Whalen Symposium Abstract

Balance and Proprioceptive Deficits in Young Athletes with Extension-Based Low Back Pain due to Lumbar Multifidi Muscle Fat Infiltration: A Pilot Study

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Introduction: Low back pain is a frequent medical problem affecting young athletes, particularly those participating in sports requiring repetitive extension movements of the spine. It is reported to affect between 10-15% of young athletes, up to 27% of college football players, and about 50% of gymnasts[1]. The lumbar multifidus muscle (LMM) aids in lumbar spinal stabilization and proprioceptive sense during static and dynamic postural balance[1,2]. Researchers have found significant proprioceptive deficits in individuals with extension-based low back pain (EBLBP)[3], suggesting there may be a correlation between EBLBP and LMM fat infiltration.

Objective: The purpose of this study is to compare differences in proprioception and balance strategies used in young athletes with EBLBP and asymptomatic controls, to test its relation to LMM fat infiltrate levels, and to calculate the required sample size to achieve 80-95% statistical power in future studies. It is hypothesized patients with EBLBP will exhibit impaired balance and proprioception during conditions requiring spinal extension compared to asymptomatic controls.

Methods: Three patients with EBLBP (age, height, weight) and three matched controls were recruited. The Sensory Organization Test (SOT) and Limits of Stability (LOS) test were performed using a NeuroCom CRS Balance Master System to assess the static and dynamic balance control, equilibrium reactions used during static and sway referenced balance, as well as their balance strategies. Directional stability in 3 different directions (back, left back, and right back) was assessed using LOS along with their reaction times (RT), directional controls (DCL), maximal excursion (MXE), end point excursion (EPE), and movement velocities (MVL). Equilibrium composite scores and balance strategy analysis were compared between groups using SOT. One-way ANOVA ($p < 0.05$) was performed to compare the variables between groups. Power analysis was performed (G*Power 3.1.7) to calculate the minimum number of participants per group required to achieve 80-95% statistical power using the variables with least and most difference between groups respectively.

Results: In the left back direction of the LOS test, EBLBP patients exhibited a statistically significant greater EPE compared to asymptomatic controls (p=0.03) (ELBP 84% +/- 4.2 vs. controls 74.5% +/- 4.9). No other statistically significant differences were found in the right back direction (p=0.28-0.7) or in the back direction (p=0.16-0.41) of the LOS test. Regarding the SOT, no statistically significant differences were found (p=0.16-1.0).

Using variable with maximum difference between groups, EPE for left back ($\alpha = 0.05$), the sample size required to achieve 95% statistical power is 6 participants per group. In contrast, using variable with minimum difference between groups, for DCL for right back, 47 participants are required to achieve 80% statistical power is 47 participants per group.

Discussion: EPE is measured as a percentage of the theoretical limit (100%) of how far an individual can shift/lean their COG on their first attempt without losing balance, falling, or taking a recovery step. The results of this study suggest that individuals with EBLBP achieve greater amounts of movement toward the target in the left back direction on their first attempt. The relationship between these findings and the grade and location of fat infiltrate within the LMM, the type of sport an athlete plays, and symmetry of activity should be considered. In this pilot study, the lacrosse player, representing a unilateral upper extremity dominant athlete, exhibits greater (grade 2) LMM fat infiltrate in the left L4/5-L5/S1 area compared to the right (grade 1). In contrast, the gymnast, representing a predominantly pure extension athlete, exhibits symmetrical LMM fat infiltration with bilateral grade 1 in L4/5 and bilateral grade 2 in L5/S1. A clinician might consider a patient's willingness to move in their first attempt suggestive of the individual's perception of their own safety limits[4]. Though, individuals with EBLBP overestimate the lumbar target during joint repositioning proprioception testing[5]. Individuals with EBLBP have also been shown to assume greater lumbar lordosis postures during standing[3,6]. Thus, these athletes with EBLBP may have an impaired sense of how much back extension they are achieving during their respective sports, potentially worsening their extension-based low back pain.

Conclusion: There are no major differences observed in balance and proprioception with this small sample, but the pilot results were beneficial to explore the required sample to attain statistical significance in the results. Anecdotally, clinicians should include proprioceptive training in the rehabilitation protocols of young athletes with EBLBP to achieve improved postural stability and proprioception.

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