International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(3): 488-492
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www.orthopaper.com
Received: 07-05-2020
Accepted: 11-06-2020

Dr. Arvind Kumar K
Karpaga Vinayaga Institute of Medical Sciences and Research Center, Maduranthagam, Tamil Nadu, India

Dr. Arun Kumar Ramanathan
Assistant Professor, Department of Orthopedics, Karpaga Vinayaga Institute of Medical Sciences and Research Center, Maduranthagam, Tamil Nadu, India

Corresponding Author:
Dr. Arvind Kumar K
Karpaga Vinayaga Institute of Medical Sciences and Research Center, Maduranthagam, Tamil Nadu, India

Functional outcome of microscopic lumbar discectomy for the treatment of lumbar disc prolapse in tertiary care hospital in South India

Dr. Arvind Kumar K and Dr. Arun Kumar Ramanathan

DOI: https://doi.org/10.22271/ortho.2020.v6.i3h.2242

Abstract
Background: Microscopic lumbar discectomy has become the "gold standard" treatment for disc prolapse with early recovery of patients and quick return to work. Potential benefits include smaller incisions of the skin and fascia, less traumatic surgical procedure, reduced postoperative pain and hospital stay. We have evaluated the efficacy of microscopic lumber discectomy.
Methods: This is a prospective observational study conducted in the Department of Orthopaedics in Karpaga Vinayaga Institute of Medical Sciences, Maduranthakam over a 2-year period from 2017 to 2019 on a convenience sample from patients undergoing micro lumbar discectomy for lumbar disc herniation. Functional outcome was evaluated periodically over a 14-week period with the Oswestry Disability Index (ODI).
Results: A total of 30 subjects with a mean age of 41.73 years with a mean duration of low back pain of 10.13 months undergoing microscopic lumbar discectomy for lumbar disc prolapse were included in the study. On MRI Finding, 60.00% are noted to have extrusion, 33.33% protrusion and 6.67% sequestration. The mean duration of surgery is 1.28 hours, the mean blood loss is 153.33 mL, the mean duration of hospital stay is 3.17 days. The mean ODI has reduced from preoperative 73.67 ± 7.54 to 16 ± 3.28 at 14-week follow-up, which is statistically significant (P Value <0.001).
Conclusion: The current study concludes that microscopic lumbar discectomy for herniated lumbar disc is indeed "gold standard" with minimal blood loss and less hospital stay with a good functional outcome, leading to early return to work.

Keywords: Microdiscectomy, functional outcome, lumbar disc prolapse, herniation, oswestry disability index

Introduction
Microscopic lumbar discectomy has become the "gold standard" treatment for disc prolapse with early recovery of patients and quick return to work [1]. Potential benefits include smaller incisions of the skin and fascia, less traumatic surgical procedure, reduced postoperative pain and hospital stay [2].
Low back pain strikes almost 80% of people at some point in their life, and it is the most frequent cause of limitations of activity in persons less than 45 years. Lumbar disc prolapse is the most common cause of back pain in patients presenting to the orthopaedic or neurosurgical outpatient department. It falls upon the Orthopaedic surgeon to diagnose and appropriately treat this ailment for which lumbar intervertebral disc prolapse is usually the most common cause [3]. The incidence of low back pain in a population has been reported to be roughly around 60%, and that of sciatica has been reported to be 1% [4]. Aslam *et al*. have mentioned lifetime incidence of low back pain in the range of 50-70% including sciatica among 40%, but clinically significant sciatica requiring special attention accounts for only 4-6% cases. Degeneration of disc due to various factors leads to prolapse of the intervertebral disc into intervertebral foramina, especially into L4-L5 and L5-S1 level. The L3-L4 & L2-L3 region accounts for the majority of remaining prolapse [5].
Mixter and Barr in 1934 first recognized that the most common cause of nerve compression in the lumbar spinal canal is herniated disc in the lumbar spinal canal and advocated a surgical approach to the problem [6].

Various surgical techniques have evolved over time ranging from wide extensive laminectomy to hemilaminectomy to interlaminar fenestration described by Loew to the present-day conservative dissection techniques. All these techniques are minimally invasive procedures with a wide range, like chemonucleolysis, percutaneous systems and endoscopic systems of different surgeons like Yeung [7]. A technique for percutaneous non-visualized indirect spinal canal decompression, percutaneous nucleotomy, through a posterolateral approach was described by Parvis Kambin in 1973 and Hijikata *et al*. in 1975 [8]. In 1977, Yasargil and Caspar independently introduced the technique of microdiscectomy for treating lumbar disc herniation. Microscopic discectomy offers better visual control of the operation field, requires smaller incisions and minimal soft tissue dissection which are less traumatic compared to the standard open discectomy [9]. The next step in the advancement of the percutaneous discectomy technique was the addition of the endoscope. The first endoscopic views of a herniated nucleus pulposus were published by Kambin *et al*. in 1988 [8]. The role of other treatment options such as minimally invasive discectomy (MID), chemonucleolysis and endoscopic discectomy is still unclear, and both open discectomy and microdiscectomy are still considered the best surgical treatment options and are the most commonly used treatment modalities today [9]. Williams first used the operating microscope and emphasized its advantages such as better visualization of the dural structures and nerve roots and called it a conservative approach [10]. With the introduction of this technique, it was pointed out that microdiscectomy is just as efficient as standard discectomy, with certain advantages over the latter [10].

