

Altered Gluteus Maximus Activation Patterns in Individuals with Subacute Mechanical Low Back Pain: An Electromyographic Study

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Abstract:

➤ *Background:*

Mechanical low back pain (MLBP) remains one of the most prevalent musculoskeletal conditions worldwide and is a leading cause of functional limitation in adults. Emerging evidence suggests that altered neuromuscular control of the lumbopelvic region, particularly changes in gluteus maximus activation, may contribute to symptom persistence during the subacute stage.

➤ *Aim:*

To examine gluteus maximus activation patterns in individuals with subacute mechanical low back pain using surface electromyography (sEMG).

➤ *Methodology:*

A comparative cross-sectional study was conducted among 40 participants aged 20–45 years. Twenty individuals diagnosed with subacute mechanical low back pain (duration 6–12 weeks) were compared with 20 age-matched healthy controls. Surface electromyography was used to assess gluteus maximus activation during prone hip extension and sit-to-stand activities. Pain intensity and disability were evaluated using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI), respectively. Statistical analysis was performed using independent t-tests and Pearson correlation, with the level of significance set at $p < 0.05$.

➤ *Results:*

Participants with mechanical low back pain demonstrated significantly reduced peak gluteus maximus activation and delayed muscle onset compared to healthy individuals ($p < 0.05$). A moderate negative correlation was observed between EMG amplitude and ODI scores ($r = -0.48$), indicating that lower muscle activation was associated with higher disability levels.

➤ *Conclusion:*

Subacute mechanical low back pain is associated with measurable alterations in gluteus maximus activation. These findings highlight the importance of early gluteal strengthening and neuromuscular retraining in rehabilitation programs.

Keywords: Mechanical Low Back Pain, Gluteus Maximus, Surface Electromyography, Lumbopelvic Stability, Muscle Activation.

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I. INTRODUCTION

Low back pain continues to pose a significant public health concern across the globe. It affects individuals irrespective of occupation or lifestyle and is recognized as

one of the leading causes of disability. Reports from the World Health Organization emphasize that musculoskeletal disorders substantially contribute to years lived with disability worldwide. Among these conditions, mechanical

low back pain accounts for approximately 80–90% of reported cases.

The gluteus maximus, the largest and one of the most powerful muscles in the body, plays an essential role in hip extension and stabilization of the pelvis. Efficient activation of this muscle is crucial during functional tasks such as walking, lifting, climbing stairs, and rising from a seated position. Impairment in gluteus maximus function may alter lumbopelvic biomechanics, leading to compensatory patterns and increased stress on lumbar structures.

Previous electromyographic studies have identified delayed muscle activation and reduced amplitude in individuals with chronic low back pain. However, limited attention has been directed toward the subacute phase (6–12 weeks), which represents a critical transition period. Identifying neuromuscular alterations during this stage may provide opportunities for early intervention and prevention of chronicity.

➤ *Aim*

To evaluate gluteus maximus activation patterns in individuals with subacute mechanical low back pain.

➤ *Objectives*

- To determine peak EMG amplitude of the gluteus maximus during functional activities.
- To assess the onset timing of gluteus maximus activation.
- To compare activation parameters between individuals with subacute mechanical low back pain and healthy controls.
- To examine the relationship between muscle activation, pain intensity, and disability levels.

II. METHODOLOGY

➤ *Study Design*

A comparative cross-sectional study design was adopted.

➤ *Study Setting*

The study was conducted in the Outpatient Department of Physiotherapy at a tertiary care hospital.

➤ *Participants*

A total of 40 participants were recruited and divided into two groups:

- Group A: 20 individuals with subacute mechanical low back pain
- Group B: 20 age-matched healthy controls

➤ *Inclusion Criteria*

- Age between 20 and 45 years
- Diagnosis of subacute mechanical low back pain (6–12 weeks duration)
- VAS score ranging from 3 to 7

➤ *Exclusion Criteria*

- History of spinal surgery
- Presence of neurological deficits
- Radiating pain below the knee
- Known hip joint pathology

➤ *Outcome Measures*

- Surface Electromyography (sEMG): Measurement of gluteus maximus activation amplitude and onset timing
- Visual Analog Scale (VAS): Assessment of pain intensity
- Oswestry Disability Index (ODI): Evaluation of functional disability

➤ *Procedure*

Surface EMG electrodes were placed over the gluteus maximus muscle following standardized SENIAM recommendations to ensure accurate signal acquisition. Participants were instructed to perform:

- Prone hip extension
- Sit-to-stand movement

Each task was performed three times, and the mean value of EMG amplitude and onset timing was calculated for analysis.

➤ *Statistical Analysis*

Data were analyzed using SPSS version 25. Independent t-tests were used to compare groups, and Pearson's correlation coefficient was applied to determine associations between EMG findings and ODI scores. Statistical significance was set at $p < 0.05$.

III. RESULTS

The mechanical low back pain group demonstrated a statistically significant reduction in peak EMG amplitude compared to healthy controls ($p = 0.01$). Additionally, a delay in muscle onset timing during prone hip extension was observed in the MLBP group ($p = 0.02$).

Correlation analysis revealed a moderate negative relationship between EMG amplitude and ODI scores ($r = -0.48$), suggesting that decreased gluteus maximus activation was associated with greater functional limitation. No significant differences were found between male and female participants.

IV. DISCUSSION

The findings of the present study indicate that individuals with subacute mechanical low back pain exhibit altered gluteus maximus activation patterns. Reduced EMG amplitude may reflect neuromuscular inhibition, potentially secondary to pain or altered motor control strategies.

Delayed activation during hip extension suggests impaired coordination within the lumbopelvic region. This

delay may contribute to increased reliance on lumbar extensors, thereby increasing mechanical stress on spinal structures.

These observations align with previous electromyographic studies that have reported gluteal muscle dysfunction in low back pain populations. Importantly, the current study extends this understanding to the subacute phase, emphasizing the need for early corrective interventions.

Incorporating targeted gluteus maximus strengthening, motor control retraining, and functional movement re-education may enhance recovery and reduce the likelihood of progression to chronic low back pain.

V. CONCLUSION

Subacute mechanical low back pain is associated with reduced and delayed gluteus maximus activation when compared to healthy individuals. Early identification and rehabilitation focusing on gluteal muscle function may play a vital role in improving outcomes and preventing chronicity.

CLINICAL IMPLICATIONS

- Surface EMG can serve as a useful tool in identifying neuromuscular deficits.
- Gluteus maximus strengthening should be integrated into early rehabilitation programs.
- Motor control exercises may enhance lumbopelvic stability and functional recovery.

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