QUANTIFICATION OF THE MIDTARSAL JOINT LOCKING MECHANISM

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**Background:** The foot is a complex mechanism capable of being both a mobile adapter during weight acceptance and a rigid lever arm during propulsion. The combination of the talonavicular and calcaneocuboid joints (i.e., the midtarsal joint) is thought to play an important role in this transition. By examining the concept of midtarsal joint locking, we will provide new insight into a basic biomechanical function of the foot specifically the effect of hindfoot position and arch height on forefoot mobility. The purpose of this study was to quantify the effect of midtarsal joint locking on forefoot mobility. In general, we hypothesized that there would be more motion in the forefoot when the calcaneous is everted than when the calcaneous is inverted.

**Study Design and Methods:** Using nine cadaveric feet, the talus was fixed to the tibia and Polhemus Fastrak electromagnetic sensors were used to collect positional data. All measurements were made statically; before any data was collected, the foot was loaded and held for 30 seconds to account for soft tissue creep. The tibia and talus sensors were held constant throughout three trials, while the third and fourth sensors were moved from the calcaneous and cuboid to the navicular and 1st metatarsal, and the 2nd and 5th metatarsals, respectively. Nine total positions were used to collect data. A neutral reading was taken first then the hindfoot was held in maximum eversion and the forefoot was held in maximum plantar flexion and dorsiflexion, followed by the forefoot in maximum inversion and eversion. The protocol was repeated with the hindfoot in maximum inversion. We used a repeated measures analysis of variance (ANOVA) to examine the effect hindfoot position on the range of motion of the forefoot.

**Results:**

1st metatarsal: The average sagittal plane motion from dorsiflexion to plantar flexion with calc everted was 12.629° and with calc inverted was 7.096° P= 0.0029. 2nd metatarsal: The average sagittal plane motion from dorsiflexion to plantar flexion with calc everted was 10.948° and with calc inverted was 6.724° P= 0.0025. 5th metatarsal: The average sagittal plane from dorsiflexion to plantar flexion with calc everted was 10.143° and with calc inverted was 6.378° P= 0.0016.

**Discussion:** As expected, there was increased sagittal plane range of motion in the 1st, 2nd and 5th metatarsals when the calcaneous is everted as compared to when the calcaneous is inverted. However, there was no increase in frontal plane motion of either the cuboid or navicular in forefoot eversion and inversion.