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Comparative Analysis of Spinal Flexibility in Patients with and Without Lumbar Disc Herniation

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Abstract:
Lumbar disc herniation (LDH) is a common spinal disorder associated with significant pain and disability. Spinal flexibility plays a crucial role in maintaining spinal health and may influence the development and progression of LDH. However, the relationship between spinal flexibility and LDH remains unclear. This study aimed to investigate the association between spinal flexibility and LDH through a comparative analysis of flexion, extension, and lateral bending in patients with and without LDH. A cross-sectional study was conducted involving 60 participants, including 30 patients with clinically and radiologically confirmed LDH and 30 control participants without LDH. Spinal flexibility was assessed using digital inclinometers and goniometers to measure flexion, extension, and lateral bending. Demographic and clinical data were also collected. Statistical analysis was performed using independent t-tests to compare flexibility measurements between groups. Patients with LDH demonstrated significantly reduced spinal flexibility compared to the control group. The LDH group exhibited lower degrees of flexion, extension, and lateral bending in comparison. These differences were statistically significant ($p < 0.05$) for all measures. This study provides evidence of a significant association between reduced spinal flexibility and lumbar disc herniation. Maintaining and improving spinal flexibility may be crucial in preventing and managing LDH. Targeted interventions aimed at enhancing flexibility, such as stretching exercises and physical therapy, should be considered as part of comprehensive strategies for LDH management.

Keywords: Lumbar disc herniation, spinal flexibility, flexion, extension, lateral bending, back pain

1. INTRODUCTION:

Lumbar disc herniation (LDH) is a common spinal disorder characterized by the displacement of intervertebral disc material beyond its anatomical boundaries, often resulting in nerve root compression, pain, and functional limitations (Boden et al., 1990). The incidence of LDH increases with age and is a leading cause of chronic low back pain, contributing significantly to socioeconomic and healthcare burdens (Martin et al., 2008). Understanding the risk factors and biomechanical mechanisms underlying LDH is essential for developing effective preventive and therapeutic strategies.

Spinal flexibility, defined as the range of motion (ROM) available in the spinal column, is a potential factor influencing LDH development. This parameter encompasses movements such as flexion, extension, lateral bending, and rotation. Reduced lumbar flexibility may increase mechanical stress on

intervertebral discs, predisposing individuals to herniation (McGill & Cholewicki, 2001). Conversely, excessive flexibility or hypermobility can lead to spinal instability, potentially contributing to disc pathology (Panjabi, 2003).

The association between spinal flexibility and LDH remains inconclusive, with prior studies yielding conflicting results. Some evidence suggests that diminished lumbar flexibility leads to increased stiffness and mechanical loading on the intervertebral discs, thereby elevating the risk of herniation (Luoma et al., 2000). Conversely, excessive flexibility, as observed in conditions such as ligamentous laxity, may compromise spinal stability, thereby also increasing susceptibility to LDH (Beighton et al., 1973). Given these discrepancies, a comprehensive analysis comparing spinal flexibility in individuals with and without LDH is warranted to elucidate this relationship.

This study aimed to conduct a comparative analysis of spinal flexibility in individuals diagnosed with LDH and a control group without LDH. By assessing ROM across various spinal movements, this study sought to identify specific flexibility patterns associated with LDH. The findings may inform the development of targeted preventive strategies and rehabilitation programs aimed at optimizing spinal flexibility to mitigate LDH risk.

2. Method:

A cross-sectional study design was employed to compare spinal flexibility between patients with lumbar disc herniation (LDH) and a control group without LDH. A total of 60 participants were recruited and divided into two groups: 30 patients diagnosed with LDH and 30 control participants without LDH.

Inclusion Criteria:

LDH Group:

- Adults aged 18-65 years.
- Clinically and radiologically confirmed diagnosis of lumbar disc herniation within the past 6 months.
- Presence of symptoms such as radicular pain, numbness, or weakness correlating with the herniation level.

Control Group:

- Adults aged 18-65 years.
- No history of lumbar disc herniation or other significant spinal pathology.
- Absence of current low back pain or related symptoms.

Exclusion Criteria:

- History of spinal surgery.
- Presence of any other significant musculoskeletal or neurological disorders.
- Current pregnancy.
- Participation in flexibility training programs or regular intense physical activity within the past 6 months.
- Inability to provide informed consent or complete study assessments.

Participants in the LDH group were recruited from orthopedic clinics, while control participants without a history of lumbar disc herniation were recruited from the general population through community outreach efforts. Eligible participants underwent a screening process to ensure they met the inclusion and exclusion criteria. All participants provided written informed consent before participation. Confidentiality and anonymity of the participants were maintained throughout the study.

Data Collection:

1. **Demographic and Clinical Data:**

- Age, gender, height, weight, body mass index (BMI), and occupation.
- Detailed medical history, including the onset and duration of symptoms, previous treatments, and physical activity levels.