The Oswestry Disability Index (ODI) was originally developed in 1980 (version 1) [11] and slightly modified in 1989[12] to the version 2.1, which is regularly used today [13]. The 2.1a version had a single word change in the introductory statement [14]. This ODI version measures the impact of low back pain on the patients' functional ability covering 10 domains of activities in daily life ('personal care', 'lifting', 'walking', 'sitting', 'standing', 'sleeping', 'sex life', 'social life', and 'travelling'). Each item has 6 statements with scoring 0-5 to be scored by the patient oer his/her current functional status. The sum of all 10 item scores is expressed as a percentage of the maximum score [15] Psychometric characteristics (validity, reliability, and responsiveness) of the ODI are the final determinants of the questionnaire's suitability as a clinically useful measure [16]. The scoring system includes a description of degrees of disability relating to scores on the ODI. Scores from 0% to 20% indicate minimal disability; 20% to 40%, moderate disability; 40% to 60%, severe disability; 60% to 80%, crippled; and 80% to 100%, bedbound or exaggerating [17].

The potential benefits of microscopic discectomy are less muscle and tissue damage resulting in better cosmesis with less pain and operative time and faster recovery after surgery and less peridural scar tissue formation [7,18]. However, there appears to be no particular advantage of either technique in terms of functional outcome since both result in good overall outcome [19]. The current study is an attempt to identify the advantages of microscopic lumbar discectomy in terms of duration of surgery, blood loss, complications and functional outcomes as measured by Oswestry Disability Index (ODI) over a 14-week period after the surgery.

Objectives

1. To assess the duration of surgery, blood loss, complications and functional outcomes of micro lumbar discectomy.
2. To assess the functional outcome of patients operated by micro lumbar discectomy using the Oswestry Disability Index (ODI).

Materials and Methods

This is a prospective observational study conducted in the Department of Orthopaedics in Karpaga Vinayaga Institute of Medical Sciences, Maduranthakam over a two-year period from 2017 to 2019. The study group is a convenience sample from a population of patients undergoing micro lumbar discectomy for lumbar disc herniation. Exclusion criteria are patients with other spine deformities (congenital or acquired), medically unfit and below 18 years age. Patients are discharged within the third postoperative day and are followed up for a period of six months and are evaluated with Oswestry Disability Index (ODI).

Preoperative procedure: All the pateints who were selected for surgery were assessed with anterposterior and lateral radiographs of the lumbosacral spine, magnetic resonance imaging of the lumbosacral spine. Ethical clearance for the study was obtained from the institutional ethical committee.

Routine preoperative evaluation was done and medical comorbities were treated by the concerned specialists. Preanaesthetic clearance was obtained.

After obtaining written informed consent, all the patients have undergone the operative procedure under general anaesthesia. The patient is positioned prone, and the level is marked under fluoroscopic guidance. Using a posterior midline incision with minimal paraspinal muscle dissection, the corresponding interlaminar space is exposed. Under microscopic magnification, ligamentum flavum is excised and the underlying dural sac is exposed. The disc fragment compressing the nerve and dural sac is removed and the nerve freed. Copius wash given and the wound closed. The patient is extubated and shifted to postoperative ward and the neurology is assessed. Duration of surgery, blood loss, duration of catheterization, length of hospital stay are recorded. The patients are discharged within the third postoperative day and are followed up for a period of 14-weeks.

Functional outcome assessments are evaluated with the Oswestry Disability Questionnaire (ODI). The ODI is considered the 'gold standard' of low back functional outcome tools [15]. ODI (Preoperative and different follow-up periods) are considered as primary outcome variables. Demographic and clinical parameters are considered as Primary explanatory variable.

Ethical issues: Written informed consent is obtained from the patients. There are no risks involved in the study. Participation in the study is completely voluntary and confidentiality will be maintained.

