ACUTE BICEP FEMORIS MUSCLE ARCHITECURE RESPONSES FOLLOWING SIMULATED SOCCER PERFORMANCE

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Introduction

Despite a high volume of recent research, hamstring strain injury (HSI) remains high in soccer (Ekstrand et al., 2016). Short (≤10.56 cm) bicep femoris long head (BF_{LH}) muscle fascicles have been reported as a modifiable risk factor for HIS (Timmins et al., 2016), along with other modifiable risks such as neuromuscular fatigue status (Timmins et al. 2016), with nearly half of all HSIs in soccer occurring in the final third of each half of match-play (Woods et al., 2004). Acute muscle architectural changes in response to neuromuscular fatigue have been observed in the quadriceps femoris (QF) by Brancaccio et al. (2008), however no much observations have been reported for the BF_{LH}. The aims of the current study were to observe acute changes in BF_{LH} muscle fascicle length (FL), muscle thickness (MT) and fascicle pennation angle (PA) in response to a simulated soccer protocol ($SAFT_{45}$), using ultrasonography. It was hypothesised that a decrease in FL and an increase in MT and PA would be observed immediately following the $SAFT_{45}$.

Methods

10 female collegiate-level soccer players (age: 23 ± 3 years; height: 163 ± 3 cm; body mass: 66 ± 12 kg; weekly soccer training: 234 ± 64 mins) volunteered for the study. Two-dimensional ultrasound (I. LOGIQ e R7, 5 MHz) images were taken of the BF_{LH} by placing a 45 mm probe at 50% distance between the ischial tuberosity and fibular head, along the orientation of the muscle. Three images were taken at pre-and post-$SAFT_{45}$, with mean FL, MT and PA estimated using ImageJ as seen in Figure 1. Imaging procedures were repeated for the contralateral limb. All ultrasound images were collected and analysed by the lead researcher. After obtaining baseline images, all participants completed a standardised warm-up, before taking part in the $SAFT_{45}$ which has been cited as a reliable protocol for the simulation of soccer-specific movement demands. Post-$SAFT_{45}$ BFLH images were obtained immediately following the conclusion of the $SAFT_{45}$. The study was granted institutional ethics approval prior to participant recruitment or testing. .

Statistical Analyses

Intra-rater reliability of ultrasound muscle architecture estimations was completed using the intra-class coefficient (ICC 2,1) and coefficient of variation (CV) with acceptable reliability set at ≥0.8 and ≤10%. A paired-samples t-test was used to compare pre-and post measures of muscle architecture. A priori alpha level was set at 0.05. Cohen's d effect sizes were reported using the following scale: trivial 0–0.2; small 0.2–0.6; moderate 0.6–1.2; large 1.2–2.0; very large 2.0–4.0. Data are reported as means (SD ±) with uncertainty of estimates expressed as 95% confidence intervals (95% Cis).

Results

Intra-rater reliability of all ultrasound muscle architecture estimates were found to be acceptable (ICC and %CV at ≥0.8 and ≤10%). There was a possibly small increase in FL (Figure 2) in the dominant limb (0.89 ± 1.9 cm, 95% CI -0.5 cm – 2.2 cm, *d* = 0.45), however this was found to be non-significant (*p* = ≥0.05). There was a possibly large increase in dominant limb MT (Figure 3) post-$SAFT_{45}$ (0.14 ± 0.27 cm, 95% CI -0.49 cm – 0.34 cm, *d* = 2.4), however this was not found to be statistically significant *(p* = ≥0.05). All other observations were found to be non-significant (*p* = ≥0.05, *d* = ≤0.2). There was no statistically significant between-limb differences observed (*p* = ≥0.05).

