# Open discectomy versus microscopic discectomy for lumbar disc herniation

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# Abstract

Background Discectomy for symptomatic lumbar disc herniation is the most common surgical procedure in spine surgery. Lumbar discectomy can be done by traditional open method or by varieties of minimal invasive techniques mainly microscopic or endoscopic procedures. This study evaluates the effectiveness of microdiscectomy compared with open discectomy in the treatment of lumbar disc herniation as a relation to the relief of leg pain, post-operative back pain, postoperative hospital stay and returns to daily activity.

Methods Sixty patients were included in this study, 30 patients underwent an open discectomy and 30 patients underwent microdiscectomy. Those patients were followed up for 12 months after surgery. Each patient was evaluated for the postoperative back pain, leg pain, duration of hospital stay postoperatively and return to sedentary daily activity. The methods used to evaluate each patient are Visual analogue scale for back pain and leg pain and Oswestry disability index.

Results Results showed that there is a significant difference in the postoperative back pain, duration of postoperative hospital stay and the time of return to sedentary daily activities between open discectomy and microdiscectomy with superiority for microdiscectomy while there is no significant difference in the relieving leg pain between the open discectomy and microdiscectomy.

Conclusion Microdisctomy is effective as open discectomy in the aspect of relieving the leg pain with the advantage of less postoperative back pain, less postoperative hospital stay and early return to sedentary daily activities.


# Background

Low back pain is one of the most common problems in orthopedics and neurosurgery and one of the important causes of low back pain is lumbar disc herniation which can be presented with low back pain, leg pain (radicular pain) or both. Treatment of lumbar disc herniation varies from conservative treatment, with different modalities, to surgical treatment which involved several surgical procedures starting from most invasive techniques to minimal invasive techniques.[1–7]

Minimal invasive techniques for lumbar disc herniation should give the same galls of standard techniques but with minimal soft tissue damage, less blood loss and early recovery of the patient. These minimal invasive techniques for surgical treatment of lumbar disc herniation involved using Microscope or endoscopy with many modifications aiming to minimize soft tissue damage and improve the early patient recovery with optimum results.

There are several studies compared between the different modalities of surgical treatment of lumbar disc herniation with variable results [8–10].

Our study investigates the comparison between two surgical techniques for treatment of lumbar disc herniation one of them is traditional laminectomy and discectomy and the second one is microscopic discectomy.

# Methods

## Study design and patients

This study was a single center, prospective, randomized comparative controlled trial. This study was done in Erbil Teaching Hospital and PAR private hospital (Kurdistan, Iraq) by a Neurosurgeon and orthopaedic surgeon from March 2015 until October 2016. Sixty patients are involved in this study. All subjects who fulfilled the inclusion criteria were randomly divided into two groups; Thirty patients were randomly allocated to each group. Group A: 30 patients were treated with conventional fenestration laminectomy and discectomy and Group B: 30 patients were treated with microdiscectomy.

All the patient was suffering from symptomatic lumbar disc herniation L4-5. Each patient was assessed clinically and MRI was done for all the patients to prove clinically, the symptomatic lumbar disc herniation which was present in all patients. Conservative treatment for 6 weeks was failed in all the patient selected for this study.

Exclusion criteria included smoking, previous lumbar spine surgery, Diabetes Mellitus (DM), neuromuscular disorders and motor neurological deficit.

The selection of patients into 2 groups was done randomly by odd and even numbers.

All patients were assessed preoperatively and postoperatively by two methods; Visual Analog Scale (VAS) for back pain and leg pain and Oswestry Disability Index (ODI). Those patients were followed for 1 month, 6 months and 12 months after surgery. Other parameters of follow up are length of hospital stay and time to return for daily sedentary activities.

## Surgical technique

Group A: In open discectomy, under general anesthesia or spinal anesthesia with prone position, the level of L4-L5 was determined with a needle marker and fluoroscopy, midline incision done 5 cm, the deep facia incised and the paraspinal muscles on the symptomatic side was separated to expose the lamina, fenestration was done in the lamina and removal of ligaments flavor done to decompress the nerve root and by using nerve retractor the herniated disc identified and excised in case of sequestered herniation or in case of contained herniation by a tenotome small oblique opening done and by pituitary ronjour the herniated part of the disc was removed. Hemostasis was secured and the incision was closed in layers without drain.

