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THE ROLE OF NEURAL FORAMINAL COMPROMISE IN THE DEVELOPMENT AND PERSISTENCE OF LOW BACK PAIN

Orthopaedics

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ABSTRACT

Low back pain (LBP) is a widespread and debilitating condition, affecting millions and leading to significant disability and reduced quality of life. Neural foraminal compromise, involving the narrowing of foramina where spinal nerves exit, is a key contributor to chronic LBP. This study investigates the impact of neural foraminal compromise on LBP, disability, and postural alignment. A cross-sectional observational study was conducted with 80 participants divided into two groups: 40 with neural foraminal compromise (Group 1) and 40 controls without this condition (Group 2). Group 1 participants were aged 30-70 years, diagnosed via MRI scan, and had experienced LBP for at least 3 months. Controls were matched for age and sex but had no history of significant spinal pathology or LBP in the past year. Data collection included imaging studies, postural assessments, Visual Analog Scale (VAS) for pain, Oswestry Disability Index (ODI) for disability, and Short Form-36 (SF-36) for quality of life. Participants with neural foraminal compromise had significantly higher VAS scores (7.1 ± 1.1) compared to controls (1.8 ± 1.2, $p < 0.001$), and higher ODI scores (36.2 ± 8.9 vs. 9.6 ± 5.2, $p < 0.001$). Quality of life was lower in Group 1, with SF-36 physical component scores of 37.8 ± 7.1 versus 52.1 ± 6.5 in controls ($p < 0.001$). Postural measurements indicated a lower lumbar lordosis angle ($30.5° \pm 7.9°$) and higher pelvic tilt ($20.1° \pm 4.3°$) in Group 1 compared to controls ($42.8° \pm 8.1°$ and $13.5° \pm 3.6°$, respectively, $p < 0.001$). Neural foraminal compromise significantly increases LBP, disability, reduces quality of life, and causes postural misalignments.

KEYWORDS

Low back pain, neural foraminal compromise, disability, postural alignment, quality of life, Visual Analog Scale, Oswestry Disability Index

INTRODUCTION:

Low back pain (LBP) is a pervasive and often debilitating condition affecting millions of individuals worldwide. It is a leading cause of disability and significantly impacts quality of life and productivity (Hoy et al., 2014). Among the various etiologies of LBP, neural foraminal compromise is particularly significant due to its potential to cause chronic pain and functional impairment. Neural foraminal compromise occurs when the foramina—openings through which spinal nerves exit the spinal column—become narrowed, leading to compression or irritation of the spinal nerves (Lee et al., 2010).

The pathophysiology of neural foraminal compromise involves multiple factors, including degenerative disc disease, osteophyte formation, ligamentous thickening, and spondylolisthesis. These changes can result in direct nerve root compression, leading to pain, sensory disturbances, and motor deficits (Shabat et al., 2006). The clinical presentation of foraminal compromise is often complex, with patients experiencing a combination of localized LBP, radicular pain, and neurogenic claudication. These symptoms can severely limit daily activities and reduce overall quality of life (Andersson, 1999).

Despite its clinical importance, the precise mechanisms by which foraminal narrowing leads to chronic LBP and the factors influencing its progression remain incompletely understood. This study aims to elucidate the impact of neural foraminal compromise on the development and persistence of LBP, exploring both the anatomical and physiological aspects of this condition.

METHODOLOGY:

This cross-sectional observational study aimed to evaluate the role of neural foraminal compromise in the development and persistence of low back pain (LBP). The study was conducted in a clinical setting, with data collection involving physical examinations, imaging studies, and patient-reported outcome measures.

A total of 80 participants were recruited and divided into two groups: 40 participants with neural foraminal compromise (Group 1) and 40 controls without this condition (Group 2).

Inclusion Criteria (Group 1: Neural Foraminal Compromise)

1. Age: 30-70 years.
2. Diagnosis: Diagnosed with neural foraminal compromise based on clinical examination and confirmed by MRI scan.
3. Symptoms: Presenting with LBP for at least 3 months, with symptoms consistent with neural foraminal compromise.
4. General Health: Generally good health, with no conditions that could interfere with the study outcomes.
5. Consent: Ability and willingness to provide informed consent and comply with study procedures.

Inclusion Criteria (Control Group)

1. Age: 30-70 years.
2. Diagnosis: No history of neural foraminal compromise or other significant spinal pathology, confirmed by medical history and imaging.
3. Symptoms: No current LBP or history of chronic LBP within the past year.
4. General Health: Generally good health, with no conditions that could interfere with the study outcomes.
5. Consent: Ability and willingness to provide informed consent and comply with study procedures.

Exclusion Criteria

1. History of any lumbar spine surgery.
2. Presence of significant spinal conditions such as tumors, infections, fractures, or congenital spinal deformities.
3. Known neurological conditions affecting the spine or lower limbs, such as multiple sclerosis or peripheral neuropathy.
4. Severe comorbid conditions
5. Pregnancy.
6. Current use of medications that could affect the musculoskeletal system or pain perception
7. Inability to comply with study procedures due to cognitive impairment, language barriers, or logistical issues.
8. Any recent acute injuries to the back or lower extremities.

