INTRODUCTION

Anterior cruciate ligament (ACL) injuries are one of the most prevalent injuries in athletics, affecting females at a much greater rate than males. The musculature around the knee is affected in several ways, but the most negative effects occur in the vastii muscle group, and more specifically the vastus lateralis [1]. Muscle volume is indicative of the power a muscle can produce and therefore knowing muscle volume at different points in the process (post injury, reconstruction surgery, and rehabilitation to full participation) can provide insight into how the muscle is effected by injury, surgery, and rehabilitation. Additionally, thigh circumference is used clinically to track muscle volume changes and there is no consensus if this is accurate. Therefore, the purpose of this study was to quantify vastus lateralis volume post ACL injury and throughout the reconstruction surgery and rehabilitation process and to compare volume changes to changes in thigh circumference.

METHODS

The participant was a 20 year old female Division III soccer athlete whose mass was 59kg, and height was 1.63m. Informed consent was obtained in accordance with The Pennsylvania State University Institutional Review Board. The athlete suffered a non-contact ACL injury during a game. The ACL was reconstructed using a bone-patellar-bone autograft approximately 3 weeks post-injury. Weekly measures of vastus lateralis volume (estimated using B-mode ultrasound; EchoBlaster 128, Telemed, Lithuania) and thigh circumference commenced 4 days post injury following the procedures detailed in Infantolino et al. [2]. Briefly, a system of wire guides was placed on the thigh to break up the vastus lateralis on the ultrasound image (Figures 1 and 2).

RESULTS AND DISCUSSION

The results of the Pearson’s correlation test indicated a correlation between muscle volume and thigh circumference measures (p < 0.05). Figure 3
illustrates muscle volume throughout time. Important points of change in the volume occur at:
- Week 3 – the measurement after ACL reconstruction (volume probably influenced by swelling post surgery).
- Week 5 – volumes illustrate how much volume decreased 2 weeks after surgery (36% from week 1).
- Week 15 – subject stopped attending physical therapy after 30 sessions.
- Week 19 – subject returned to physical therapy.

Figure 3. Vasuts Lateralis volume throughout time.

CONCLUSIONS

The results of the correlation indicate that thigh circumference is an accurate method for assessing vastus lateralis volume changes during rehabilitation following ACL reconstruction. This is clinically important as thigh circumference measurements are used to track muscle hypertrophy during rehabilitation and are much quicker measurements than measuring muscle volume. Another important finding was how quickly atrophy ensued following discontinuation of rehabilitation. In this study the subject stopped attending regular physical therapy sessions during the winter break. During this time her vastus lateralis volume decreased by nearly 18%. This demonstrates that consistent rehabilitation is critical to maintaining muscle hypertrophy gains.

Some limitations exist in this study with the largest limitation being sample size. Since the injury, operation, and rehabilitation were not unique there is no reason to believe that these results would not be seen on other individuals. However, without additional subjects it is difficult to categorically state that these findings would generalize to other individuals. Another limitation would be the focus on the vastus lateralis muscle. Given that previous literature has shown decreases in the other quadriceps muscles there is no reason to suspect that these findings would not apply to the other quadriceps.

Clinically, these results indicate that thigh circumference can be used to estimate vastus lateralis muscle volume changes. Muscle volume is an indicator of the power a muscle can produce and therefore can be used during rehabilitation as an independent measure of muscle power production ability. Finally, these results also demonstrate the need for continuous rehabilitation (even months post-op) to continue increasing vastus lateralis muscle volume.

REFERENCES