RESEARCH ARTICLE

Effect of Duration of Symptoms on the Clinical and Functional Outcomes of Lumbar Microdiscectomy: A Randomized Controlled Trial

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Objectives: The objective is to determine whether the preoperative duration of symptoms can affect the clinical and functional outcomes after microdiscectomy.

Method: This study is a single blind randomized controlled trial with level 1 evidence. From 3 January 2016 to 15 February 2017, 122 adult patients with symptomatic lumbar disc herniation were divided randomly by computer system into three groups were treated by microdiscectomy at 6 weeks, 3 months and 6 months from onset of symptoms respectively. Ninety-seven patients, age (19–47) years, 42 males and 55 females, were analyzed at the end of this study with 3 years of follow up. Primary outcome measures are Oswestry Disability Index (ODI), Roland-Morris Questionnaire (RMQ) and Visual Analogue Scale (VAS) for back pain and leg pain. Secondary outcome measures are post-operative complications, length of hospital stay and time of return to daily activities.

Results: There was significant difference in VAS for back pain among study groups ($P = 0.002$) at 2 weeks). There were significant differences in VAS for leg pain among study groups ($P < 0.001$) at 2 weeks and at 3 months ($P = 0.003$). There was significant difference in ODI among study groups at 2 weeks, 3, 6 months, 1, 2 and 3 years ($P = 0.037$ at 2 weeks and $P < 0.001$ at other periods of assessments) and we found that the mean of ODI in group 6 weeks was better than group 3 months and this was better than group 6 months in all periods of assessment. Group 6 weeks was better than group 3 months and this was better than group 6 months in postoperative improvements regarding RMQ with significant difference at 2 weeks postoperatively ($P < 0.001$) and at 3 months postoperatively ($P < 0.001$).

Conclusion: Duration of preoperative symptoms, in patients with lumbar disc herniation, can affect the clinical and functional outcomes after lumbar microdiscectomy as the shorter duration of symptoms resulted in better postoperative clinical and functional outcomes.

Key words: Duration of symptoms; Lumbar microdiscectomy; Oswestry Disability Index; Roland-Morris Questionnaire; Visual Analogue Scale

Background

Lumbar disc herniation is the most common cause of low back pain and sciatica in orthopedics and neurosurgery. The annual incidence of lumbar disc herniation is 0.1%–0.5%. It has a lifetime incidence about 1%–2%. Treatment of symptomatic lumbar disc herniation can be conservative or surgical treatment. Surgical treatment can be through open discectomy or minimal invasive procedures which be microscopic or endoscopic procedures. Mixter and Barr were first inventors of surgical treatment for symptomatic lumbar disc herniation through open laminectomy and discectomy in 1934. Open discectomy for symptomatic lumbar disc

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herniation can achieve excellent nerve root decompression with disadvantage of excessive tissue damage which open the way for minimal invasive procedures to get nerve root decompression with less tissue damage. The surgical microscope was introduced in spinal surgery By Yasargil and Caspar in the late of 1960s. Recently, microscopic lumbar discectomy is a widely used surgical procedure for symptomatic lumbar disc herniation when conservative management failed. Many studies concluded that microdiscectomy is now the standard surgical procedure for symptomatic lumbar disc herniation with good to excellent outcomes. Minimal invasive surgery using microscope for lumbar disc herniation should give the same goals of open procedures regarding neural decompression with advantages of minimal tissue damage and early patient's recovery[1–7].

There are many factors can affect the clinical and functional outcomes after lumbar microdiscectomy such as the duration of symptoms before surgery. Although, there is no agreement among the previous studies about the certainty of the effect of preoperative duration of symptoms on patients' clinical and functional outcomes after microdiscectomy and absence of randomized controlled trial regarding this issue. Nygaard *et al.*[8] concluded that unfavorable postoperative outcomes and inability to return to works were associated with preoperative duration of leg pain for more than 8 months before surgery for lumbar disc herniation. Fisher *et al.*[9] showed in their results that duration of symptoms before surgery was inversely related with health-related quality of life after surgery for lumbar disc herniation. Ng *et al.*[10] concluded that patients with sciatica for more than 12 months had less favorable outcomes after surgery and they detected that there was no variation in the results for patients operated on in whom the duration of preoperative sciatica was less than 12 months. Omidi-Kashani *et al.*[11] concluded that more or less than 12 months duration of preoperative sciatica may not affect the surgical outcomes of simple disc herniation after discectomy. Shrestha *et al.*[12] showed in their study that preoperative duration of symptoms did not affect the post-operative patients' outcomes measured by Oswestry Disability Index (ODI). Wankhade *et al.*[13] concluded that long duration of preoperative symptoms is one of the negative predictors of functional outcomes. Pitsika *et al.*[14] showed that significant benefit and substantial functional gain were seen in patients with preoperative symptom of more than 2 years and they stress on the importance of clinical and radiological correlation on the individual basis and to offer the surgical treatment regardless of duration of sciatica.

Rushton *et al.*[15] showed, in their systematic review, that "low level evidence supports duration of leg pain preoperatively not being associated with outcome. The results of prospective observational studies can help clinicians to decide which people should receive surgery or rehabilitation. However, a limitation is that a difference in prognosis does not necessarily mean a causal link with the surgery. Therefore, when we understand the prognostic factors, we need to investigate them in a randomized controlled trial to investigate predictors of treatment response"; for this reason, the current study was made to answer such debate.

Ahmadi *et al.*[16] showed in their study that better outcomes were associated with early surgery for lumbar disc herniation. Gelalis *et al.*[17] showed no significant association between duration of preoperative symptoms and scores of Visual Analogue Scale (VAS), ODI and Roland-Morris Questionnaire (RMQ). They concluded that duration of preoperative symptoms had no impact on the clinical results with follow up of 5 years.

Basques *et al.*[18] concluded, in their cohort retrospective study, that patients with shorter duration of symptoms had significant improvement in ODI score and obtained minimum clinically important difference at a greater rate than those with longer duration of symptoms.

The purpose of our study can be itemized in three points:

1. To answer a hypothesis of "Can preoperative duration of symptoms affect the clinical and functional outcomes after microdiscectomy for those patients with symptomatic lumbar disc herniation?"
2. To make a randomized controlled trial that can answer the debate about loss of consensus, whether duration of preoperative symptoms can affect the clinical and functional outcomes after lumbar microdiscectomy or not, in previous studies as we noticed that there was no previous randomized controlled trial regarding this issue.
3. To show whether the duration of preoperative symptoms can affect intraoperative and postoperative complications of lumbar microdiscectomy as dural tear, cerebrospinal fluid leakage, hematoma, infection or recurrence of lumbar disc herniation and also to see if the duration of preoperative symptoms can affect the length of hospital stay after surgery and time of returning to daily activities.

