

MANAGEMENT OF DISC HERNIATION AT THE LUMBAR REGION THAT IS COMPLICATED WITH SPINAL STENOSIS USING SMALL INCISION FENESTRATION

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ABSTRACT

Objectives: The objective of the current study was to compare the alternative approach of smaller incision fenestration in managing lumbar disc herniation with spinal stenosis to previous conventional laminectomy procedures.

Patients and methods: The current case-control study included a total of 290 patients who were represented by two groups. Those patients were complaining of herniation of the lumbar disc with a complication of stenosis of the lumbar segments. Patients in the study group were treated by a small incision fenestration approach, whereas patients in the control group were treated by posterior laminectomy and decompression. Those patients were selected retrospectively from the pool of patients visiting the orthopedic units of Adiwanayah Teaching Hospital, Adiwanayah province, Iraq.

Results: Mean hospital stay of patients in the study group was lower in a significant way in comparison with that of patients in the control group, 6.03 ± 2.08 days versus 8.07 ± 3.13 days, separately ($p < 0.001$). Added to that, mean operative loss was significantly lower in a group of intervention in comparison with the control group, 52.12 ± 5.17 ml versus 65.48 ± 5.08 ml, respectively ($p < 0.001$). Added to that, mean operative time was lower in a significant way in the group of intervention in comparison with patients in the group of control, 62.62 ± 3.09 minutes versus 87.09 ± 3.47 minutes, respectively ($p < 0.001$). The mean "visual analogue score (VAS)" was significantly lower in the study group in comparison with the control group, 3.09 ± 1.15 versus 6.08 ± 2.17 , respectively ($p < 0.001$). A comparison of the mean "Japanese orthopedic association (JOA) score" for nerve function between the study group and the control group is shown in Figure 2. The mean "Japanese orthopedic association (JOA) score" was higher in a significant manner in the group of an intervention study in comparison with the control group, 27.15 ± 3.07 versus 20.18 ± 4.81 , respectively ($p < 0.001$).

Conclusion: Small incision fenestration techniques are associated with significantly less hospital stay, less duration of operation, less blood loss, less visual pain score and better nerve function in comparison with conventional laminectomy procedure.

Keywords: smaller incision fenestration, lumbar disc herniation, spinal stenosis

This article may be cited as: Kadhim AA. Management Of Disc Herniation At The Lumbar Region That Is Complicated With Spinal Stenosis Using Small Incision Fenestration. J Med Sci 2024 january;32(1):76-81

INTRODUCTION

Herniation of the lumbar intervertebral disc is regarded as the leading cause of sciatica worldwide, though, acute attacks of sciatica are mostly managed by conservative measures.¹ Nevertheless, the surgical managements provide a fast relief of pain in cases where surgery is the choice.² The previous research indicated that the relief of pain, better functional restoration, and patient satisfaction were greater in patients who underwent surgical operations than the patients who were treated conser-

vatively.³⁻⁵

As the spinal cord courses in the vertebral canal posterior to the intervertebral disc and bodies of the vertebrae, the herniated disc may make compression of the spinal nerves or even cauda equina that leads to pain in the legs at its posterior aspect or even incontinence, and in severe cases, paralysis may occur.⁶ Compression of the sac of the dura and spinal cord may lead to nerve-dys-functional disease which is referred to as spinal stenosis syndrome. The patient complains of pain in the legs, weakness, and numbness after walking, these are relieved relatively by sitting or squatting, while at rest there are no symptoms.^{7,8}

Herniation of the lumbar disc associated with spinal stenosis is a commonly seen problem in clinics. The patients complain mainly of intermittent claudication during the activity of the patients. When the condition be-

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Date Received: 18/08/2023

Date Revised: 03/12/2023

Date Accepted: 04/03/2024

comes chronic, there is a pain-free period during rest.^{9, 10}

The developments in minimally invasive techniques in spine surgery via endoscopic instrumentations and other assisted tools, furthermore trained surgeons, and patient's requests lead to the increase in the prevalence of these techniques in spine surgery.¹¹ Percutaneous-transforaminal endoscopic discectomy (PTED) and micro-endoscopic discectomy (MED) are regarded as the most commonly used two procedures which have been used in the last years.

