The Relationship of Lumbopelvic Stability and Lumbopelvic Muscle Cross-Sectional Area and Asymmetry

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Summary

Lumbopelvic stability (LPS) relies in large part on the contributions muscles. MRI assessed muscle cross-sectional area (CSA) in 16 active adults, with asymmetry classified as >10% bilateral difference. The active hip abduction (AHAbd) test evaluated LPS. Quadratus lumborum (QL) and psoas major (PM) muscle asymmetries were significant (p = .011), while the other trunk and pelvic muscles showed no asymmetry. QL asymmetry correlated with poor AHAbd performance suggesting its role in compensatory stabilization. Findings highlight QL CSA asymmetry in lumbopelvic function, with implications for movement and injury risk.

Introduction

LPS is crucial for postural control and force transmission. The gluteus medius (GM), QL, and multifidus (MF) muscles stabilize the lumbopelvic complex, especially during single-leg stance [1,2]. GM generates forces up to twice body weight to maintain pelvic alignment, but deficits are associated with compensatory QL activation and may lead to instability [3,4]. Also, muscle asymmetries have been shown to further impair LPS and increase injury risk [5,6]. Likewise, this study examined the relationship between lumbopelvic muscle CSA and lumbopelvic stability.

Methods

16 healthy, right-hand dominant physically active adults (aged 25-50y; 9M/7F, height 1.76m ±0.12, weight 75.2kg ±13.7, and BMI 24.6kg/m^2 ±3.7). Muscle CSA was obtained from MRI using a Siemens Magnetom 3T PrismaFit scanner. The lumbopelvic musculature quantified were: QL, PM, GM, MF, and the internal oblique, external oblique, and transverse abdominis groups into the lateral abdominal wall (LAW). CSA was calculated using ITK-SNAP software (v4.2, www.itksnap.org) [5]. Asymmetry was classified when the dominant side exceeded the non-dominant side by more than 10% or vice versa, whereas symmetry was assigned when the bilateral difference was less than 10%. The AHAbd test was used on both limbs to assess LPS and categorized participants into unstable (poor control; score of 2 or 3) and stable (good control; score of 0 or 1). Paired t-tests were used to assess statistically significant CSA asymmetry. Spearman Rank correlation coefficients were used to determine the association between lumbopelvic stability and muscle CSA.

Results and Discussion

QL (510.19 ± 112.19 mm^2, p = .011) and PM (711.92 ± 190.85 mm^2, p = 0.002) CSA were significantly different between sides and were greater than 10% (were asymmetrical), whereas no significant bilateral CSA differences were observed in the other muscle groups. These findings suggest that the QL and PS exhibit greater morphological differences between sides compared to other lumbopelvic muscles.

Further, Spearman rank correlation analysis indicated a significant relationship between QL asymmetry and AHAbd task performance (right: ρ = -.75, p = 0.005; left: ρ = -.68, p = 0.013). This correlation suggests that variations in QL CSA influenced lumbopelvic control strategies during unilateral tasks. Given the QL's role in lateral pelvic stability, its asymmetry may contribute to the compensatory movements observed during the AHAbd test.

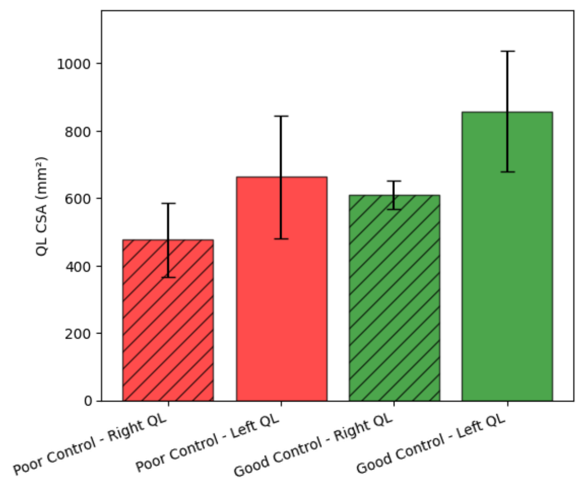

Figure 1: Mean QL CSA in poor and good control groups, categorized by right and left QL. The poor control group exhibited a smaller right QL CSA compared to the good control group, while the left (contralateral) QL CSA was larger across both groups.

Conclusions

QL and PM asymmetries suggest these muscles exhibit greater morphological differences between sides compared to other lumbopelvic muscles. Additionally, the relationship between QL asymmetry and AHAbd test performance indicates that imbalances in QL size may influence lumbopelvic stability and compensatory control strategies during unilateral tasks.

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