2. **Spinal Flexibility Assessment:**

- **Flexion and Extension:** Assessed using a digital inclinometer. Participants were asked to perform maximal flexion and extension movements, and the angles were recorded.
- **Lateral Bending:** Measured bilaterally using a goniometer. Participants bent sideways as far as possible, and the angles were recorded.

Data Analysis:

Data were analyzed using SPSS software. Descriptive statistics summarized the demographic and clinical characteristics of the participants. Independent t-tests were conducted to compare the means of spinal flexibility measurements between the LDH and control groups. Chi-square tests were used for categorical variables. Pearson correlation coefficients assessed the relationship between spinal flexibility and pain/functional scores. A significance level of $p < 0.05$ was considered statistically significant.

3. Result:

Participants Characteristics

The study included a total of 60 participants, with 30 patients in the LDH group and 30 participants in the control group. The demographic and clinical characteristics of the participants are summarized in Table 1.

Table1: demographic and clinical characteristics of participants

Characteristics	LDH Group (n=30)	Control group (n=30)	p-value
Age (years)	45.3 ± 10.2	44.8 ± 11.0	0.842
Gender (Male/Female)	16/14	15/15	0.795
BMI (kg/m²)	27.5 ± 3.6	26.9 ± 3.4	0.547
Duration of Symptoms (months)	5.6 ± 1.4	-	-

Spinal Flexibility Assessment

Flexion, extension, and lateral bending measurements were compared between the LDH and control groups. The results are presented in Table 2.

Table 2: spinal flexibility measurements

Flexibility Measure	LDH Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Flexion (degrees)	45.6 ± 8.4	55.8 ± 7.6	<0.001**
Extension (degrees)	18.3 ± 5.2	22.7 ± 4.8	0.002**
Lateral Bending (left)	20.5 ± 4.5	24.6 ± 3.9	<0.001**
Lateral Bending (right)	21.0 ± 4.7	25.1 ± 4.1	<0.001**

Note: ****p < 0.05 is considered statistically significant**

These results suggest that patients with lumbar disc herniation have significantly reduced spinal flexibility compared to individuals without LDH. This finding highlights the potential importance of maintaining spinal flexibility as part of the preventive and rehabilitative strategies for LDH.

4. Discussion:

The results of this study indicate that patients with lumbar disc herniation (LDH) exhibit significantly reduced spinal flexibility compared to individuals without LDH. Specifically, the LDH group demonstrated lower degrees of flexion, extension, and lateral bending. These findings suggest a potential link between reduced spinal flexibility and the development of LDH, aligning with previous research that highlights the importance of spinal flexibility in maintaining spinal health.

The significant differences in spinal flexibility between the LDH and control groups underscore the impact of disc herniation on spinal mechanics. Flexion and extension, which involve the bending and straightening of the spine, are critical movements that distribute mechanical loads across the intervertebral discs. The reduced flexion (45.6 ± 8.4 degrees) and extension (18.3 ± 5.2 degrees) observed in LDH patients could result from increased stiffness and pain associated with disc herniation, which limits the range of motion (McGill & Cholewicki, 2001).

Lateral bending, an essential movement for trunk mobility, was also significantly restricted in the LDH group. The mean lateral bending angles were 20.5 ± 4.5 degrees (left) and 21.0 ± 4.7 degrees (right) in the LDH group, compared to 24.6 ± 3.9 degrees (left) and 25.1 ± 4.1 degrees (right) in the control group. This restriction may be attributed to the protective muscle guarding and altered biomechanics resulting from the herniated disc (Hides, Richardson, & Jull, 1996).

The findings of this study highlight the potential importance of maintaining and improving spinal flexibility as part of preventive and rehabilitative strategies for LDH. Interventions such as targeted stretching exercises, physical therapy, and ergonomic modifications could help enhance spinal flexibility and reduce the risk of disc herniation. For instance, yoga and Pilates, which emphasize flexibility and core strength, have been shown to improve spinal health and may be beneficial for individuals at risk of LDH (Sherman et al., 2005).

While this study provides valuable insights into the relationship between spinal flexibility and LDH, several limitations should be acknowledged. The cross-sectional design precludes the establishment of a causal relationship between reduced flexibility and LDH. Longitudinal studies are needed to determine whether reduced flexibility precedes the development of LDH or results from it. Additionally, the sample size was relatively small, and larger studies are warranted to confirm these findings and explore the impact of flexibility training on LDH prevention and management.

Future research should also investigate the underlying mechanisms linking reduced flexibility to LDH. Understanding the biomechanical and physiological changes associated with reduced spinal flexibility could inform the development of more effective interventions. Furthermore, exploring the role of flexibility in different populations, such as athletes and individuals with occupational risks, could provide a more comprehensive understanding of its importance in spinal health.

5. Conclusion:

This study demonstrates that patients with lumbar disc herniation exhibit significantly reduced spinal flexibility compared to individuals without LDH. These findings suggest that maintaining spinal flexibility may be crucial in preventing and managing LDH. Interventions aimed at improving spinal

flexibility should be considered as part of comprehensive strategies to enhance spinal health and reduce the burden of LDH.

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