Group B: In a minimally invasive lumbar microdiscectomies, under general or spinal anesthesia the operating level was first identified by a needle marker and C- arm imaging. A midline skin incision of 1.5 cm was done. The deep fascia was incised and the paraspinal muscles were retracted on the symptomatic side using Casper reactor to expose the lamia of L4 then with a diamond drill small hole done in the lower part of L4 lamina then with a hook passing under the ligamantum flavum which was incised by a tenotome over the hook then by a karyson part of ligament flavum was removed to expose the nerve root and by nerve root retractor the herniated disc was exposed and removed with a ronjour. Hemostasis was secured by bipolar electrocautery and incision closed in layers without drain.

Postoperative care: early mobilization was done as pain allowed and stitches are removed 2 weeks after surgery.

### Data Analysis

Statistical analysis was carried out using SPSS version 21 (SPSS, IBM Company, Chicago, USA). Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). Student t-test was used to compare means between two groups. Paired t-test was used to compare means for paired reading. Pearson's chi square ($X^2$) was used to find the association between categorical variables. A *p*-value of $\leq 0.05$ was considered as significant.

## Results

Table-1 shows the distribution of patients according to socio-demographic characteristics including (age and gender).

Table 1
The Distribution of patients according to socio-demographic characteristics

| **Socio-demographic variables** | | |
|---|---|---|
| Age (years) | (41.35 ± 6.50) | (29.0–50.0) |
| Gender<br>Male<br>Female<br>Total | 22<br>38<br>60 | 36.7%<br>63.3%<br>100.0% |

Table-2 shows the mean differences of age between study groups including (group A and group B). There were no significant differences between means of age between these two groups.

Table 2

The mean differences of age between study groups

| Study variables | Study groups | N | Mean | SD | t-test | P-value |
|---|---|---|---|---|---|---|
| Age (years) | Group A | 30 | 41.26 | 6.45 | -0.098 | 0.922 |
| | Group B | 30 | 41.43 | 6.66 | | |

Table-3 shows the association between gender and study group including (group A and Group B). There was no significant association between gender and study group.

Table 3

The association between gender and study group

| Study variables | Study group | | $\chi^2$ | P-value |
|---|---|---|---|---|
| | Group A | Group B | | |
| Gender | 11 (36.7) | 11 (36.7) | 0.000 | 1.000 |
| Male | 19 (63.3) | 19 (63.3) | | |
| Female | 30 (100.0) | 30 (100.0) | | |
| Total | | | | |
| *p value ≤ 0.05 was significant. | | | | |

Figure-1 shows the mean differences of post-operative VAS for back pain between study groups including (group A and group B) in four periods of assessments. There were significant differences between means of post-operative VAS for back pain between these two groups after one weeks (t = 13.28, P = < 0.001*) and after 3 months (t = 10.54, P = < 0.001*), while non-significant differences between two groups after six months of operation (t = 0.00, P = 1.000) and twelve months (t=-1.523.00, P = 0.134).

Figure-2 shows the mean differences of post-operative VAS for leg pain between study groups including (group A and Group B) in four periods of assessments. There were no significant differences between means of post-operative VAS for leg pain between these two groups after one weeks (t = 1.046, P = 0.3) and after 3 months (t = 0.766, P = 0.447).

Figure-3 shows the distribution of group A patients according to ODI pre-operatively and 1 week, 3 months, 6 months, and twelve months postoperatively.

Figure-4 shows the distribution of group B patients according to ODI pre-operatively and 1 week, 3 months, 6 months, and twelve months, postoperatively.

Table-4 shows the mean differences of length of hospital stay and time of returning to sedentary daily activity between study groups including (group A and group B). There were significant differences between means of length of hospital stay and time of returning to sedentary daily activity between these two groups after one weeks.

