative it was; 28.05 for MED group, and 25.10 for MD group. After 6 months postoperative it was; 22.16 for MED group, and 18.96 for MD group. In the study of Arts et al,[4] mean ODI 1 month postoperatively was 38.10 for MED group, and 37.20 for MD group. And mean ODI after 6 months was 23.5 for MED group, and 17.0 for MD group. There was no statistical significant difference between both techniques regarding disability at all recorded times, either in this study or other studies.

The mean value for length of hospital stay (hours) in this study was 11.1 hours for MED group which is significantly less than 36.2 hours for MD group, due to less immediate postoperative wound pain in endoscopic group. As for hospital stay in Huang et al,[18] it was 85.7 hours for MED, 120 hours for MD. It's a much longer postoperative hospital stay but may be these authors prefer to lengthen the immediate postoperative observation period of their patients for study purpose, but we usually discharge the patient as soon as he gets stable with no complications that need more hospitalization.

There are few objective laboratory data to confirm the reduced systemic responses in the early phase after lumbar discectomy. In order to substantiate the reduced invasiveness of MED compared to MD, the invasiveness of each surgical procedure was evaluated by measuring serum levels of CRP reflective of a post-operative inflammatory reaction and damage to the paravertebral muscles.[31] In this study the post-operative increase of CRP in MD group was higher than MED group. Our results were similar to those of Lei Pan et al,[27] shin et al,[33] and, Huang et al,[18]. Muscle damage was quantified by an increase of Creatine Phosphokinase (CPK) in serum and reaches a maximal value on 1 day after surgery.[21,22] In our study the post-operative increase of CPK in MD group was higher than MED group. Again this matches the results published by Shen et al.[33]

Conclusion

Both microendoscopic lumbar discectomy (MED) and microdiscectomy (MD) techniques gave comparable clinical outcome although early back pain score and tissue markers were in favor of MED technique.

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The authors report no conflict of interest.

الملخص العربي

مقارنة مدي تلف الأنسجة بين إستخدام المنظار و الميكروسكوب الجراحي في حالات إستئصال الإنزلاق الغضروفي القطني بإستخدام الدلالات البيوكيميائية

البيانات الخلفية: يمكن تصنيف جراحة استئصال الإنزلاق الغضروف القطني إلى فئتين رئيسيتين: الجراحة المفتوحة (التقليدية) مقابل الجراحة الأقل تدخلا.و يمكن تصنيف الجراحة الأقل تدخلا إلى جراحات ميكروسكوبية ومنظارية وعن طريق الجلد. ظلت عملية استئصال الإنزلاق الغضروف القطني بواسطة الميكروسكوب الجراحي هي العملية المثالية لجراحة الإنزلاقات الغضروفية. و يعتبر استئصال الإنزلاق الغضروف القطني بواسطة المنظار الجراحي فريد من نوعه من حيث أنه يجمع بين المبادئ الجراحية المسكروسكوبية و تكنولوجيا المناظير.

الغرض: أجريت هذه الدراسة لتقييم النتائج الجراحية ، وخاصة تخفيف الألم، و مدى تلف الأنسجة باستخدام الدلالات البيوكيميائية بين عملية استئصال الإنزلاق الغضروف القطني بواسطة الميكروسكوب الجراحي و بواسطة المنظار الجراحي.

تصميم الدراسة: دراسة مستقبلية، اشتملت 40 مريضا تم تشخيصهم بالإنزلاق الغضروفي القطني، بقسم جراحة المخ والأعصاب؛ كلية الطب، جامعة الإسكندرية. تم تقسيمهم عشوائياً إلي مجموعتين. الأولي ستخضع للجراحة الميكروسكوبية و الثانية ستخضع للجراحة بواسطة المنظار.

المرضي و الطرق: شملت الدراسة 40 مريضًا مصابًا بالإنزلاق الغضروفي القطني. تم جمع نتائج الكشف السريرية والإشعاعية و الدلالات البيوكيميائية لإلتهابات الأنسجة قبل الجراحة وبعد الجراحة للمقارنة. تم متابعة المرضى لمدة 6 أشهر.

النتائج: كان 26 مريضا من الذكور و 14 من الإناث. كان متوسط العمر للمجموعة الأولي 40.8 سنة ، و40.2 سنة للمجموعة الثانية. سريريا كان جميع المرضى يعانون من آلام أسفل الظهر وألم جذري في الساق. لم يكن هناك فروق ذات دلالة إحصائية بين مدة الجراحة في كلا المجموعتين. كان طول مدة الإقامة في المستشفى أقل بكثير في مجموعة المنظار الجراحي. كان طول جرح الجلد أقل بكثير في مجموعة المنظار الجراحي. بالنسبة لآلام أسفل الظهر انخفض متوسط VAS في كلا المجموعتين ، وكان الانخفاض ذو دلالة إحصائية في مجموعة المنظار الجراحي؛ على الفور بعد العملية الجراحية وبعد شهر. ومع ذلك ، بعد ستة أشهر ، أظهرت كلا المجموعتين انخفاض في القيم المتوسطة ؛ مع عدم وجود فروق ذات دلالة إحصائية. إنخفض متوسط VAS لالام جذور الأعصاب في كلا المجموعتين ؛ مع عدم وجود فروق ذات دلالة إحصائية في جميع الفترات الخاصة بالدراسة. فيما يتعلق بمؤشر ODI ، فإن النسبة المئوية للتحسن من ODI لها قيم قريبة جدا في فترات المتابعة بين المجموعتين و بدون وجود فروق ذات دلالة إحصائية.

كانت زيادة CRP بعد العملية الجراحية بواسطة المنظار الجراحي أقل بكثير و ذات دلالة إحصائيه (P<0.001). و كانت الزيادة بعد العملية الجراحية بواسطة الميكروسكوب الجراحي من CPK أكثر و ذات دلالة إحصائية (P<0.001).

الاستنتاج: أعطت كلا التقنيتين نتائج جيدة للمرضى فيما يتعلق بتخفيف الألم والنتائج الوظيفية. وكانت مزايا المنظار الجراحي حدوث جرح أصغر، كما كانت مدة الإقامة في المستشفى أقصر. يجب توخي الحذر حين اتخاذ القرار لكل مريض واختيار أفضل تقنية جراحية ، والتي يجب أن تكون الأنسب لحالة المريض ويكون الجراح علي دراية جيدة بها للحصول علي افضل نتيجة .