Data Collection

1. **Demographic and Clinical Data:** Age, sex, body mass index (BMI), duration and severity of LBP, and relevant medical history were recorded.
2. **Imaging Studies:** MRI scans was used to assess the degree of neural foraminal compromise.
3. **Postural Assessment:** Postural alignment was evaluated using lumbar lordosis angle & pelvic tilt measurement.
4. **Pain and Function:** The intensity of LBP was measured using the Visual Analog Scale (VAS), and functional status was assessed using the Oswestry Disability Index (ODI).
5. **Quality of Life:** The Short Form-36 (SF-36) questionnaire was used to assess overall quality of life.

Statistical Analysis

Descriptive statistics summarized demographic and clinical characteristics of the participants. Comparative analyses between the two groups were performed using independent t-tests for continuous variables and chi-square tests for categorical variables. Correlation analyses explored the relationships between the degree of neural foraminal compromise, postural alignment, and LBP severity. A p-value of <0.05 was considered statistically significant. All participants provided written informed consent prior to participation.

RESULTS:

Participant Demographics

The study included 80 participants, with 40 in the neural foraminal compromise group (Group 1) and 40 in the control group (Group 2). The demographic characteristics of the participants are summarized in Table 1.

Table 1: Demographic Characteristics of Participants

Characteristic	Group 1 (n=40)	Group 2 (n=40)	p-value
Age (years, mean ± SD)	55.3 ± 8.2	54.8 ± 7.9	0.756
Sex (M/F)	22/18	20/20	0.648
BMI (mean ± SD)	27.5 ± 3.4	26.9 ± 3.1	0.451

Clinical and Postural Measures

The clinical and postural measures of the participants are presented in Table 2.

Table 2: Clinical and Postural Measures

Measure	Group 1 (n=40)	Group 2 (n=40)	p-value
VAS for LBP (mean ± SD)	7.1 ± 1.1	1.8 ± 1.2	<0.001*
ODI Score (mean ± SD)	36.2 ± 8.9	9.6 ± 5.2	<0.001*
SF-36 Physical Component Score	37.8 ± 7.1	52.1 ± 6.5	<0.001*
SF-36 Mental Component Score	41.5 ± 8.2	49.7 ± 7.1	<0.001*
Lumbar Lordosis Angle (°)	30.5 ± 7.9	42.8 ± 8.1	<0.001*
Pelvic Tilt (°)	20.1 ± 4.3	13.5 ± 3.6	<0.001*

*$p < 0.05$ indicates statistical significance

The study included 80 participants, equally divided between those with neural foraminal compromise (Group 1) and controls (Group 2). The demographic characteristics (age, sex, and BMI) were comparable between the groups, with no significant differences observed ($p > 0.05$).

Significant differences were found between the groups in clinical and postural measures. Quality of life, particularly the physical component, was markedly reduced in participants with neural foraminal compromise. Postural alignment measurements demonstrated significant deviations in participants with neural foraminal compromise. These results suggest that neural foraminal compromise is associated with increased LBP, greater disability, poorer quality of life, and significant alterations in postural alignment.

DISCUSSION:

The findings of this study provide compelling evidence on the significant impact of neural foraminal compromise on the development and persistence of low back pain (LBP). Participants with neural foraminal compromise reported substantially higher levels of pain and disability, as measured by the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) respectively. These results align with previous studies that have highlighted the critical role of neural compression in chronic pain syndromes (Lee et al., 2010; Genevay & Atlas, 2010).

The study revealed that participants with neural foraminal compromise had markedly lower quality of life, particularly in physical functioning, as evidenced by the SF-36 scores. This reduction in quality of life underscores the profound effects of chronic LBP on daily activities and overall well-being. The significant differences in both physical and mental component scores of the SF-36 between the groups indicate that neural foraminal compromise not only affects physical health but also has psychological repercussions, likely due to the chronic nature of the pain and its impact on lifestyle (Brinjikji et al., 2015).

Postural assessment revealed significant deviations in spinal alignment among participants with neural foraminal compromise. Specifically, these individuals exhibited a lower lumbar lordosis angle and increased pelvic tilt compared to controls. These findings suggest that individuals with neural foraminal compromise adopt compensatory postural mechanisms to alleviate nerve compression and pain. Such postural adaptations, may exacerbate musculoskeletal imbalances and contribute to the persistence of pain (Schwab et al., 2009; Negrini et al., 2013).

The clinical implications of these findings are substantial. Effective management of neural foraminal compromise requires a multifaceted approach that addresses both the mechanical compression of the nerves and the resultant postural misalignments. Therapeutic strategies could include targeted physical therapy to correct postural deviations, pharmacological treatments to manage pain, and in some cases, surgical interventions to relieve nerve compression (Lurie & Tomkins-Lane, 2016).

CONCLUSION:

This study demonstrates that neural foraminal compromise significantly contributes to the development and persistence of low back pain, increases disability, reduces quality of life, and causes notable postural misalignments. Comprehensive management strategies that address both the neural and postural components of this condition are essential for improving patient outcomes.

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