

### Modification of the Distal Tibiofibular Relationship of the Normal Ankle in Plantar Flexion and Dorsiflexion Measured on MRI

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**Purpose:** Classically, the position of the foot was thought to be important during reduction and fixation of a syndesmotic injury to avoid loss of dorsiflexion. Even if most cadaveric studies showed that the tibiofibular mediolateral distance increase in dorsiflexion, Tornetta et al showed that the position of the foot did not impact ankle dorsiflexion as long as the syndesmosis was anatomically reduced. A validated measurement system was previously developed to describe the distal tibiofibular joint on both MRI and CT scan. The purpose of this study was to evaluate the impact of the position of the foot in the sagittal plane (dorsiflexion [DF], plantar flexion [PF]) on the syndesmosis using this measurement system.

**Methods:** 34 volunteers were recruited and had a series of ankle MRI scans in three different ankle positions: dorsiflexion, plantar flexion, and neutral position. Inclusion criteria were no previous ankle injuries and no contraindication to MRI examination. Three different holders were designed to keep the ankle stable in the 3 positions. Measurements (6 translational measurements and 2 angles) were then taken on each of the three sets of MRI scans. Paired t tests were done to establish significant differences between measurements.

**Results:** The mean angle between the leg and the foot for the three positions were  $152^\circ \pm 8^\circ$  for plantar flexion,  $95^\circ \pm 3^\circ$  for neutral position, and  $80^\circ \pm 5^\circ$  for dorsiflexion, and this was significantly different. The first set of analyses was between PF and DF. The distance between the most anterior point of the incisura and the nearest most anterior point of the fibula varied from 2.5 mm (PF) to 3.9 mm (DF) ( $P < 0.0001$ ). The same posterior measurement was not significant. The fibular angle also changed from  $8.7^\circ$  (PF) to  $7.8^\circ$  (DF) of internal rotation ( $P = 0.046$ ). The distance between the tibia and the fibula in the middle of the incisura was 1.5 mm in PF and increased to 2.6 mm in DF ( $P < 0.0001$ ). In the anteroposterior plane, there was a significant anterior displacement of the fibular in the incisura of 0.4 mm ( $P = 0.007$  and  $P = 0.037$ ). Those differences were essentially from PF to neutral position. The only parameter increase of 0.4 mm from neutral to DF was the anterior distance ( $P < 0.002$ ).

**Conclusion:** There are significant changes in normal anatomy of syndesmosis between dorsiflexion and plantar flexion. Specifically, there is an increase in external rotation and lateral translation of the fibula. These changes are visible with MRI using a validated measurement system and values are concordant with those reported on cadaveric studies. Taking ankle position into consideration will be important for future research studies that focus on syndesmosis imaging.