Results

A total of 30 subjects were included in the final analysis.The mean age is 41.73 years. Among the study population, 12 (40.00%) are male and remaining 18 (60.00%) participants are female. Occupation wise, 46.67% participants are housewives, 40% participants are non-skilled workers and 13.33% participants are skilled workers. (Table 1)

Table 1: Summary of demographic parameters (N=30)

Demographic parameters	Summary
Age (years) Mean ± SD	41.73 ± 8.83 (21 to 60)
Gender	
Male	12 (40.00%)
Female	18 (60.00%)
Occupation	
House-Wife	14 (46.67%)
Skilled	4 (13.33%)
Non-Skilled	12 (40.00%)

The mean duration of low back pain is 10.13 months. Among the people with radiculopathy, 11 (36.67%) participants have LT, 8 (26.67%) participants have RT, and 11 (36.67%) have bilateral radiculopathy. Paracentral disc herniation is noted in 93.33% of the participants and 6.67% participants have foraminal herniation. MRI Finding revealed majority of the participants with 60.00% of them having extrusion, 33.33% protrusion and 6.67% sequestration. (Table 2)

Table 2: Summary of Clinical parameters (N=30)

Clinical parameters	Summary
Duration of low back Pain (Month) Mean ± SD	10.13 ± 2.79 (6 to 16)
Radiculopathy	
LT	11 (36.67%)
RT	8 (26.67%)
B/L	11 (36.67%)
Type of herniation	
Foraminal	2 (6.67%)
Paracentral	28 (93.33%)
Stage of disc herniation MRI Finding	
Extrusion	18 (60.00%)
Protrusion	10 (33.33%)
Sequestered	2 (6.67%)

The mean duration of surgery is 1.28 hours (ranged between 0 to 2.35), the mean blood loss is 153.33 ml (ranged between 75 to 300), the mean duration of hospital stay is 3.17 days (ranged between 2 to 5). 40% of the participants had 1-day hospital stay and 24.14% people had 2 days hospital stay. The mean ODI preoperative, postoperative 6th week, 10th week and 14th week is 73.67 ± 7.54 (62 to 86), 44.6 ± 5.83 (36 to 54), 27.47 ± 2.78 (22 to 30) and 16 ± 3.28 (10 to 20). Among the study population, 3 (10%) participants noticed weakness. Majority, with 80% of the participants have IVDP (L4-L5), 40% have IVDP (L5-S1) and 16.67% participants have IVDP (L3-L4). 93.33% of the participants have MLD at L4-L5, 40% have MLD at L5-S1 and 16.67% have MLD at L3-L4. (Table 3)

Table 3: Summary of Outcome Parameter (N=30)

Outcome Parameter	Summary
Duration of Surgery (Hours) Mean ± SD	1.28 ± 0.54 (0 to 2.35)
Blood Loss (ml) Mean ± SD	153.33 ± 61.07 (75 to 300)
Duration of Stay (Days) Mean ± SD	3.17 ± 0.99 (2 to 5)
Average Duration Catheterization (Days)	
0	11 (37.93%)
1	12 (40.00%)
2	7 (24.14%)
ODI	
Pre-Op	73.67 ± 7.54 (62 to 86)
Post Op 6th week	44.6 ± 5.83 (36 to 54)
Post Op 10th week	27.47 ± 2.78 (22 to 30)
Post Op 14th week	16 ± 3.28 (10 to 20)
Complication	
Weakness	3 (10%)
No	27 (90%)
Diagnosis	
IVDP (L3L4)	5 (16.67%)
IVDP (L4L5)	24 (80%)
IVDP (L5S1)	12 (40.00%)
Level of surgery	
MLD (micro lumbar discectomy) (L4L5)	28 (93.33%)
MLD (micro lumbar discectomy) (L5S1)	12 (40.00%)
MLD (micro lumbar discectomy) (L3L4)	5 (16.67%)

Among the study population, ODI median is 72 (IQR 70, 80.5) preoperative, it is 44 (IQR 40, 50.5) postoperative 6th week, it is 28 (IQR 26, 30) postoperative 10th week and it is 16 (IQR 14, 20) postoperative 14th week. The difference in between pre- and postoperative ODI is statistically significant (P Value <0.001) (Table 4).

Table 4: Comparison of pre-op ODI with postoperative ODI at different time periods (N=30)

Time periods	ODI Median (IQR)	(Wilcoxon signed rank) P value
PRE-OP (Baseline)	72 (70,80.5)	
POST OP 6 week	44 (40,50.5)	<0.001
POST OP 10 week	28 (26,30)	<0.001
POST OP14 week	16 (14,20)	<0.001

Discussion

The present study conducted on patients with lumbar disc herniation shows that micro lumbar discectomy resulted in minimal blood loss and less hospital stay with a good functional outcome, leading to early return to work. A total of 30 subjects are included in the final analysis, with a mean age of 41.73 years. Our study has predominantly female population with 60.00% females and 40.00% male. Contrary to our study, Aziz *et al*. had a predominantly male population at 69.20% with 30.80% being female [7]. The mean age of patients in the microdiscectomy group was 44.8 years in Kovacevic *et al*.'s study group [20] which is almost similar to our study group, but the male to female ratio is different from our study with 60.70% male and 30.30% female population. The mean duration of low back pain is 10.13 months in our study group, with 36.67% having left-sided radiculopathy, 26.67% having right-sided radiculopathy and 36.67% with bilateral radiculopathy. Majority of them have paracentral herniation with 93.33%, and a minor 6.67% have foraminal herniation. The average period of symptom before surgery was 13.8 months (range 2 to 12 months) in Shrestha *et al*.'s study [21].