Table 4
The mean differences of length of hospital stay and time of returning to sedentary daily activity between study groups

| Study variables | Study group | N | Mean | SD | t-test | P-value |
|---|---|---|---|---|---|---|
| Length of hospital stay (days) | Group A | 30 | 2.00 | 0.00 | 20.149 | < 0.001 |
| | Group B | 30 | 1.06 | 0.25 | | |
| Time of returning to sedentary daily activity (days) | Group A | 30 | 7.33 | 0.84 | 14.73 | < 0.001 |
| | Group B | 30 | 4.03 | 0.88 | | |

Table-5 shows the mean differences of VAS for back pain pre-operative and post-operative assessments in four time periods (after 1 weeks, 3 months, 6 months and 12 months) for group A patients. There were significant differences between means of VAS for back pain pre-operative and post-operative assessments in four time periods.

Table 5
The mean differences of (VAS for back pain) between pre-operative and post-operative assessments in four time periods

| Study variables | Periods of assessment | N | Mean | SD | Paired t-test | P-value |
|---|---|---|---|---|---|---|
| VAS for back pain | VAS for back pain preoperatively | 30 | 7.73 | 0.78 | 25.98 | < 0.001 |
| | VAS for back pain 1 weeks postoperatively | 30 | 3.70 | 0.46 | | |
| | VAS for back pain preoperatively | 30 | 7.73 | 0.78 | 47.29 | < 0.001 |
| | VAS for back pain 3 months postoperatively | 30 | 1.73 | 0.44 | | |
| | VAS for back pain preoperatively | 30 | 7.73 | 0.78 | 65.23 | < 0.001 |
| | VAS for back pain 6 months postoperatively | 30 | 0.23 | 0.43 | | |
| | VAS for back pain preoperatively | 30 | 7.73 | 0.78 | 59.04 | < 0.001 |
| | VAS for back pain 12 months postoperatively | 30 | 0.06 | 0.25 | | |

Table-6 shows the mean differences of VAS for back pain between pre-operative and post-operative assessments in four time periods (after 1 weeks, 3 months, 6 months, and 12 months) for group B patients. There were significant differences between means of VAS for back pain pre-operative and post-operative assessments in four time periods.

Table 6
The mean differences of (VAS for back pain) between pre-operative and post-operative assessments in four time periods

| Study variables | Periods of assessment | N | Mean | SD | Paired t-test | P-value |
|---|---|---|---|---|---|---|
| VAS for back pain | VAS for back pain preoperatively | 30 | 7.66 | 0.75 | 33.28 | < 0.001 |
| | VAS for back pain 1 weeks postoperatively | 30 | 2.20 | 0.40 | | |
| | VAS for back pain preoperatively | 30 | 7.66 | 0.75 | 44.13 | < 0.001 |
| | VAS for back pain 3 months postoperatively | 30 | 0.43 | 0.50 | | |
| | VAS for back pain preoperatively | 30 | 7.66 | 0.75 | 49.82 | < 0.001 |
| | VAS for back pain 6 months postoperatively | 30 | 0.23 | 0.43 | | |
| | VAS for back pain preoperatively | 30 | 7.66 | 0.75 | 49.91 | < 0.001 |
| | VAS for back pain 12 months postoperatively | 30 | 0.20 | 0.40 | | |

Table-7 shows the mean differences of VAS for leg pain pre-operative and post-operative assessments in four time periods (after 1 weeks, 3 months, 6 months, and 12 months) for group A patients. There were significant differences between means of VAS for leg pain pre-operative and post-operative assessments in four time periods.

