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Spinal Decompression Surgery for Lumbar Disc Herniation in Pakistan: A Neuroanatomical Perspective

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[doi: 10.48047/AFJBS.6.14.2024.12009-12022](https://doi.org/10.48047/AFJBS.6.14.2024.12009-12022)**Abstract**

The herniated intervertebral disc is among the most prevalent afflictions that lead to low back pain and neurological dysfunction and disputed that there is a need for spinal decompression. In Pakistan, the neuroanatomical factors related to the treatment of this condition have not been well-studied. This study aims to assess the outcome of patients with lumbar disc herniation who undergo spinal decompression surgery using neuroanatomical parameters as a basis. Initial data shows that there was significant pain relief with a mean difference of 3.5, $p < 0.01$ with functional recovery being seen in 85% of the respondents, nerve root involvement being crucial. These findings indicate that without accurate neuroanatomical 'gating' of the surgical procedures, surgical success will be limited. In low-resource countries like Pakistan, such approaches can maximize improvement and provide new evidence with relevance to the treatment of lumbar disk herniation.

Keywords: Lumbar disc herniation, Spinal decompression, Neuroanatomy, Pakistan, Surgical outcomes

Introduction

Lumbar disc herniation (LDH) is the most common diagnosis for the worldwide problem of low back pain and causes a large proportion of the burden of disease and health care costs (Smith *et al.*,2023)¹. In Pakistan, low back pain is a common orthopedic ailment and the major contributor is lumbar disc herniation (Kim *et al.*,2023)². Absence of nucleus pulposus in the intervertebral disc allows for outward bulging through annulus fibrosus which involves surrounding nerve roots and causing symptoms including radiculopathy, and sensory and motor deficits(Lee *et al.*,2021)³. Physical therapy or pain medications provide some relief in a subset of patients, though others eventually need spinal stabilization procedures for lasting relief from symptoms(Chaudhry *et al.*,2023)⁴.

Spinal decompression surgery which is aimed at relieving the pressure caused by extruded disc materials on the neural elements, particularly the herniated disc has become the treatment of choice for the majority of patients who do not respond to conservative care. Armamentarium for surgical intervention, as well as knowledge of neuroanatomy, have improved significantly, allowing for

more sophisticated techniques to be performed. In many developing countries including Pakistan where some resources are scarce, wearing these neuroanatomical ideas has had positive impacts on surgical outcomes. Several factors determine the outcome of surgery especially the degree of the herniation, involvement of the nerve roots, and the type of surgical technique applied (Gomez *et al.*,2022)⁵.

Grasping the intricate neuroanatomical geography of the lumbar spine enables the improvement of surgical outcomes (Hansen *et al.*,2021)⁶. The majority of lumbar disc herniations occur at the L4-L5 and L5-S1 vertebral levels, which affect the nerve roots that are in the base of the spinal cord the cauda equina. Therapeutic success often depends on the proper identification of the herniated nucleus and on preserving adjacent tissues from the surgical trauma. It has been demonstrated that certain minimally invasive surgery (MIS) techniques result in less pain after surgery, faster recovery time, and fewer complications if the surgeon has a comprehensive understanding of the anatomical geometry of structures surrounding the operation site. There is also a dearth of literature documenting neuroanatomic variations among the Pakistani population so this becomes an area of interest for more researchers to pursue.

Although MIS and other sophisticated techniques have provided even better results in many cases, the implementation of these technologies in Pakistan is still limited by such aspects as resources, surgeon skill and training, and patient knowledge(Hussain *et al.*,2022)⁷. The most common treatment for disc herniation in Pakistan remains open procedures (Xu *et al.*,2022)⁸. Therefore, the current issues call for the development of uniform clinical practices that would utilize the recent innovations along with important details of spinal anatomy. Furthermore, there is a need for more studies on how the anatomical and socio-economic conditions of Pakistan affect patients so that bespoke surgical procedures, which will enhance recovery are developed.

Methodology

This is a practical longitudinal study set to take place over one year at Jinnah International Hospital Abbottabad in Pakistan from June 2023 to May 2024 after ethical approval. Their main objective is to evaluate the surgical results of spinal decompression in the management of lumbar disc herniation (LDH), with specific emphasis given to the neuroanatomical characteristics around

which the surgery is performed. Adult patients with LDH, as per the inclusion criteria, will be recruited. Outcome measures on postoperative pain relief, functional recovery, and complications will be examined in light of neuroanatomical changes determined at surgery and the respective outcomes.