The precise information about the location and morphology of the herniated lumbar disc which is enhanced by the development of imaging procedures pre-operatively, allows the ideal approach for each case. The procedure involved fenestration or extrusion of the herniated disc through the foraminal interlaminar way with or without facet joint or lamina removal.¹²

By this approach, the stability of the vertebra is proportional to the amount of the removed bone, and to overcome these disadvantages, extrusion of the disc by direct approaches has been developed. Previous studies have described this procedure Di Lorenzo et al. and Soldner et al. used a similar technique which they described as a "translaminar approach"^{13, 14} There is a generalized agreement between these authors about the efficacy of the inter-articular or translaminar approach as being the less effect on the stability of the vertebra.

The technique is increasingly performed for the release of the compression and removing the nucleus pulposus. The posterolateral approach is the route performed by the surgeons.^{15, 16} Furthermore, it is shown that this procedure has therapeutic advantages that mimic the traditional procedures, and it is superior by other privileges like decreased loss of blood, smaller incision, less tissue trauma and fewer complications, adding to that, the short post-operative recovery periods and less financial cost.^{17, 18}

However, the widespread use of Percutaneous Endoscopic Lumbar Discectomy (PELD), with the recurrence of disc herniation as the most frequent complication, has raised some fresh concerns over postoperative complications. With a 12-year follow-up, Choi et al. evaluated 10,228 patients who had PELD and discovered that 4.3% of the procedures failed, primarily due to the recurrence of disc herniation. However, some studies showed that the most common complication seen is the recurrence of herniation, as documented by Choi et al.¹⁵

Failure of conservative management in patients makes them a candidate for surgery. Removal of the herniated disc is the aim of the operation, in order to relieve the compression on the nerve root and at the same time preserve the stability of the vertebrae. The technique is commonly done, and it is regarded as the standard oper-

ation due to its feasibility and providing a good visual field to treat herniation of lumbar disc.^{19, 20}

Despite its many benefits, percutaneous endoscopic transforaminal discectomy (PETD) frequently results in a disc herniation that returns. The recurrence rate of (PELD) in various investigations carried out at various spinal levels ranges from 0 to 7.4%. Nevertheless, fenestration discectomy is a widely used operation for the treatment of herniated lumbar disc. This technique is relatively easy and provides a good visual field, where the surgeon can visualize the ligamentum flavum and dissect it a way, at the same time the hyperplastic bone, too, as the purpose to decompress and expand the nerve canals.^{21, 22}

MATERIALS & METHODS

The current case control study included a total of 290 patients who were represented by two groups. Those patients were complaining of herniation of lumbar disc with a complication of stenosis of lumbar segments. Patients in the study group were treated by a small incision fenestration approach, whereas patients in the control group were treated by posterior laminectomy and decompression.

Those patients were selected retrospectively from the pool of patients visiting the orthopedic units of Adiwan-yah Teaching Hospital, Adiwan-yah province, Iraq. The reports of those patients were retrieved and included those records of patients visiting the unit during the period extending from January 2018 to December 2022. The study group included 200 patients, 115 females and 85 males with an age range of 48 to 62 years.

The control group included 90 patients, 40 males and 50 females with an age range of 47 to 63 years. The diagnosis of lumbar disc herniation and spinal stenosis was based on clinical presentation combined with imaging documentation if the form of magnetic resonance imaging or computed tomogram or both.

All enrolled patients, in their reports, signed an informed consent to perform either of the two surgical approaches mentioned previously. Variables included gender, age, body mass index, duration of disease, visual analogue score (VAS), Japanese orthopedic association (JOA) score, duration of operation, blood loss during operation and hospital stay duration.

ETHICAL CONSIDERATION

The approval of the research was issued by the committee of ethical consideration of University of Al-Qadisiyah / College of Medicine. Because the collection of data was retrospective, written consent in the records of those patients was accepted by the ethical committee.

Patients were positioned prone on a spinal surgery frame with continuous epidural anesthesia. CT scans guided the fenestration point determination for precise in-

cisions. Care was taken to minimize damage to the spinal laminae. A 'narrow edged periosteal detacher' was used to delicately release the ligamentum flavum from the vertebral plates, ensuring minimal bone removal and creating a narrow operative window.