Table 7

The mean differences of (VAS for leg pain) between pre-operative and post-operative assessments in four time periods

| Study variables | Periods of assessment | N | Mean | SD | Paired t-test | P-value |
|---|---|---|---|---|---|---|
| VAS for back pain | VAS for back pain preoperatively | 30 | 9.63 | 0.49 | 63.99 | < 0.001 |
| | VAS for back pain 1 weeks postoperatively | 30 | 1.46 | 0.50 | | |
| | VAS for back pain preoperatively | 30 | 9.63 | 0.49 | 85.13 | < 0.001 |
| | VAS for back pain 3 months postoperatively | 30 | 0.56 | 0.50 | | |
| | VAS for back pain preoperatively | 30 | 9.63 | 0.49 | 107.65 | < 0.001 |
| | VAS for back pain 6 months postoperatively | 30 | 0.00 | 0.000 | | |
| | VAS for back pain preoperatively | 30 | 9.63 | 0.49 | 107.65 | < 0.001 |
| | VAS for back pain 12 months postoperatively | 30 | 0.00 | 0.000 | | |

Table-8 shows the mean differences of VAS for leg pain between pre-operative and post-operative assessments in four time periods (after 1 weeks, 3 months, 6 months, and 12 months) for group B patients. There were significant differences between means of VAS for back pain pre-operative and post-operative assessments in four time periods.

Table 8

The mean differences of (VAS for leg pain) between pre-operative and post-operative assessments in four time periods

| Study variables | Periods of assessment | N | Mean | SD | Paired t-test | P-value |
|---|---|---|---|---|---|---|
| VAS for back pain | VAS for back pain preoperatively | 30 | 9.53 | 0.50 | 67.60 | < 0.001 |
| | VAS for back pain 1 weeks postoperatively | 30 | 1.33 | 0.47 | | |
| | VAS for back pain preoperatively | 30 | 9.53 | 0.50 | 67.13 | < 0.001 |
| | VAS for back pain 3 months postoperatively | 30 | 0.46 | 0.50 | | |
| | VAS for back pain preoperatively | 30 | 9.53 | 0.50 | 102.90 | < 0.001 |
| | VAS for back pain 6 months postoperatively | 30 | 0.00 | 0.00 | | |
| | VAS for back pain preoperatively | 30 | 9.53 | 0.50 | 102.90 | < 0.001 |
| | VAS for back pain 12 months postoperatively | 30 | 0.00 | 0.00 | | |

# Discussion

In this study, we found no significant difference between the two groups regarding the age and gender (Tables 1,2, and 3).

There were significant differences between means of post-operative VAS for back pain between these two groups after one weeks (t = 13.28, P = < 0.001) and after 3 months (t = 10.54, P = < 0.001), while non-significant differences between two groups after six months of operation (t = 0.00, P = 1.000) and twelve months (t=-1.523.00, P = 0.134)(Fig. 1). This can explain how Microdiscectomy is minimal invasive technique with less tissue damage than open discectomy so the back pain was less in group B in early stages due to less interference with soft and bony tissues.

There were no significant differences between means of post-operative VAS for leg pain between these two groups after one weeks (t = 1.046, P = 0.3) and after 3 months (t = 0.766, P = 0.447) and even 6 months and 12 months (Fig. 2). This will explain that both techniques (open and Microdiscectomy) are effective in decompression of the nerve root and removal the herniated disc fragments.

When we compare the ODI preoperatively and postoperatively through all periods of assessment in both groups A and B, there is significant deference which means that both methods of treatment is effective in achieving excellent functional improvement for patients with symptomatic lumbar disc herniation with no response to conservative treatment. (Figs. 3 and 4), There were significant differences between means of length of hospital stay and time of returning to sedentary daily activity between these two groups after one weeks (Table 4) with better results in group B because of minimal tissue damage in Microdiscectomy and less pain postoperatively so the patients can discharged home early and can return to daily activity sooner.

There were significant differences between means of VAS for back pain and leg pain in pre-operative and post-operative assessments in four time periods for both groups A and B (Tables 5,6,7, and 8) and these results also showed the effect of both treatment methods as standard for lumbar disc herniation.

Katayama et al. [8] concluded that there is no significant difference between the two groups (conventional and microsurgical techniques) in outcomes based on Japanese Orthopaedic Association (JOA) score and VAS for leg pain as in our study. A statistically significant difference was noted regarding VAS for back pain in the Katayama study, which also has been found in our study.

Huang et al. [9] found a smaller blood loss in the group of patients treated endoscopically when compared to those treated with the classic technique as we found in microdiscectomy, minimal soft tissue dissection and less blood loss.