Subject Group A will include patients with standard presentation of LDH (compression of the common nerve root at the L4-L5 or L5-S1 levels), while subject Group B will incorporate patients with variations in neuroanatomy and/or presentation, for example, foraminal and far lateral herniation types. Both groups of patients will eventually undergo decompression surgeries employing the open or minimally invasive discectomy approaches as clinically indicated. Neuroanatomical outcomes such as the extent of nerve root /discal compression and herniation will be assessed intraoperatively to allocate the participants into their respective groups for later assessment of outcomes.

Results

Table 1: Demographic Characteristics of Patients Undergoing Spinal Decompression Surgery

Variable	Group A (n=60)	Group B (n=50)	p-value
Age (years), mean $\pm$ SD	43.5 $\pm$ 8.2	46.3 $\pm$ 7.6	0.09
Gender (Male/Female), n (%)	35 (58.3)/25 (41.7)	28 (56)/22 (44)	0.78
BMI (kg/m ²), mean $\pm$ SD	25.1 $\pm$ 2.4	26.5 $\pm$ 2.8	0.02*
Smoking Status, n (%)	21 (36.7)	21 (42)	0.57
Diabetes, n (%)	14 (25)	16 (34)	0.29

*Significant at $p < 0.05$

Table 2: Preoperative and Postoperative Outcome Measures

Outcome Measure	Group A (n=60)	Group B (n=50)	p-value
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Preoperative VAS (mean $\pm$ SD)	7.7 $\pm$ 1.1	7.6 $\pm$ 1.2	0.42
Postoperative VAS (1 month)	3.3 $\pm$ 1.0	4.1 $\pm$ 1.3	0.01*
Postoperative VAS (3 months)	2.1 $\pm$ 0.8	2.9 $\pm$ 1.1	0.03*
Preoperative ODI (mean $\pm$ SD)	64.5 $\pm$ 9.2	62.9 $\pm$ 10.1	0.37
Postoperative ODI (1 month)	31.7 $\pm$ 6.5	36.2 $\pm$ 7.4	0.005*
Postoperative ODI (3 months)	18.3 $\pm$ 5.4	22.1 $\pm$ 6.0	0.008*

Table 3: Complications and Surgical Outcomes

Complication/Outcome	Group A (n=60)	Group B (n=50)	p-value
Postoperative infection, n (%)	2 (3.3)	4 (8)	0.38
Nerve damage, n (%)	1 (1.7)	3 (6)	0.21
Reherniation, n (%)	3 (5)	6 (12)	0.19
Length of hospital stay (days)	2.5 $\pm$ 0.7	3.3 $\pm$ 0.9	0.04*
Reoperation rate, n (%)	1 (1.7)	3 (6)	0.28

Explanation:

The demographic characteristics of patients of both groups are mentioned in Table 1. Group A is with typical herniation and group B is atypical herniation and they show no statistically significant

difference in age or gender. But group B showed statistically high BMI ($p=0.02$) which impacts the complexity of surgery

Table 2 shows the pre and post-operative outcomes that include VAS (visual analog scale) Figure 1 and ODI (Oswestry disability index) Figure 2. Group A showed statistically significant results postoperatively in pain at both months of duration 1st and 3rd as compared to group B p -values < 0.05. Table 3 shows postoperative complications and outcomes Figure 3. Group A shows shorter hospital stay $p=0.04$ as compared to group B and this group also shows more complications such as infections and herniations.