Methods and Materials

Inclusion criteria are: (i) age between 18–50 years old; (ii) L3-L4 Symptomatic disc herniation; (iii) L4-L5 symptomatic disc herniation: (iv) L5-S1 symptomatic disc herniation; (v) extruded disc herniation: and (vi) sequestrated disc herniation.

Exclusion criteria are: (i) spondylolysis; (ii) spondyl olisthesis; (iii) spinal deformity like scoliosis; (iv) previous spinal surgery; (v) previous spinal infection; (vi) cauda equina syndrome; (vii) lumbar segmental instability on dynamic radiograph; translation more than three millimeter (3 mm) or change in angulation more than 10° because of need for stabilization; (viii) smoking; (ix) diabetes Mellitus; (x) disc herniation other than L3-L4, L4-L5 and L5-S1 levels; (xi) more than single level disc herniation; (xii) Bbody mass index 30 or more than 30; and (xiii) three contained disc herniation by MRI.

Participants

One hundred thirty-three patients had eligibility criteria. Eleven patients were excluded because they refused to

participate in this study. One hundred twenty-two patients entered the randomization program by computer system with allocation 1:1:1 into three groups: group 6 weeks, group 3 months and group 6 months as shown in Fig. 1. Patients were assessed by history, physical examination and imaging studies including plain radiographs of the lumbosacral spine, dynamic radiographs with lumbosacral spine in flexion and extension and MRI of lumbosacral spine. Patients were treated by conservative treatment involved change of life style, non-steroidal anti-inflammatory analgesics, pregabalin, gabapentin and physiotherapy until time of surgery according to allocated group. The time of surgery by microdiscectomy was 6 weeks from onset of symptoms in group 6 weeks and it was 3 months for group 3 months, while it was 6 months for group 6 months.

In group 6 weeks, five patients were improved by conservative treatment and three patients sustained a progressive neurological deficit that necessitate early surgical treatment so only 33 patients underwent microdiscectomy at the planned time of 6 weeks from onset of symptoms.

In group 3 months, seven patients were improved by conservative treatment and two patients sustained a progressive neurological deficit that necessitate early surgical treatment so 32 patients underwent microdiscectomy at the planned time of 3 months from onset of symptoms.

In group 6 months, four patients were improved by conservative treatment and one patient sustained a progressive neurological deficit that necessitate early surgical treatment so 45 patients underwent microdiscectomy at the planned time of 6 months from onset of symptoms.

Imaging Studies

Plain radiograph with dynamic study in flexion and extension movements were used to exclude any vertebral segmental instability in all patients as three-millimeters translation or 10° angulation was regarded as exclusion criteria to involved the patients in this study. So regarding the measures of instability by dynamic plain radiographs were similar in all three groups of this study.

MRI is the gold standard imaging modality for lumbar disc herniation which will show nerve root compression. All patients in the three groups of study had extruded or sequestrated disc herniation with nerve root compression that was corelated with clinical features. Spinal stenosis by other causes other than herniated disc was not involved in the study groups.

In considering the imaging studies, all three groups of this study had similar basic conditions and comparability.

Sample size calculation

Sample sized calculation was done by using the following formula[19]:

$$\left(N = \frac{Z^2\,\mathrm{p}\,(1-\mathrm{p})}{d^2}\right),$$

where N = sample size; Z = 1.96; P = the proportion; and d = relative precision = 0.05.

According to that formula, sample size for this study should not be less than 30 patients to be statistically acceptable, so, 97 patients have been analyzed at the end of this study and this was statistically acceptable as a sample size for current study.

Intervention

Surgical procedure of lumbar microdiscectomy was done in the following steps.

Step 1 (Anesthesia and position)

General anesthesia was used in all patients except six patients for whom spinal anesthesia was used. All patients were operated in prone position by using bolsters under chest and pelvis and padding to protect pressure areas. A prophylactic antibiotic (ceftriaxone 1gm) was given at time of induction of anesthesia.

Step 2 (Approach and exposure)

Level of operation was identified using spinal needle and C-Arm fluoroscopy on the symptomatic side. The incision was made in the midline from the spinous process of the upper vertebra to the superior margin of the spinous process of the lower vertebra at the involved level. This usually results in 25–30 mm skin incision. Fascia were incised at the midline. By using appropriate depth of Casper retractor, lamina identified and by using a high-speed drill, with microscope, we remove small part of inferior border of superior lamina to allow passing of a blunt hook under the ligamentum flavum so we can open it with a tenotomy. A Kerrison was used to remove the ligamentum flavum to expose the dura and nerve root.

Step 3 (Pathological resection)

The nerve root was retracted at its shoulder to expose the disc herniation. The herniated disc material was removed by Pituitary rongeur.

Step 4 (Closure)

Hemostasis was secured by using bipolar diathermy and surgical wound was closed in layers without drain. Adhesive dressing was used.

Post-operative care

Patients were encouraged to become mobile as early as possible. Stiches were removed after 2 weeks.

Comparison

We compared the three groups (group 6 weeks, group 3 months and 6 months) with each other to assess patients' clinical and functional outcomes after lumbar microdiscectomy as well as we assessed the intra-operative and postoperative complications, length of hospital stays postoperatively and time of return to daily activities.