Tissue forceps and a thin nerve stripper were used to carefully manipulate the ligamentum flavum, allowing for the removal of herniated disc material and treatment of stenosis. Key steps included separating nerve roots and dura mater, cutting the fiber ring and longitudinal ligament, and removing nucleus pulposus. Techniques were adapted for specific conditions like cauda equina syndrome. Post-surgery, the focus was on thorough cleaning of the surgical site and effective wound closure. The study also compared operation duration, blood loss, and hospital stays between two patient groups.

In the control group, patients underwent posterior laminectomy and spinal decompression. The procedure included making a median incision, positioning vertebrae with a C-arm fluoroscopic device and pedicle screws, removing the ligamentum flavum, intervertebral disc, and part of the vertebral plate, and concluding with a bone transplant secured with screws and nuts.

The visual analogue score (VAS) was used to assess pain of patients after treatment (23). Nerve function was evaluated using Japanese orthopedic association (JOA) score (24).

"Data were analyzed using statistical package for social sciences (SPSS, Chicago, USA, IBM, version 16.0)". Qualitative variables were outlined as number and percentage and quantitative ones were shown as range, standard deviation and mean. "Independent samples t-test was used to compare means between groups". "Chi-square test was used to compare proportions between groups". The level of significance was suggested at $p \leq$

0.05.

RESULTS

General features of subjects included in this work are demonstrated in table 1. Significant difference was not obtained in proportion of females and males between study groups and control groups. There was, in addition, no significant difference in mean age between both groups. Moreover, significant difference was not obtained in mean BMI between both groups. Furthermore, significant difference was not obtained in mean disease duration, 8.31 ± 3.72 years versus 7.92 ± 4.05 years, respectively ($p = 0.108$).

Comparison of mean hospital stay, operative blood loss and operative time between control group and study group is shown in table 2. Mean hospital stay was significantly lower in study group in comparison with control group. In addition, mean operative loss was significantly lower in study group in comparison with control group. Added to that, mean operative time was significantly lower in study group in comparison with control group.

Comparison of mean "visual analogue score (VAS)" for pain between study group and control group is shown in figure 1. Mean visual analogue score (VAS) was significantly lower in study group in comparison with control group. Comparison of mean "Japanese orthopedic association (JOA) score" for nerve function between study group and control group is shown in figure 2. Mean "Japanese orthopedic association (JOA) score" was significantly higher in study group in comparison with control group

BMI: body mass index; SD: standard deviation; n: number of cases; I: independent samples t-test; NS: not significant

DISCUSSION

In the current study, we found that smaller incision

Table 1: General characteristics of patients included in this study.

Characteristic	Study group n = 200	Control group n = 90	p
Gender			
Male, n (%)	85 (42.5 %)	40 (44.4 %)	0.757 C NS
Female, n (%)	115 (57.5 %)	50 (55.6 %)	
Age (years)			
Mean ±SD	53.08 ±10.73	52.92 ±9.73	0.473 I NS
Range	48-62	47-63	
BMI (kg/m2)			
Mean ±SD	28.06 ±8.71	27.92 ±6.92	0.392 I NS
Range	23.03-36.18	22.92-37.16	
Mean ±SD	8.31 ±3.72	7.92 ±4.05	0.108 I NS
Range	2-9	3-8	

BMI: body mass index; SD: standard deviation; n: number of cases; I: independent samples t-test; NS: not significant

Table 2: Comparison of mean hospital stay, operative blood loss and operative time between study group and control group.

Characteristic	Study group n = 200	Control group n = 90	p
Hospital stay (days)			
Mean $\pm$ SD	6.03 $\pm$ 2.08	8.07 $\pm$ 3.13	<0.001 ***
Operative blood loss (ml)			
Mean $\pm$ SD	52.12 $\pm$ 5.17	65.48 $\pm$ 5.08	<0.001 ***
Operative time (min)			
Mean $\pm$ SD	62.62 $\pm$ 3.09	87.09 $\pm$ 3.47	<0.001 ***

SD: standard deviation; n: number of cases; | : independent samples t-test; ***: significant at $p \leq 0.001$