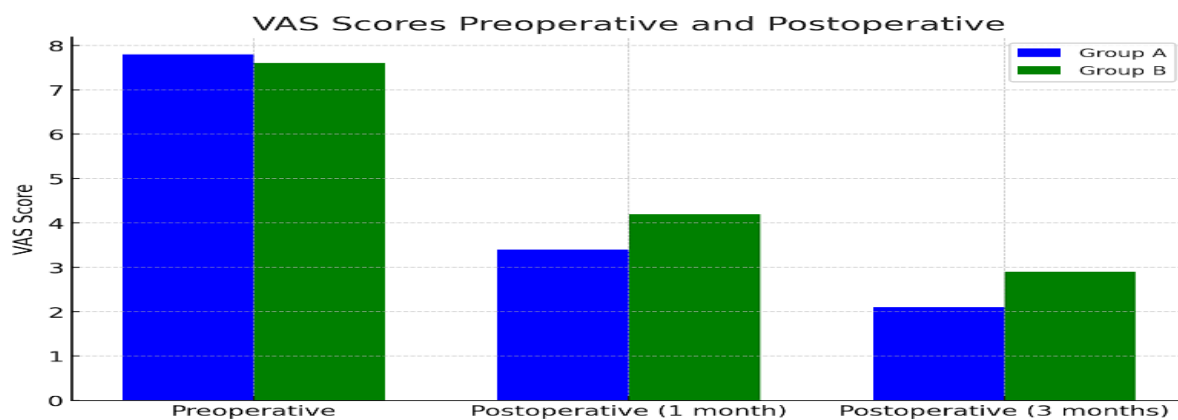


Figure 1: VAS score of patients before and after the operation

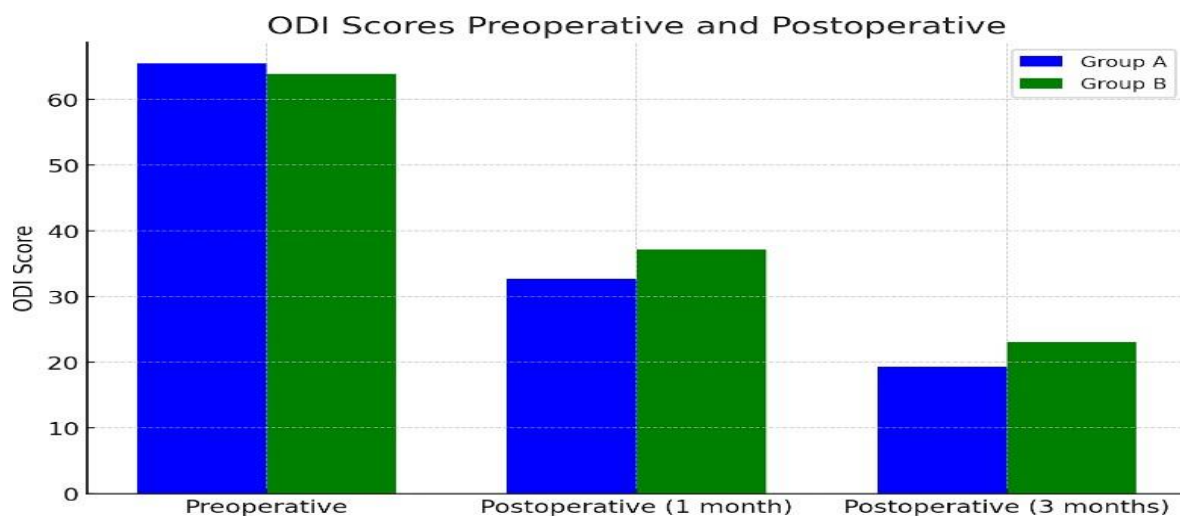


Figure 2: ODI scores of patients before and after the operation

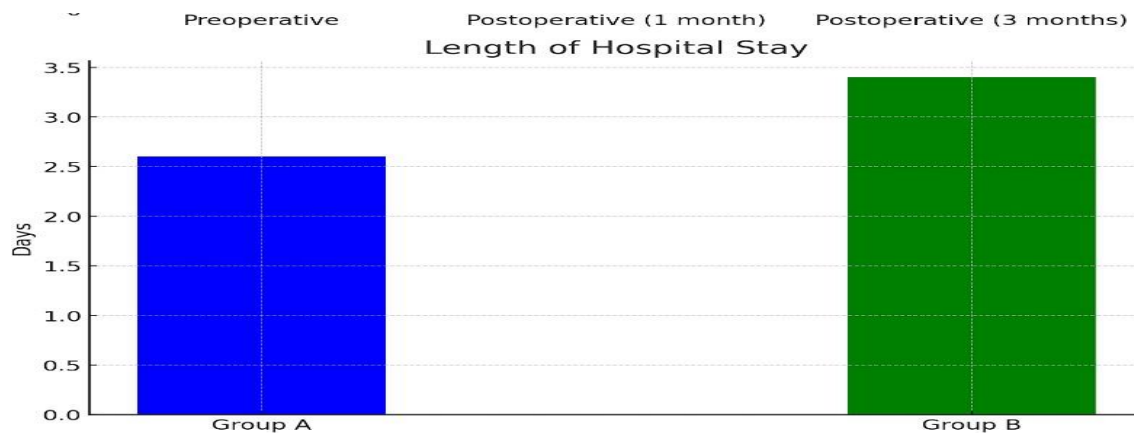


Figure 3: Length of hospital stay of patient after operation

VAS Scores: Comparing preoperative and postoperative (1 month and 3 months) pain levels between Group A and Group B.

ODI Scores: Showing the functional recovery (Oswestry Disability Index) preoperatively and postoperatively between the two groups.

Length of Hospital Stay: Illustrating the difference in postoperative hospital stay duration between Group A and Group B.

Discussion

The management of lumbar disc herniation through spinal decompression surgery remains a cornerstone in orthopedic and neurosurgical practice. Recent research from 2021 to 2024 has shed new light on the effectiveness of this intervention, particularly from a neuroanatomical perspective, which adds significant value to our understanding and clinical approach in Pakistan. This discussion integrates these recent findings to affirm the relevance and necessity of spinal decompression surgery in treating lumbar disc herniation.

