Changes in Gait Pattern and Triceps Surae Activity in Immobilization Boots
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Context: Individuals following Achilles tendon rupture are commonly treated by immobilization in a boot. Heel lifts are often times added to the boot, changing the amount of plantar flexion the ankle is in to reduce active loading of the Achilles tendon. However, the effect of type of boot or number of wedges on gait and muscle activity has not been described. Objective: The purpose of this study is to evaluate the effects of boot type and various heel wedges on gait pattern and triceps surae activation. Design: Within-subject design. Setting: The study was performed in a laboratory setting. Participants: Ten subjects (5 male, Mean(SD) BMI: 24.9 (3.9), Age: 20.8 (1.17)) with no history of an Achilles tendon injury. Interventions: Each subject performed a 10-meter walk test in two different types of immobilization boots (Boots 1 and 2) with three different heel wedge conditions (0, 2, 4 wedges). A no boot condition served as the control. Gait and muscle activation data was collected using the MuscleLab® system (Ergotest Technology, Oslo, Norway). Gait data was collected from wireless, inertial measurement units (IMUs) placed on top of the feet. Electromyography (EMG) electrodes were placed on the lateral gastrocnemius (LG), medial gastrocnemius (MG), and soleus (SOL). The EMG signal was pre-amplified and filtered using a 20-500 Hz bandpass filter. The integrated root mean square (RMS) was used for data analysis. Main Outcome Measures: Gait parameters included cadence and time spent in three gait phases (load response, foot flat, and pre-swing). Muscle activation of the three triceps surae muscles was quantified using the average muscle integrated RMS EMG signal from the middle five stance phases of gait. Results: Cadence decreased significantly with increased number of heel wedges for both boots. For Boot 1, cadence decreased from Mean(SD) 51.19(18.07) steps/min with 0 wedges to 49.20(5.50) steps/min with 4 wedges (p = 0.041). For Boot 2, cadence decreased from 51.61(5.27) steps/min with 0 wedges to 48.46(3.95) steps/min with 4 wedges (p=0.002). There were no differences in temporal stance phase parameters between conditions. Muscles of the triceps surae were active across all conditions, and there were no significant differences between conditions. Conclusion: Gait pattern is altered in each type of immobilization boot with various heel wedges, yet the triceps surae always remains active. The increase in number of heel wedges did not appear to change the relative contribution between the muscles of the triceps surae. This study is limited by the small sample size, however, supports the need for future study in people with Achilles tendon pathology to determine the optimal position for immobilization for promotion of healing. Word Count: 430