Kelly et al. [10] concluded that patients undergoing microdiscectomy had less tissue trauma when compared with those who underwent the classic technique; however, no difference could be noted in the clinical response.

Acharya et al. [11] have found good results in 96.5% of patients with minimally invasive lumbar discectomy in primary cases. However, there is no control group for this study.

Findlay et al. [12] retrospectively reviewed a cohort of 88 patients and reported the outcome of microlumbar discectomy at 10 years. They reported an initial success rate of 91% which declined to 83% in 10-year follow-up.

In a controlled randomised trial, Henrikson et al. [13] concluded that there is no significant advantage in postoperative outcomes and duration of hospital stay between conventional fenestration discectomy and microlumbar discectomy. Porchet et al. [14] in an observational study have concluded that there is no difference between the two techniques when patient response outcomes were studied.

Tureyen [15] compared the outcome of single-sided, single-level, first-time lumbar disc herniation treated with and without the help of a microscope in 114 patients followed up for 1 year. They found that MLD had 90% success rate while conventional surgery had 89% success rate.

Majeed et al. [16] showed that both Minimally invasive lumbar discectomy (MLD) and fenestration give comparable results at short-term follow-up. There is a statistically significant improvement in MLD with regard to improvement in JOA, VAS and Roland-Morris (RM) scores at 2 years. However, the difference is not large and may not be clinically significant.

Righesso and colleagues [17] and Ryang et al. [18] reported the results of 2 prospective randomized trials of minimally invasive versus open microdiscectomy in patients with first-time lumbar radiculopathy caused by disc herniation. In both studies the investigators identified no differences in clinical outcome between the groups at a mean follow-up of 16 months as determined by Visual Analog Scale, Oswestry Disability Index, and Short Form- 36 score. It should be noted that a power analysis was not included in either study, and it is possible that these studies were underpowered to identify small differences between groups.

German et al.[19] concluded in their retrospective study, that patients who underwent minimally invasive discectomy were found to have similar perioperative results as those who underwent open microsurgical discectomy. The differences, although statistically significant, are of modest clinical significance.

# Conclusion

Microdisctomy is effective as open discectomy in treatment of symptomatic lumbar disc herniation with the advantage of less postoperative back pain, less postoperative hospital stay and early return to daily activities.

# Abbreviations

PAR: It is the name of the hospital where the operations were performed. It is not an abbreviation; MRI: Magnetic resonance imaging; L:Lumbar; DM: Diabetes Mellitus; VAS: Visual analogue scale; ODI: Oswestry Disability index; cm: Centimeter; MLD: Minimal invasive lumbar discectomy; RM score: Roland Morris score.

# Declarations


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## Authors’ contributions

S.A. Hamawandi was responsible for experiment design, conceptualization, supervision, data collection, and manuscript writing; I.I. Sulaiman conducted data collection, data entry, and contributed to manuscript writing. A.K. Al-Humairi made the statistical data analysis.


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No funding was received.

### Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

### Declarations

- **Ethics approval and consent to participate**

The protocol of this clinical study was reviewed and approved by the research ethics committee in Hawler Medical University. Consent to participate was obtained from all patients prior study conduction. The guarantee was given for confidentiality of their personal information.

- **Consent for publication**

This paper is approved by all authors for publication.

### Competing interests

The authors declare that they have no competing interests.