Outcome

Primary outcome measures are: (i) Oswestry disability index (ODI); (ii) Roland-Morris Questionnaire (RMQ); (iii) Visual Analogue Scale (VAS) for back pain; and (iv) VAS for leg pain. All these primary outcome measures were assessed

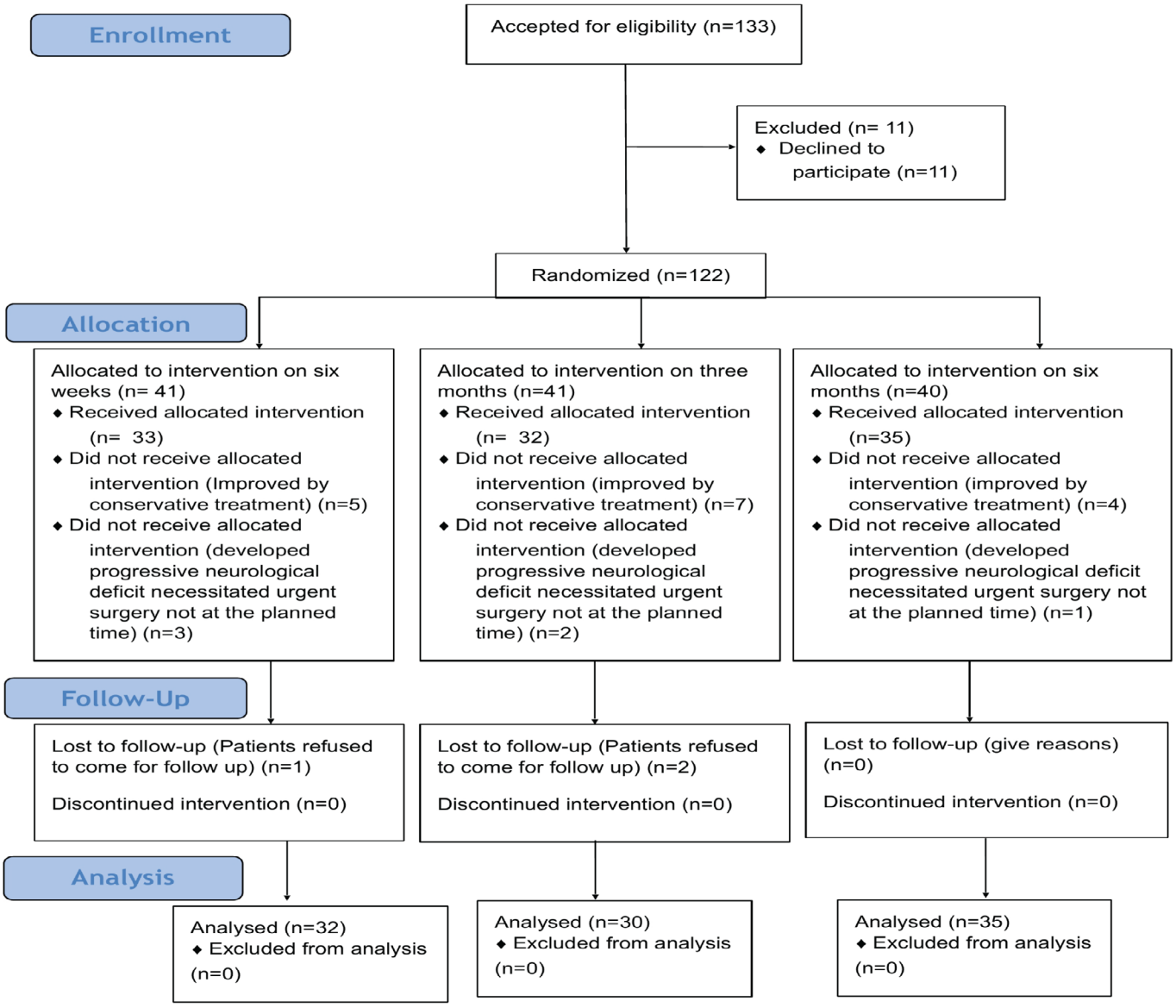

Fig. 1 Study flow chart. This diagram showed that 133 patients were assessed for eligibility criteria. Eleven patients declined to participate in the study. One hundred twenty-two patients were allocated randomly into three groups; 41 patients in group 6 weeks, 41 patients in group 3 months and 40 patients in group 6 months. Regarding group 6 weeks, 33 patients received allocated treatment by microdiscectomy, while five patients improved by conservative treatment and three patients developed progressive neurological deterioration which necessitated urgent surgery. Regarding group 3 months, 41 patients received allocated treatment by microdiscectomy, while seven patients improved by conservative treatment and 2 patients developed progressive neurological deterioration which necessitated surgery before the allocated appointment. Regarding group 6 weeks, 40 patients received allocated treatment by microdiscectomy, while four patients improved by conservative treatment and one patient developed progressive neurological deterioration which necessitated surgery before the allocated appointment. One patient in group 6 weeks and two patients in group 3 months were lost in the follow up period because of their refusal to come for follow up. Final analyses were done for 32 patients in group 6 weeks, 30 patients in group 3 months and 35 patients in group 6 months.

preoperatively and post-operatively at periods of 2 weeks, 3, 6 months, 1, 2 and 3 years.

Secondary outcome measures are: (i) intra-operative and post-operative complications like dural tear, hematoma, cerebrospinal fluid leak, infection and recurrence of disc herniation within 3 years of follow up; (ii) length of hospital stay; and (iii) return to daily activities.

Study Design

A randomized controlled trial was performed in tertiary spine center by a team of two spine surgeons (orthopedic and neurosurgeon) from 3 January, 2016 until 15 February, 2017 with follow up of 3 years till 20 February, 2020. This study was a single blind as the doctor, who assesses the patients for study outcomes pre and post-operatively, was blind to which group was the patients were belonged.

Oswestry Disability Index (ODI)

This score is considered as the gold standard of low back functional outcome tools. Its clinical importance comes in the fact that this score has been designed to give us information as to how the back or leg pain is affecting the ability to manage in everyday life. The ODI score questionnaire consists of 10 sections: (i) pain intensity; (ii) personal care like washing and dressing; (iii) lifting; (iv) walking, (v) sitting; (vi) standing; (vii) sleeping; (viii) sex life (if applicable); (ix) social life; and (x) traveling. We ask the patient to answer the questionnaire by checking one box in each of these 10 sections for the statement that clearly describes his or her problem. For each section. The total possible score is five; if the first statement is checked so the section score will be zero, while if the last statement in the section was checked so the section score will be five. If all 10 sections are completed, the score will be calculated as follows: total score measured by the patient divided by total possible score (which is 50) then multiplied by 100. If one section was missed or not applicable then the score is calculated as follows: total score measured by the patients divided by total possible score (which is 50 minus 5 if one section was missed) then multiplied by 100. Regarding interpretation ODI score, 0%–20% means minimal disability, 21%–40% means moderate disability, 41%–60% means severe disability, 61%–80% means crippled so positive intervention is required, while 81%–100% means either bed-bound or exaggerating their symptoms[20].

