

## Subject-Specific Orientations of the Talocrural Joint Axes Estimated from the Morphology of the Talar Trochlea

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**Category:** Ankle

**Keywords:** talus, morphology, radius of curvature, talocrural joint, axis orientation, image analysis

**Introduction/Purpose:** The individual morphology variations in the talar trochlea influence subject-specific kinematics of the talocrural joint. In particular, it is suggested that the medial to lateral radius ratios of the anterior and posterior talar trochlea determine the orientations of the dorsiflexion and plantarflexion axes of the talocrural joint, respectively. However, the characteristics of the orientations of these axes of the talocrural joint have not been elucidated. The aims of this study were to assess the variations in the medial to lateral radius ratios of the anterior and posterior talar trochlea and to estimate the subject-specific orientations of the dorsiflexion and plantarflexion rotational axes of the talocrural joint.

**Methods:** Computed tomography (CT) images of forty-nine unilateral adult human male tali were enrolled in this study. The three-dimensional bone models of the talus were reconstructed from the CT images. Four circles were fitted to medial and lateral edges of each anterior and posterior trochlea, respectively. Then, the radii of curvatures of these circles were measured. The medial to lateral radius ratios of the anterior and posterior trochlea were also calculated, respectively. In addition, the line connecting the centers of the medial and lateral circles fitted to anterior trochlea was defined as a dorsiflexion axis of the talocrural joint, and that of posterior trochlea was also defined as a plantarflexion counterpart. The coronal and transverse angles of these axes were calculated.

**Results:** At the anterior trochlea, the medial to lateral radius ratio was ranged from 0.43 to 0.92. This result of the calculated values meant that the all of the lateral curvature of radius was larger than medial counterpart. On the other hand, at the posterior trochlea, the medial to lateral radius ratio was ranged from 0.58 to 1.63. The coronal and transverse angles of dorsiflexion axis were on average  $19.6 \pm 7.3^\circ$  (range,  $-3.9^\circ$  to  $38.9^\circ$ ) and  $10.3 \pm 4.6^\circ$  (range,  $-0.9^\circ$  to  $23.2^\circ$ ), respectively. The coronal and transverse angles of plantarflexion axis were on average  $-1.5 \pm 12.8^\circ$  (range,  $-31.8^\circ$  to  $31.0^\circ$ ) and  $7.5 \pm 4.5^\circ$  (range,  $-3.4^\circ$  to  $17.4^\circ$ ).

**Conclusion:** This study found different features between orientations of the dorsiflexion and plantarflexion axes of the talocrural joint. Concretely, in all the talus specimens, the dorsiflexion axis of the talocrural joint is inclined downwards and laterally on the coronal plane, and inclined backwards and laterally on the transverse plane. On the other hand, there were two types of the plantarflexion axis, one was a type whose axis inclined as the same direction as dorsiflexion axis, and the other was a type whose axis inclined downwards and medially on the coronal plane and inclined backwards and laterally on the transverse plane.

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Foot & Ankle Orthopaedics, 1(1)  
DOI: 10.1177/2473011416500280  
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