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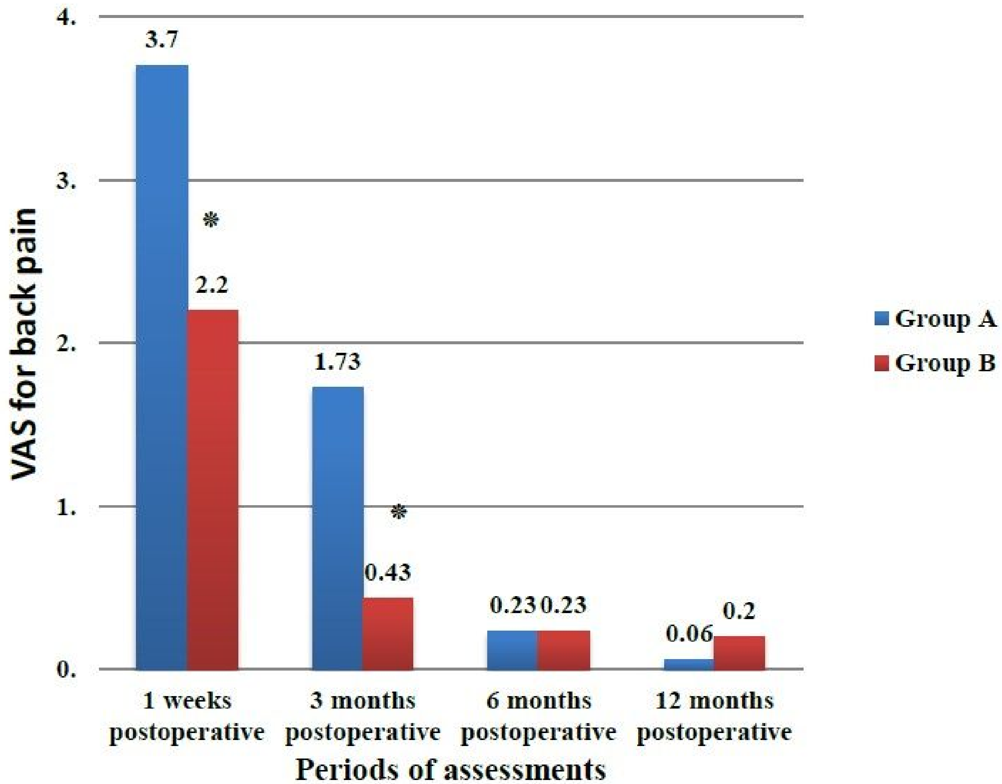
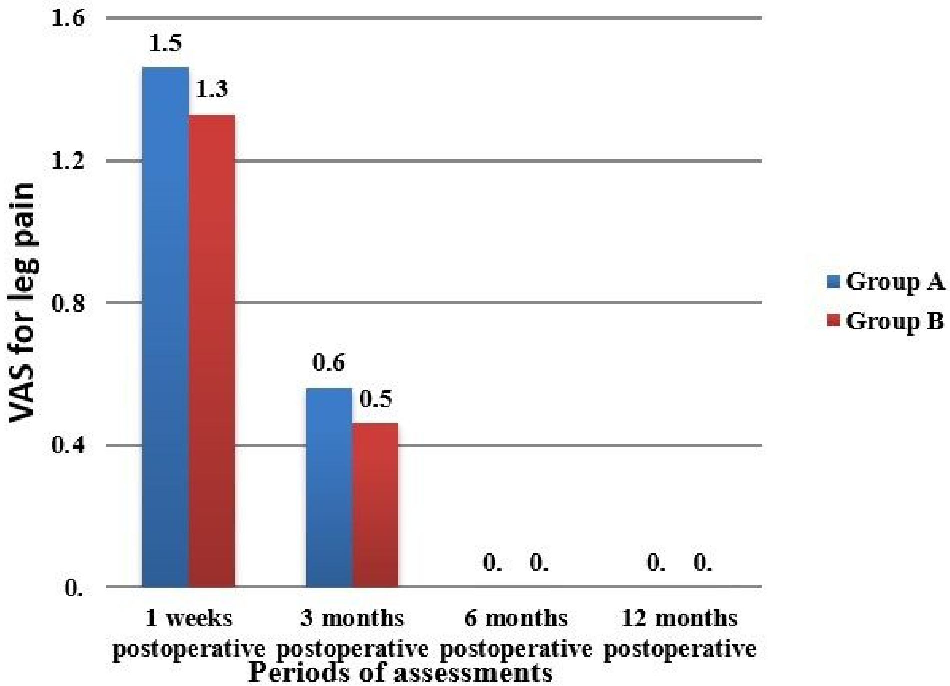
# Figures