Roland-Morris Questionnaire (RMQ)

This score is a self-administered disability measure on a 24-point scale. It is reliable and valid outcome measure score for the level of disability associated with low back pain and sciatica. The patient's score was measured by adding the total number of statements that were marked by the patient. Regarding interpretation of RMQ score, the clinical improvement over time can be measured depending on the analysis of serial score measurements. For example, if the patient's score was 12 out of 24 before microdiscectomy and became two out of 24 after microdiscectomy, this means that the patient's improvement was 83% (this measurement was done as follows: dividing the difference between the scores by the first score then multiplying by 100 so $10/12 \times 100 = 83$)[21].

Visual Analogue Scale for Pain

This is a measuring instrument of pain intensity for back pain and leg pain in this study. This scale represents a 10-centimeter horizontal line. Its left end is zero which means no pain and its right end is 10 which means most severe pain. Between these ends, there are nine grades. The patient will choose the grade which is representing the intensity of his or her pain. By this way, we can compare between different periods of assessment of our patients and can make statistical analysis for the improvement in pain relief after microdiscectomy[22].

Dural Tear

It is a complication of spine surgery in which the dura mater that covers the spinal cord was damaged by the surgeon's instrument which can be noticed during the surgical procedure. Its significance is related to risk of nerve injury, cerebrospinal fluid leakage and meningitis[23].

Cerebrospinal Fluid Leakage

There is leakage of cerebrospinal fluid through dural tear or holes in dural mater during surgical procedure. Its significance is related to the risk of meningitis and cerebrospinal fluid fistula[23].

Hematoma

Spinal epidural hematoma is one of the most serious complications of spine surgery and its significance is related to neurological deterioration after spinal surgery and can be diagnosed by magnetic resonance imaging[24].

Infection

Postoperative spine infection can be a devastating complication after spine surgery with high risk of chronic pain, neurological complications and death. This complication can be detected by clinical features of pain, swelling and erythema of incision or wound drainage. Other methods can help in diagnosis are laboratory investigations (erythrocyte sedimentation rate, C-reactive protein and white blood cell count) and imaging studies like computerized tomography and magnetic resonance imaging[25].

Recurrent Disc Herniation

It is defined as the recurrence of herniated disc material at the same level in a patient who has undergone discectomy. It can be detected when a patient sustained a get recurrence of preoperative symptoms and magnetic resonance imaging shows recurrent disc herniating at the same previously operated level. The significance of this complication is in increased risk of reoperation whether by discectomy or fusion surgery[26].

Length of Hospital Stay

This represents the time in which the patient will remain in the hospital after the surgical procedure. We measured it in days. The significant of this outcome measure is in the increase in cost.

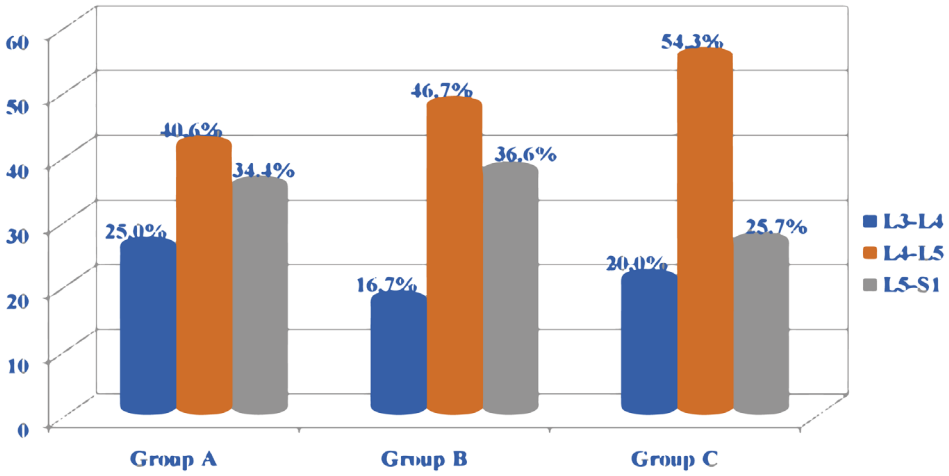

Fig. 2 The association between study's group and level of disc herniation. In all groups, L4-L5 disc herniation was the commonest type followed by L5-S1 disc herniation then L3-L4 disc herniation. In group 6 weeks, L4-5 level was 40.6%, L5-S1 level was 34.4 while L3-L4 level was 25%. In group 3 months, L4-5 level was 46.7%, L5-S1 level was 36.6 while L3-L4 level was 16.7%. In group 6 weeks, L4-5 level was 54.3%, L5-S1 level was 25.7 while L3-L4 level was 20%.

Return to Daily Activities

This represents the time needed by the patient to return to sedentary daily activities like walking and driving but without lifting heavy weights or vigorous activities. The significance of this outcome measure is to know what time the patient will be independent.

Statistical Analysis

This was carried out using statistical package for social science (SPSS) version 23 (IBM, Armonk, NY, USA). Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (means ± standard deviation). An independent sample t-test was used to compare means between two groups. Analysis of variance (ANOVA) test was used to compare means between three groups. Pearson chi-square was used to find the association between categorical variables. A probability of chance value (*P*-value) of ≤0.05 was considered as significant.

Results

Follow-up

All patients were followed up for 3 years and we had no loss of patients during this period.

General Results

In the current study, 97 patients were analyzed. The mean age of patients was (30.68 ± 7.30). The youngest was 19 years and the oldest was 47 years; males represent (43.3%) and female represent (56.7%). There was no significant difference between means of age between these three groups ($P = 0.966$). There was no significant association between gender and study groups ($X^2 = 2.271$, $P = 0.321$).

There was no significant association between study's groups and level of disc herniation. ($X^2 = 1.88$, $P = 0.756$) as shown in Fig. 2.

There was no statistically significant difference in length of hospital stay and return to daily activities among the study groups ($P = 0.302$ and $P = 0.053$ respectively). Although, group 3 months had more postoperative hospital stay and more time to return to daily activities than group 6 weeks and less than group 6 months as shown in Table 1.

Clinical Improvement

All patients in the three groups sustained a had significant clinical improvement regarding back pain and leg pain after lumbar microdiscectomy.

Visual Analogue Scale for Back Pain

There was significant difference in VAS for back pain among study groups ($P = 0.002$) at 2 weeks (means of VAS for back pain were 2.34, 2.67, 2.97 in group 6 weeks, group 3 months and group 6 months respectively), while no significant difference at 3 months of follow up until 3 year, although the means of VAS for back pain were better in group 6 weeks than group 3 months and least in group 6 months up to 1 year. However, this difference disappeared after 1 year until 3 year of follow up as shown in Table 2.