The most common level of disc herniation is at L4/L5 with 80% of the participants having intervertebral disc prolapse at L4/L5 in our study group whereas the most common level of disc herniation was at the level of L5/S1 lumbar vertebrae in Kovacevic *et al*.'s study group [20] Similar to our study, in Aziz *et al*.' s [7] and Shrestha *et al*' s [21] study groups, the majority had herniation at L4/L5 level.

On MRI finding, majority with 60.00% of the participants are found to have disc extrusion, 33.33% participants have disc protrusion and 6.67% participants have sequestration. Shrestha *et al*' s [21] study group had 40.90% with extrusion, 22.72% with protrusion and 7.95% with sequestration. The mean duration of surgery is 1.28 hours (ranged between 0 to 2.35), the mean blood loss is 153.33 mL (ranged between 75 to 300), and the mean duration of hospital stay is 3.17 days (ranged between 2 to 5). Majority with 40% of the participants had one-day hospital stay and 24.14% had two-day hospital stay. Average duration of surgery was 75 min with a range of 45-100 min, average blood loss was 200 mL with a range of 70 ml – 350 ml in Aziz *et al*.'s [7] study. The mean duration of hospital stay was 6.7±3.1 (range: 4-11) days in Kovacevic *et al*.'s study with 68.7% having duration of surgery less than one hour and 31.3% had greater than one-hour duration of surgery [20].

The Oswestry Disability Questionnaire, which evaluates the social and physical restrictions caused by low back pain, has decreased drastically showing good improvement postoperatively. The mean ODI preoperative which is 73.67 ± 7.54 has gone down to 16 ± 3.28 (10 to 20) at 14-week follow up. As per the ODI scoring system, scores from 0% to 20% indicate a minimal disability. Thus our study shows excellent result with patients scoring less than 20% just at 14-week follow-up. This outcome is comparable to the results obtained by Kovacevic *et al*., where the mean preoperative ODI was 55.1±19.13 which reduced to 22.4±16.14 at 3-month follow up [20]. In Shrestha *et al*.'s study preoperative ODI was less to start with at 37.87±8.76 which went down to 7.78±7.7 at follow up [21]. K Vishwanathan *et al.* noted from their study that the mean preoperative ODI which was 51.9+15.02 went down to 20.9+20.32 postoperatively at 6- to 12-week follow-up, which is in accordance with our study results [22].

The mean ODI score was 52.8±13.1 preoperatively in Jaiswal *et al*.'s study followed by 26.5±4.2 in the postoperative period, and 17.9±4.2 and 11.4±3.9 at the 1- and 6-month follow-ups, respectively [23]. In Hegde *et al.*'s study it was noted that the modified ODI scores preoperatively had a mean of 75 ± 11.85% which improved to 55 ± 9.18% at 6 weeks, 45 ± 9.37% at 12 weeks, and 36 ± 8.65% at 24 weeks [24], which was comparatively slow reduction compared to our study. The functional outcome also depends on various factors such as degree of herniation, adherence to outpatient surgery protocol, competent surgical/anesthetic team.

According to the criteria for minimal significant change, decrease in ODI score by ten was considered a successful outcome [21]. These results suggest that microscopic lumbar discectomy is a safe and reliable method for treating patients with lumbar disc prolapse. As it requires lesser muscle dissection it is less traumatic to the musculature and neural elements with less operative complications as blood loss, duration of operation, tissue damage with better visualization and decompression of neural structures.

Conclusions

The Oswestry Disability Questionnaire used to measure the functional outcome of microscopic lumbar discectomy in our study shows a good incidence of improvement. Where a decrease in ODI score by 10 is considered a good improvement, a mean preoperative ODI of 73.67 ± 7.54 has gone down to 16 ± 3.28 at 14-week follow-up. Thus our study results conclude that microscopic lumbar discectomy for a herniated lumbar disc is indeed "gold standard" with minimal blood loss and less hospital stay leading to early return to work. Limitations include small sample size and relatively short-term follow-up. It is recommended to follow up for longer periods to analyze the overall functional outcome of MLD.

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