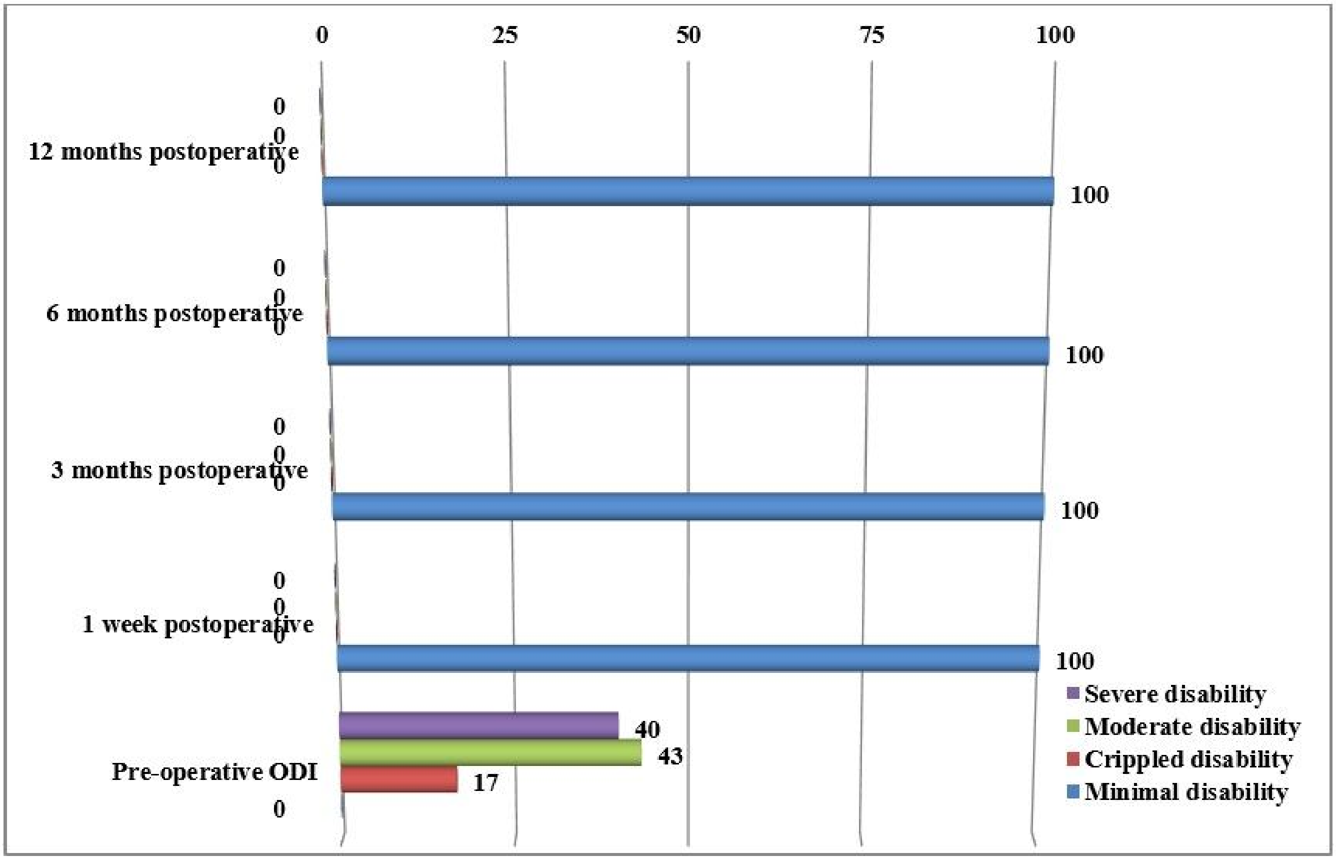

## Figure 1

The mean differences of post-operative VAS for back pain between study groups.