Visual Analogue Scale for Leg Pain

There were significant differences among study groups ($P < 0.001$) at 2 weeks (means of VAS for leg pain were 1.56, 1.87, 2.00 in group 6 weeks, group 3 months and group 6 months respectively) and at 3 months ($P = 0.003$, means of VAS for leg pain were 1.31, 1.63, 1.74 in group 6 weeks, group 3 months and group 6 months respectively) with better results in group 6 weeks than group 3 months and least in group 6 months. This difference remained at 6 months postoperatively but was not significant and disappeared at 1–3 years of follow up as shown in Table 3.

Functional Evaluation

All patients in the three groups improved significantly after surgery by functional outcomes measures of ODI and RMQ.

TABLE 1 The mean differences of length of hospital stay and return to daily activities among study groups. This table showed that length of hospital stay and time to return to daily activities were more in group 6 months and less in group 3 months and least in group of 6 weeks but these differences had no clinical or statistical significant as the *P*-value was 0.302 regarding length of hospital stay and *P*-value was 0.053 regarding time of return to daily activities

Study variables	Group	Number	Mean	Stander deviation	*F*-test	*P*-value
Length of hospital stay (days)	Group 6 weeks	32	0.53	0.507	1.211	0.302
	Group 3 months	30	0.60	0.498		
	Group 6 months	35	0.71	0.458		
Return to daily activity (days)	Group 6 weeks	32	2.38	0.492	3.039	0.053
	Group 3 months	30	2.47	0.507		
	Group 6 months	35	2.71	0.710		

TABLE 2 The mean differences of VAS for back pain among study groups. This showed significant difference among study groups at 2 weeks as *P*-value was 0.002 but no significant difference at 3, 6 months, 1, 2 and 3 years of follow up as *P*-values were 0.059, 0.715, 0.419, 0.556 and 0.949 respectively

			Visual analogue scale for back pain			
Time	Group	No	Mean	SD	*F*-test	*P*-value
2 weeks	Group 6 weeks	32	2.34	0.483	**6.901**	**0.002***
	Group 3 months	30	2.67	0.479		
	Group 6 months	35	2.97	0.954		
3 months	Group 6 weeks	32	1.84	0.369	2.921	0.059
	Group 3 months	30	2.00	0.371		
	Group 6 months	35	2.11	0.583		
6 months	Group 6 weeks	32	0.97	0.400	0.337	0.715
	Group 3 months	30	1.00	0.455		
	Group 6 months	35	1.06	0.482		
1 year	Group 6 weeks	32	0.63	0.492	0.878	0.419
	Group 3 months	30	0.77	0.430		
	Group 6 months	35	0.74	0.443		
2 years	Group 6 weeks	32	0.38	0.492	0.591	0.556
	Group 3 months	30	0.50	0.509		
	Group 6 months	35	0.49	0.507		
3 years	Group 6 weeks	32	0.22	0.420	0.052	0.949
	Group 3 months	30	0.23	0.430		
	Group 6 months	35	0.20	0.406		

Note: Bold values mean that they are statistically significant values. No, Number of patients in the group; SD, Standard deviation.; * Means statistically significant.

Oswestry Disability Index

There was significant difference in ODI among study groups at 2 weeks, 3, 6 months, 1, 2 and 3 years ($P = 0.037$ at 2 weeks and $P < 0.001$ at other periods of assessments) and we found that the mean of ODI in group 6 weeks was better than group 3 months and this was better than group 6 months in all periods of assessment, which means that early surgical intervention by microdiscectomy can result in better functional outcomes (Table 4).

Roland-Morris Questionnaire

Group 6 weeks was better than group 3 months and this was better than group 6 months in postoperative improvements regarding RMQ with significant difference at 2 weeks post-operatively ($P < 0.001$ and the means of improvement in RMQ were 78.68, 73.03 and 65.28 in group 6 weeks, group 3 months and group 6 months respectively) and at 3 months postoperatively ($P < 0.001$ and the means of improvement in RMQ were 86.20, 84.07 and 80.88 in group 6 weeks, 3 and 6 months respectively) and that difference among study groups disappeared at 1 year of follow up and thereafter (Table 5).

Complications

One patient, in group 6 weeks, sustained a superficial wound infection that was diagnosed clinical by redness of wound with induration at 5 days postoperatively and was treated by daily dressing and oral antibiotics for 10 days. One patient, in group 6 months, sustained a dural tear intraoperatively and was controlled by dural glue. One patient, in group 6 months, sustained a L5-S1 discitis at 2 weeks postoperatively and presented with increasing back

TABLE 3 The mean differences of VAS for leg pain among study groups. This showed significant difference among study groups at 2 weeks (*P*-value <0.001) and 3 months (*P*-value = 0.003) but no significant difference at 6 months, 1, 2 and 3 years of follow up as *P*-values were 0.7, 0.429, 0.791and 0.413 respectively

			Visual analogue scale for leg pain			
Time	Group	No	Mean	SD	*F*-test	*P*-value
2 weeks	Group 6 weeks	32	1.56	0.504	**8.993**	**<0.001***
	Group 3 months	30	1.87	0.346		
	Group 6 months	35	2.00	0.420		
3 months	Group 6 weeks	32	1.31	0.592	**6.299**	**0.003***
	Group 3 months	30	1.63	0.490		
	Group 6 months	35	1.74	0.443		
6 months	Group 6 weeks	32	0.81	0.397	0.358	0.7
	Group 3 months	30	0.83	0.379		
	Group 6 months	35	0.89	0.323		
1 year	Group 6 weeks	32	0.50	0.508	0.854	0.429
	Group 3 months	30	0.60	0.498		
	Group 6 months	35	0.66	0.482		
2 years	Group 6 weeks	32	0.38	0.492	0.235	0.791
	Group 3 months	30	0.43	0.504		
	Group 6 months	35	0.46	0.505		
3 years	Group 6 weeks	32	0.25	0.440	0.892	0.413
	Group 3 months	30	0.30	0.466		
	Group 6 months	35	0.40	0.497		

No, Number of patients in the group; SD, Standard deviation.; * Means statistically significant.