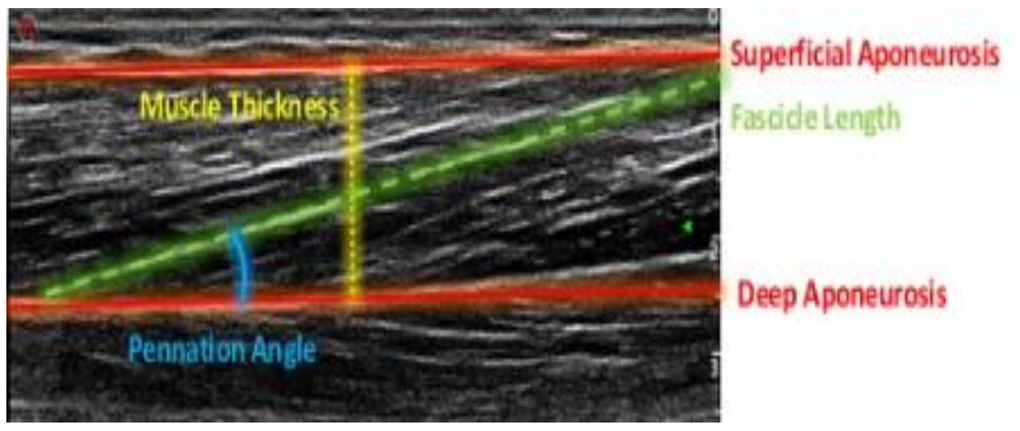


Figure 1. Method for estimation of BF_{LH} muscle architecture

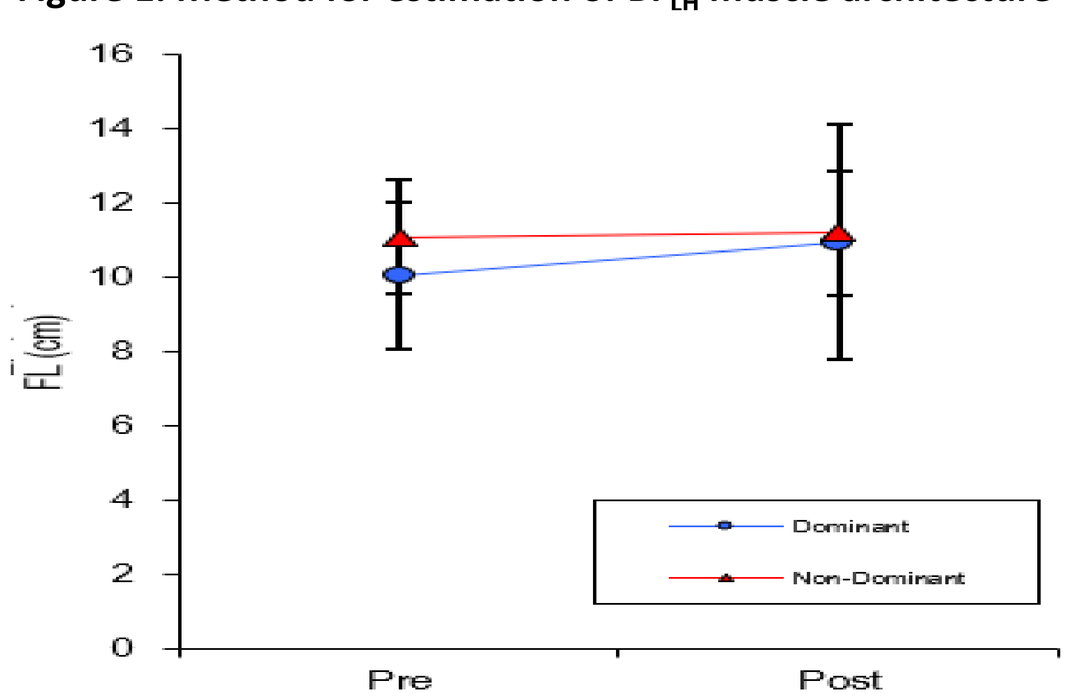
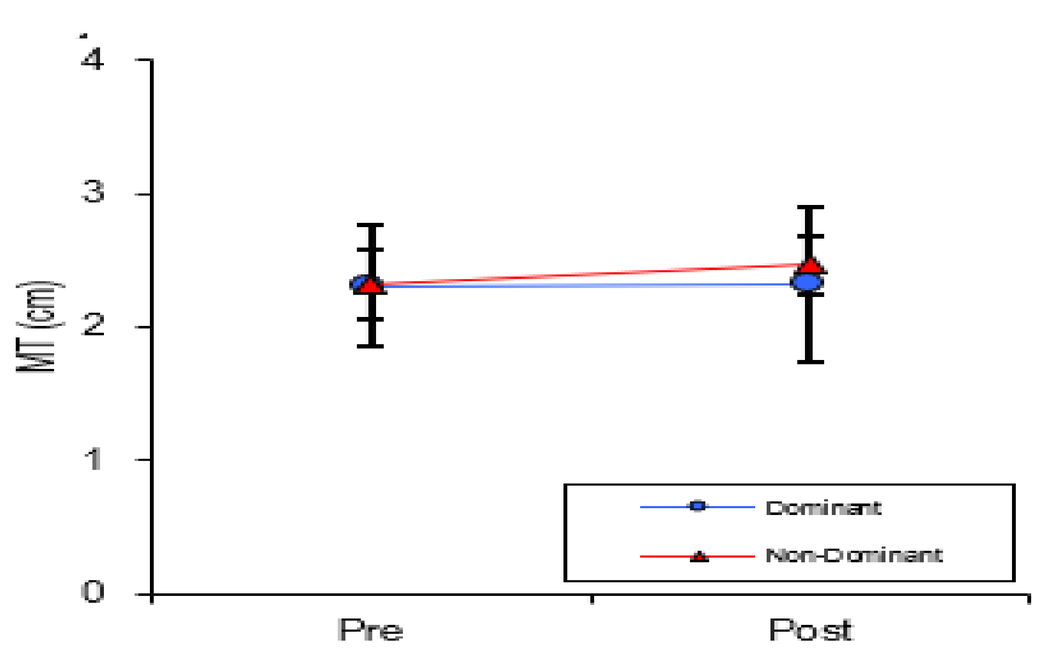


Figure 2. Mean Pre-and post-SAFT45 measures of FL



Discussion

The findings of the current study indicate that there is no significant acute changes in BF_{LH} muscle architecture in response to simulated soccer performance. From these findings, it may be suggested that the increased incidence of HSI in a fatigued state is not likely related with a change in muscle architecture. It must be noted, however that the current study did only observe changes following a non-exhaustive 45-minute simulation protocol, whereas observations in acute architectural changes in the QF were following a cycloergometer test to exhaustion (Brancaccio et al., 2008). The current study is limited by the small sample and poor ecological validity of a 45-minute soccer simulation.

Practical Application

Future studies should look to observe acute architectural changes in response to soccer match and training performance as well as incorporate measures of other modifiable risk factors such as knee flexor torque and high-speed running ability.

References

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