Stiletto Stress: The Effect of Increased Plantar Flexion on the Degree of Pronation and Supination in the Ankle

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The ankle-foot complex is a joint mechanism that can provide stability, bear heavy weight loads, and provide fluid movement. Improper alignment of the foot affects the ankle and subsequently increases medial knee loading – a known risk factor for osteoarthritis. This experiment determined the effect of increasing the heel plane on the degree of pronation or supination in the ankle joint. It was hypothesized that as heel height increased, the degree of pronation would increase. Female participants, aged 15-20, were photographed in static stances in bare feet and while wearing pump style shoes with heel heights of 3” (7.62 cm) and 4.25” (10.8 cm). Medial and lateral ankle angle data was measured using PixelStick. A triangular geometric analysis was then performed to calculate changes in ankle position. Results showed that 100% of the participants experienced supination in the medial malleolus angle and 91% experienced supination in the lateral malleolus angle. The intermalleoli angle had an average supination shift of 15.6 +/- 5.4° in the 3” heel and 21.1 +/- 6.4° in the 4.25” heel. This disproved the hypothesis. The measure of intermalleoli angle also decreased with heel height by an average of 7.6 +/- 1.6° in the 3” heels and 7.6 +/- 1.9° in the 4.25” heels, confirming talocrural joint approximation during plantar flexion. This research suggests that, even without gait, heel height causes anatomical conditions that may increase medial knee load to create an osteoarthritic risk factor.

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