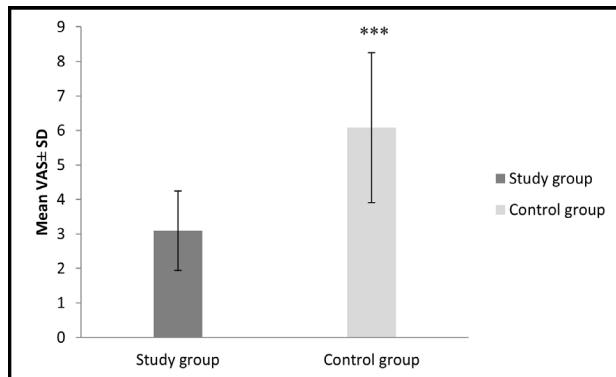


Fig 1: Bar chart showing comparison of mean visual analogue score (VAS) for pain between study group and control group. Data were shown as mean $\pm$ standard deviation; *: significant at $p \leq 0.001$.**

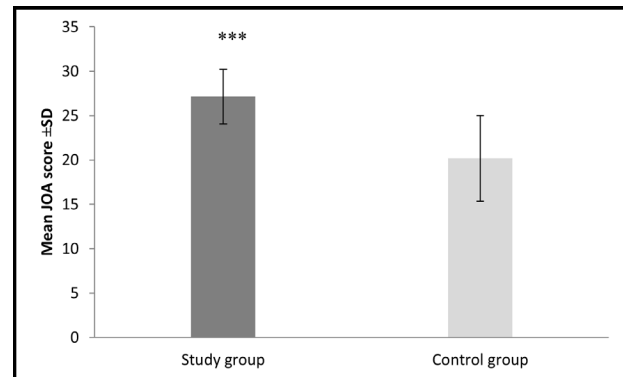


Fig 2: Bar chart showing comparison of mean Japanese orthopedic association (JOA) score for nerve function between study group and control group. Data were shown as mean $\pm$ standard deviation; *: significant at $p \leq 0.001$**

fenestration approach in managing lumbar disc herniation with spinal stenosis was better in terms of hospital stay, duration of operation, blood loss, visual pain score and nerve function in comparison with conventional laminectomy procedure.

A quick and easy way to relieve severe sciatic pain is through surgical excision of the troublesome disc, and this technique has proven to be a rather safe procedure with positive yield for the most of patients. Although the technique of fenestration has several advantages over the often-utilized laminectomy technique, it has been used extensively for years to remove the problematic disc. Due to the significant corruption of the posterior stabilizing structures of the spine and its subsequent sequelae, the classic comprehensive laminectomy and discectomy have lost their reputation.²⁵

The technique of fenestration discectomy is said to be less time-consuming, with less blood loss, with less postoperative complications, and it does not impact the integrity of the spine as compared to laminectomy due to the inherent minimally invasive nature of operation.²⁶

In this study, we were aiming at comparing the method described previously by Zhu et al. involving small incision fenestration in managing lumbar disc herniation

with spinal stenosis, to previous conventional laminectomy procedure.²⁴

Indeed, Zhu et al. described less hospital stay, shorter duration of operation and better outcomes in association with this new operative technique. In line with this study, we found significantly less hospital stay, significantly less duration of operation, significantly less blood loss, significantly less visual pain score and significantly better JOA score in association with this alternative technique in comparison with conventional laminectomy procedure. According to some earlier researchers, when comparing fenestration with laminectomy, fenestration offered the added benefits of shorter operating times, less intraoperative blood loss, quick recovery, low risk of instability, and less post-operative problems such as adhesions and arachnoiditis.^{27, 28}

Sangwan et al. claim that the only difference between fenestration technique and microdiscectomy exposure is the extent. Both just remove a small number of discs overall. The annulus fibrosus must be cut when a protruded disc herniation is found. Due to more exposure, the fenestration approach provides the benefit of treating lateral recess stenosis as well. The surgeon should be ready to do foraminotomy or undercutting of upper or lower lamina in addition to lumbar discectomy if they be-

lieve that the root of nerve is still constricted following disc excision.²⁹

CONCLUSION

Small incision fenestration technique is associated with significantly less hospital stay, less duration of operation, less blood loss, less visual pain score and better nerve function in comparison with conventional laminectomy procedure.

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Authors Contribution:

Following authors have made substantial contributions to the manuscript as under

Authors	Conceived & designed the analysis	Collected the data	Contributed data or analysis tools	Performed the analysis	Wrote the paper	Other contribution
Kadhim AA	✓	×	✓	×	✓	×

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval:

**This Manuscript was approved by the Ethical Committee of
University of Al-Qadisiyah College of Medicine, Iraq Vide No.
27/298. Dated: 09 02 2023**



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