TABLE 4 The mean differences of ODI among study groups. This showed significant difference among study groups after surgery at all periods of assessment until end of follow up at 3 years as *P*-value = 0.037 at 2 weeks and *P*-value <0.001 at 3, 6 months, 1 year, 2 years and 3 months

			ODI			
Time	Group	No	Mean	SD	*F*-test	*P*-value
2 weeks	Group 6 weeks	32	17.44	1.703	**3.427**	**0.037***
	Group 3 months	30	18.53	1.655		
	Group 6 months	35	20.74	8.486		
3 months	Group 6 weeks	32	13.19	1.595	**43.73**	**<0.001***
	Group 3 months	30	15.73	1.721		
	Group 6 months	35	17.26	2.005		
6 months	Group 6 weeks	32	9.88	1.431	**51.66**	**<0.001***
	Group 3 months	30	12.60	2.111		
	Group 6 months	35	14.46	1.945		
1 year	Group 6 weeks	32	7.94	1.390	**41.83**	**<0.001***
	Group 3 months	30	9.80	1.215		
	Group 6 months	35	11.26	1.755		
2 years	Group 6 weeks	32	5.38	0.942	**66.08**	**<0.001***
	Group 3 months	30	7.33	1.422		
	Group 6 months	35	8.86	1.309		
3 years	Group 6 weeks	32	5.00	1.016	**44.43**	**<0.001***
	Group 3 months	30	6.67	1.213		
	Group 6 months	35	7.66	1.235		

No, Number of patients in the group; SD, Standard deviation.; * Means statistically significant.

pain, MRI showed findings of L5-S1 discitis and was treated, after discussion with the hospital microbiologist, by parenteral antibiotics of Ceftriaxone 1gram twice daily for 2 weeks followed by oral antibiotics (combination of Amoxycillin plus clavulanic acid) 1gram twice daily for 4 weeks.

TABLE 5 The mean differences in improvement of RMQ among study groups. This showed significant difference among study groups at 2 weeks (*P*-value < 0.001) and 3 months (*P*-value < 0.001) but no significant difference at 6 months, 1, 2, 3 years as *P*-value were 0.229, 0.320, 0.258 and 0.185 respectively

			RMQ improvement			
Time	Group	No	Mean	SD	*F*-test	*P*-value
2 weeks	Group 6 weeks	32	78.68	2.78	**31.47**	**<0.001***
	Group 3 months	30	73.03	2.61		
	Group 6 months	35	65.28	10.98		
3 months	Group 6 weeks	32	86.20	2.002	**20.36**	**<0.001***
	Group 3 months	30	84.07	2.24		
	Group 6 months	35	80.88	4.97		
6 months	Group 6 weeks	32	91.52	2.35	1.49	0.229
	Group 3 months	30	91.25	2.40		
	Group 6 months	35	90.60	1.99		
1 year	Group 6 weeks	32	96.45	2.29	1.15	0.320
	Group 3 months	30	96.82	2.50		
	Group 6 months	35	95.95	2.11		
2 years	Group 6 weeks	32	97.88	2.46	1.37	0.258
	Group 3 months	30	98.09	2.57		
	Group 6 months	35	97.11	2.57		
3 years	Group 6 weeks	32	99.41	1.58	1.71	0.185
	Group 3 months	30	98.78	2.26		
	Group 6 months	35	98.48	2.28		

No, Number of patients in the group; SD, Standard deviation.; * Means statistically significant.

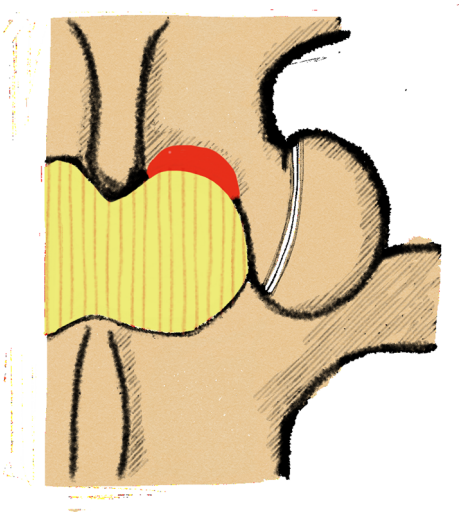

Fig. 3 Hand sketch of anatomical site for lumbar microdiscectomy. This showed the upper and lower laminae as well as the spinous process and ligamentum flavum. The red color in the upper lamina represents the site of using high speed drill to make space for the entry of our hook under the ligamentum flavum (deep yellow color) to open it.

Illustrative Diagrams

The surgical technique of lumbar microdiscectomy can be illustrated as in Figs 3 and 4. Figure 3 shows the anatomy of the vertebral lamina and ligamentum flavum and the site in the lamina where the high-speed drill used to make the hole to introduce the hook and passing underneath the ligamentum flavum in order to open it and exposing the nerve root and herniated disc. Figure 4 shows the disc herniation in relation to the nerve root so by retracting the nerve root, we can remove the herniated disc materials.

Typical Cases

Case 1: patient had right side L4-L5 disc herniation as shown in MRI Fig. 5 with compression of right L4 nerve root. Intraoperative findings were shown in Fig. 6A–F. Case 2: patient had right side L5-S1 disc herniation as shown in MRI Fig. 7 with compression of right L5 nerve root. Intraoperative findings were shown in Fig. 8A–D. Case 3: patient had left side L4-L5 disc herniation as shown in MRI Fig. 9 with compression of left L5 nerve root. Intraoperative findings were shown in Fig. 10A–E.

Discussion

Effect of Duration of Preoperative Symptoms on Oswestry Disability Index

In our study, there were significant differences in ODI among study groups at 2 weeks ($P = 0.037$), 3 months ($P < 0.001$), 6 months ($P < 0.001$), 1 year ($P < 0.001$), 2 years ($P < 0.001$) and 3 years ($P < 0.001$). The results were better in the sequence of group 6 weeks, group 3 months then group 6 months.

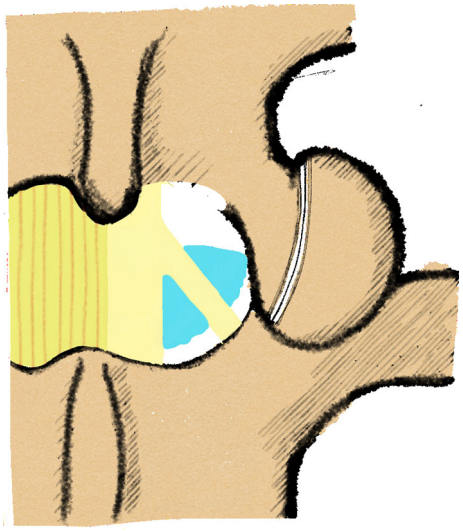

Fig. 4 Hand sketch of pathological lesion in disc herniation. This showed the herniated disc (blue color) that compressing the nerve root (light yellow color) on the left side.