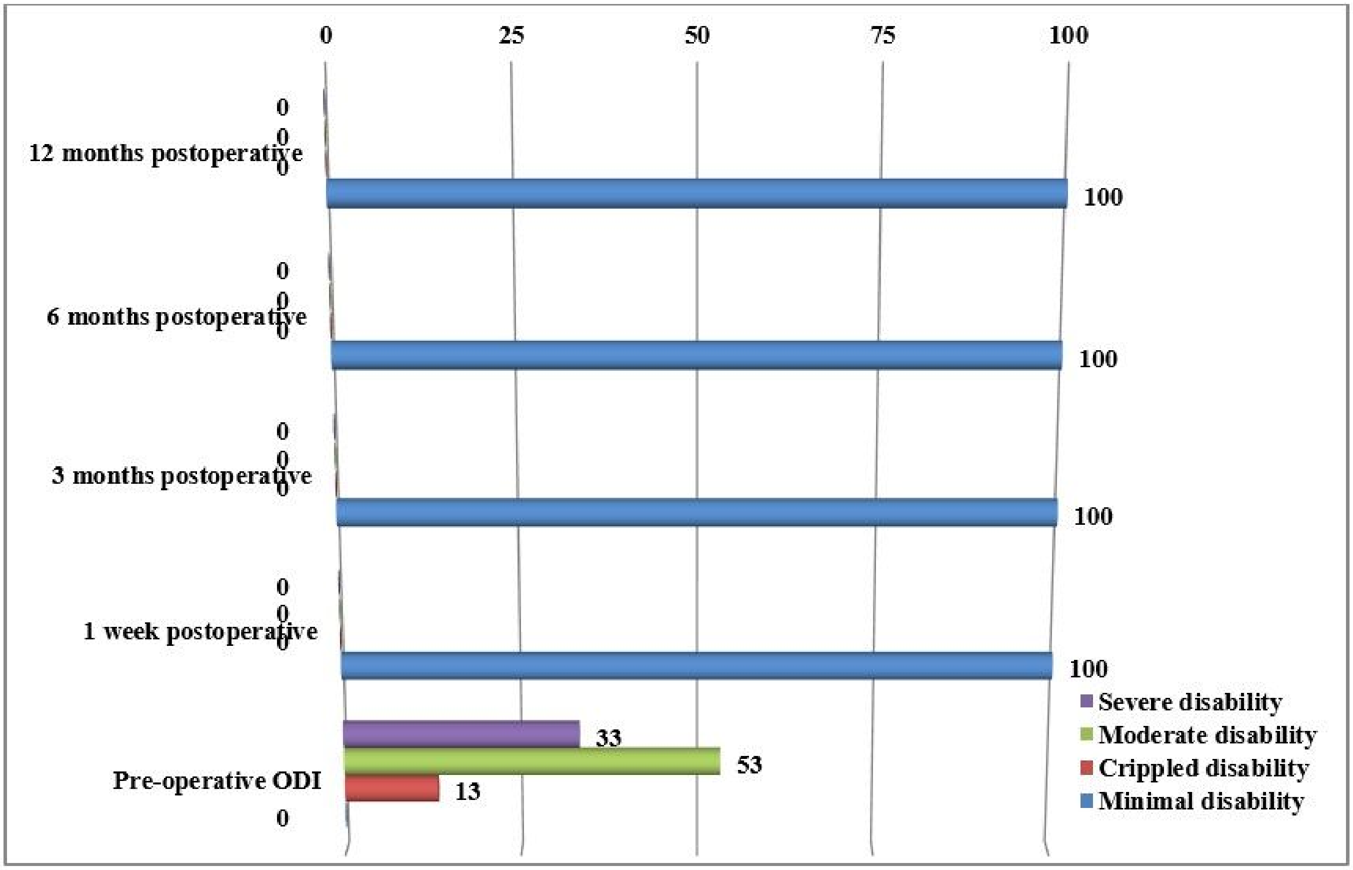

## Figure 2

The mean differences of post-operative VAS for leg pain between study groups.




## Figure 3

Distribution of group A patients according to ODI pre-operatively and 1week, 3 months, 6 months and twelve months postoperatively.




### Figure 4

Distribution of group B patients according to ODI pre-operatively and 1 week, 3 months, 6 months, and twelve months postoperatively.

# Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CompleteCONSORTchecklist.docx