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Oral presentation

The calcaneocuboid joint moves with three degrees of freedom

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Introduction

Investigations of the calcaneocuboid joint typically find that it is among the least mobile of the intrinsic foot joints [1]. When movement is found, it is shown to be highly variable among individuals [2]. The joint is therefore relegated to the presumably rigid lateral aspect of the foot. The complementary articular surfaces of the two relevant bones are both relatively flat, with some irregular undulations. This joint surface geometry suggests that movement might be limited to a single rotation and perhaps superior and lateral translations in the synovial plane. In this presentation we challenge this expectation by exploring the calcaneocuboid joint in six degrees of freedom through multiple driving actions.

Methods

Data are derived from the legs of 12 non-pathological embalmed cadavers. Legs were prepared by removing all soft tissue, so that only ligamentous structures remained to sustain limb integrity. Each specimen was cycled by moving the leg on the foot through three mutually orthogonal driving actions (Inversion-Eversion, Medial-Lateral Rotation, and Plantarflexion-Dorsiflexion) while monitoring the relative positions of the calcaneus and cuboid with an active-marker tracking system. The Functional Alignment method [3] was used to derive joint axis orientations and motion patterns for three rotational and three translational degrees of freedom. These results are explored by plotting observed movement patterns against the percentage of the movement cycle.

Results

The movements of the calcaneocuboid joint were explored in all six degrees of freedom for all three driving actions. Figure 1 shows the three clearest movement patterns that were identified. In response to the inversion-eversion driving action the cuboid rotates as much as 25° about an oblique axis – a movement best described as obvolution-involution [4]. The same driving action also produces up to 2 mm of posterior-anterior translation – an actual distraction of the synovial joint. The medial-lateral driving action produced a 6° rotational response about a differently oriented oblique axis, in a movement best described as obversion-reversion [4]. No distinctive movements were produced as a response to the plantarflexion-dorsiflexion driving action.

Conclusion

The calcaneocuboid joint is more mobile than many conventional authorities would suggest. The joint was observed to move in three distinct ways. The largest rotation, occurring only in response to inversion-eversion, meets the expectations based upon surface geometry. However, the other two motions, which require some measure of joint distraction, are not obvious consequences of this geometry.
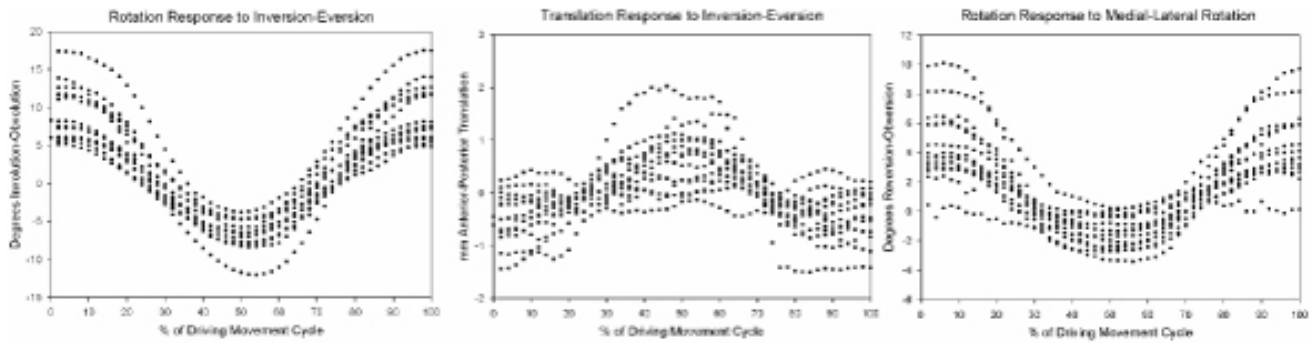
Figure I

The three movement patterns identified for the calcaneocuboid joint; a rotation and translation as the result of the inversion-eversion driving motion and a rotation produced by the medial-lateral rotation of the leg on the foot.

References

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