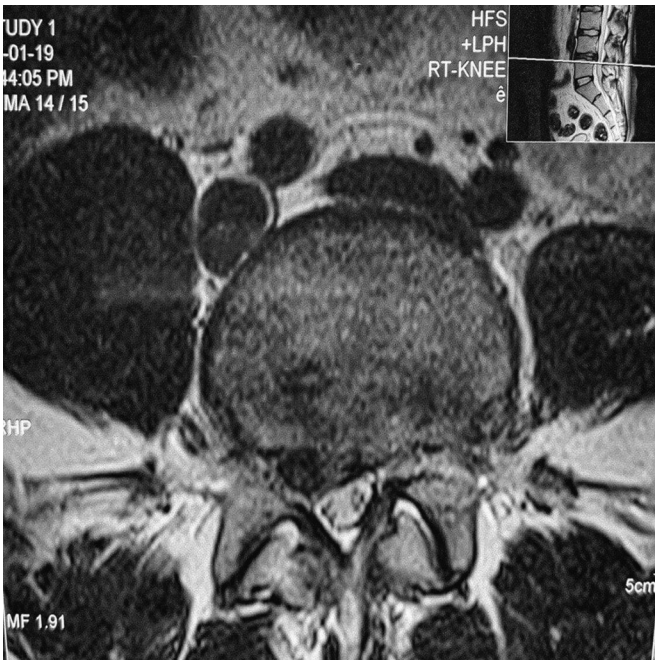

Fig. 5 Pre-operative MRI axial section of case 1 showed L4-5 disc herniation. This showed the herniated disc material with compression of the nerve root on the right side of L4-L5 level.

Effect of Duration of Preoperative Symptoms on Roland-Morris Questionnaire

In our study, there were significant difference among study groups at 2 weeks ($P < 0.001$) and 3 months ($P < 0.001$) with better results in the sequence of group 6 weeks, group 3 months then group 6 months. This difference among study groups continued till first year postoperatively, although statistically this was not significant, while disappeared after 1 year postoperatively.

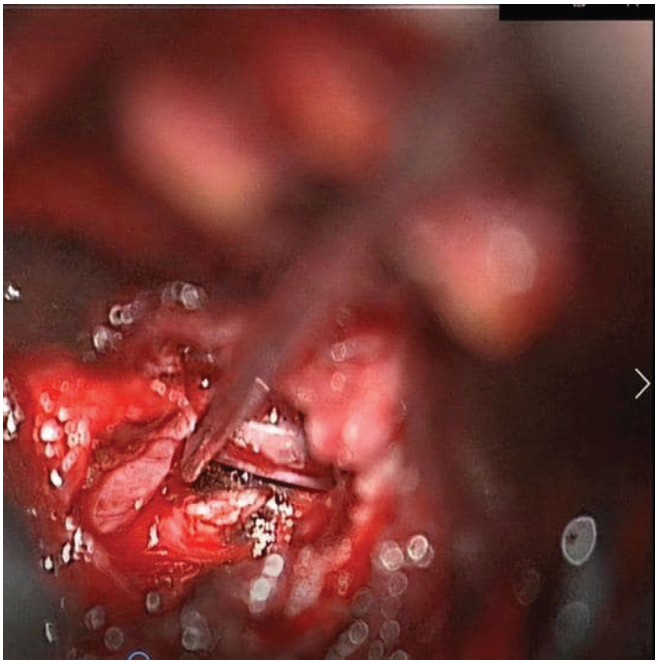

Fig. 6 Intraoperative finding of retracting the L 4 nerve root to expose the herniated dis material that compressing the nerve root in case 1 who had right side disc herniation L4-L5.

Effect of Duration of Preoperative Symptoms on Visual Analogue Scale for Back Pain

In our study, there was significant difference in VAS for back pain among study groups ($P = 0.002$) at 2 weeks, while no significant difference at 3 months of follow up until 3 year, although the means of VAS for back pain were better in sequence of group 6 weeks, group 3 months then group 6 months up to 1 year. However, this difference disappears after 1 year until 3 years of follow up.

Effect of Duration of Preoperative Symptoms on Visual Analogue Scale for Leg Pain

In our study, there were significant difference among study groups in VAS for leg pain at 2 weeks ($P < 0.001$) and at 3 months ($P = 0.003$) with better results in sequence of group 6 weeks, group 3 months then group 6 months. This difference remained at 6 months postoperatively but was not significant and disappeared at 1–3 years of follow up.

Regarding Secondary Outcome Measures

One patient, in group 6 weeks, sustained a superficial wound infection and was treated by daily dressing and oral antibiotics for 10 days. One patient, in group 6 months, sustained a dural

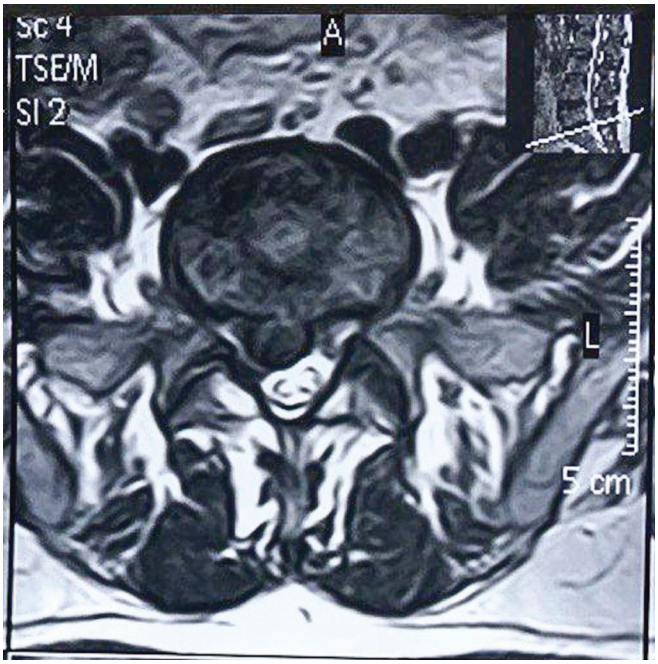

Fig. 7 Pre-operative MRI axial section of case 2 showed L5-S1 disc herniation with compression of L5 nerve root on right side.