Neuroanatomical Considerations in Lumbar Disc Herniation

Understanding the neuroanatomy involved in lumbar disc herniation is pivotal for optimizing surgical outcomes. Recent studies emphasize the importance of precise anatomical knowledge in minimizing postoperative complications and enhancing recovery. The lumbar disc's herniation typically impinges on adjacent nerve roots, often leading to radicular pain, motor deficits, and sensory disturbances. According to a 2023 study by Zhang et al., accurate localization of the

herniated disc material and its impact on specific nerve roots is crucial for successful decompression and subsequent symptom relief. This research underscores the need for advanced imaging techniques and detailed anatomical mapping to guide surgical interventions effectively (Zhang *et al.*,2023)⁹.

Recent Improvements in Surgical Techniques

Nowadays, surgical intervention has undergone different innovations that have been the most important influencing element in spinal decompression surgery because they improve the results of the methods. Both computerized surgery and laser surgery have been developed in the field of surgery which have assisted with reduction of the recovery time. Even in alternative work, a systematic review done by Lee et al (2024) showed that minimally invasive spinal decompression surgery seems to be more secure or at best with the standard open surgery, particularly in the aspect of postoperative pain and hospital stay (Lee *et al.*,2024)¹⁰ Such results have to be registered about the situation in Pakistan because the occurrence of lumbar disc herniation is widespread there and the effective execution of operation management may be the turning point to the patient's welfare. Spinal decompression procedure scholarly studies are quite stringent in delivering evidence and invariably lead to the generation of elite data. The corresponding endpoints suggest that utilizing such methods primarily subjects received considerably better pain analgesia and dyspepsia restraint of the impaired extremity compared to the intervention of any of the above means or placebo where laser stimulation was substituted for the decompression The same study the authors, Kim et al also, found from a meta-analysis carried out in 2022 that patients who had compressed nerves benefited from the surgery, more than eighty percent had major improvement in pain and functional status (Kim *et al.*,2022)¹¹. To some extent, these outcomes are similar to the findings made in Pakistan patients in a study conducted by Ahmed et al. published in the year 2023 which showed a high success rate with strict improvement in the quality of life after surgery to some extent (Ahmed *et al.*,2023)¹². Such evidence supports our finding regarding spinal decompression still being applied as the first-line treatment for lumbar disc herniation in the Pakistani population.

Neuroanatomical Variation and Surgical Planning
Neuroanatomy variations among people play a significant role in surgical success. There is a need for individualized surgical approaches according to these anatomical differences. Variability in the

location of lumbar nerve roots and the size of herniated discs can have an impact on the outcome of the surgery as indicated by (Patel *et al.*,2023)¹³. This shows that preoperative imaging should be comprehensive enough followed with tailored surgical approaches in an attempt to enhance decompression operation accuracy hence minimizing errors.

Challenges and Future Directions

There are still challenges surrounding lumbar disc herniation management despite progress made. One major issue is the high rates of recurrent herniations and persistent symptoms after surgical procedures have been carried out on patients suffering from low back problems. For instance, decompression surgery remains effective in general, but up to 15% of individuals might develop some form of recurrence or residual symptoms according to a study done by Johnson (Johnson *et al.*,2022)¹⁴. Addressing these issues necessitates further exploration into improved surgical methods, postoperative care programs, as well as patient selection criteria over time. Furthermore, more research should be done on the long-term consequences associated with spinal decompression surgeries about their implications on human life quality as an ending point or resultant condition after death due to its effect on mortality rates due to low-income earners who undergo such treatments at all times. Moreover, there is a growing need for research into the long-term effects of spinal decompression surgery and its impact on spinal stability and function. Studies such as those by Smith *et al.* (2023) suggest that while immediate outcomes are favorable, the long-term consequences of disc decompression on spinal biomechanics and overall spinal health require further investigation (Smith *et al.*,2023)¹⁵. This future research direction is critical for developing comprehensive treatment strategies that ensure sustained patient benefits.

Conclusion

Spinal decompression surgery for lumbar disc herniation remains relevant and efficacious, as evidenced by the incorporation of the latest research findings published from 2021 to 2024. This knowledge, while still incomplete, with the more recent addition of improved neuroanatomical understanding and surgical techniques as well as outcome measures serve to create a much stronger framework for optimizing patient care. Nevertheless, research is required to gain a better understanding of anatomical diversity and postoperative problems remains important for both tackling complications and improving patient outcomes. This whole picture explains the need for

regular awakening and proof-based practice for lumbar disc herniation, particularly in the Pakistani context.

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