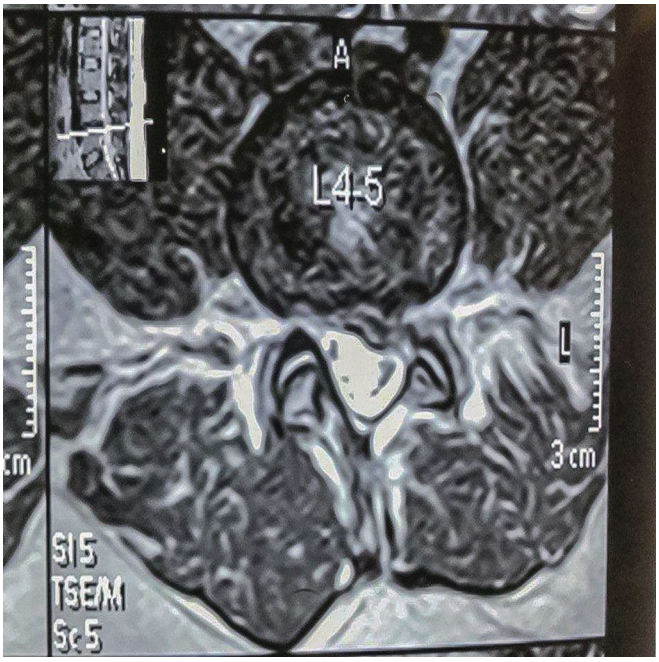

Fig. 9 Pre-operative MRI axial section of case 3 showed L4-L5 disc herniation with compression of L4 nerve on the left side.

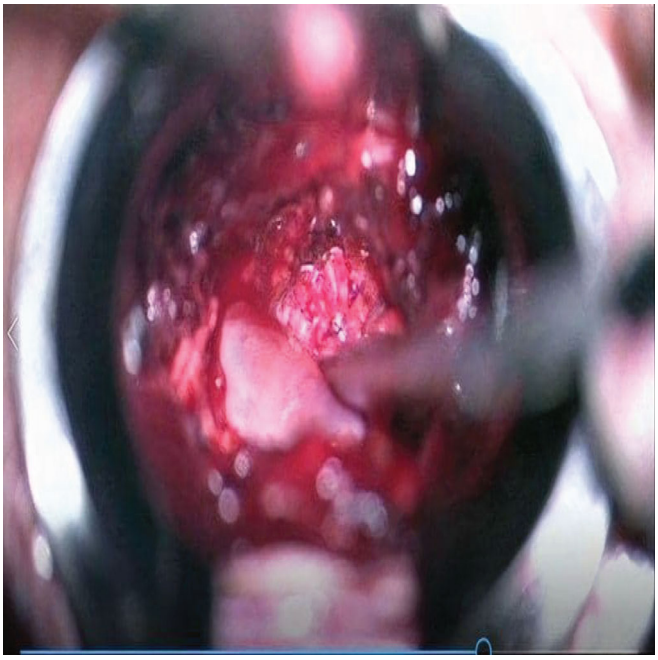

Fig. 8 Intraoperative finding of exposure herniated disc after L5 nerve root retraction in case 2 who had right side disc herniation L5-S1.

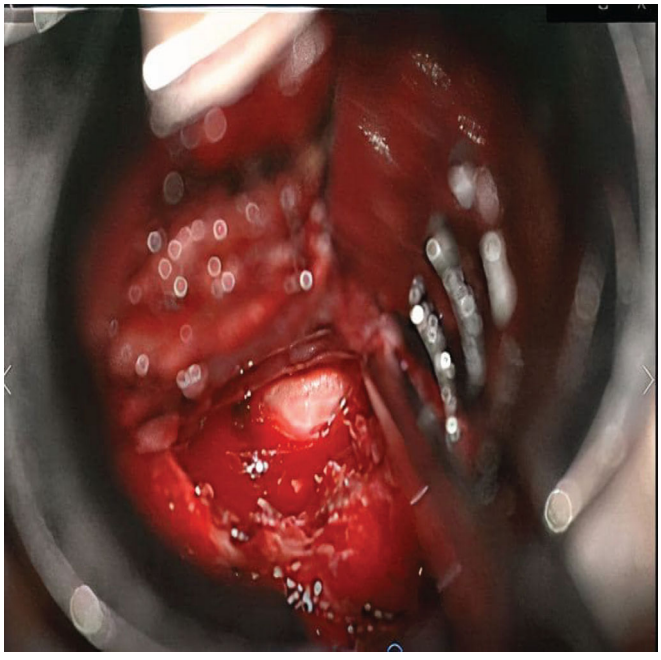

Fig. 10 Intraoperative finding of L4 nerve root retraction to expose the herniated disc material in case 3 who had left side disc herniation L4-L5.

tear and was controlled by dural glue. One patient, in group 6 months, sustained an L5-S1 discitis and was treated by parenteral antibiotics for 2 weeks and oral antibiotics for 4 weeks.

There was no statistically significant difference in length of hospital stay and return to daily activities among the study groups. Although, shorter hospital stays and quicker return to

daily activities were seen in sequence of group 6 weeks, group 3 months then group 6 months.

Comparison with Other Studies

The current study showed better clinical and functional outcomes with early surgical intervention by microdiscectomy as reported by the studies of Nygaard *et al*., Fisher *et al*., Ng *et al*., Omidi-kashani et al, Wankhade *et al*., Pitsika *et al*., Ahmadi *et al*. and Basques *et al*.[8–11,13,14,16,18] while the study by Shrestha *et al*.[12] showed no significant correlation between duration of symptoms and ODI. Gelalis *et al*.[17] showed no impact of duration of symptoms on clinical outcomes. Regarding previous studies, none of them was randomized controlled trial and this point makes the importance of current study.

Limitation of the Study

This study did not consider preoperative duration of symptoms after 6 months from onset, so our recommendation to make another randomized controlled trial with preoperative duration of symptoms more than 6 months.

Conclusion

Preoperative duration of symptoms in patients with lumbar disc herniation can affect the clinical and functional outcomes after microdiscectomy. The shorter the duration of symptoms, the better postoperative outcomes are. This effect of duration of symptoms on postoperative outcomes is more significant in early postoperative period.

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Disclosure Statement

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Authorship Declaration

All authors met the criteria of authorship and all in agreement with this manuscript.

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