Invisible Injuries in Ankle Fractures: A Biomechanical Study
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Introduction/Purpose: Ankle fractures are often associated with ligamentous injuries of the distal tibiofibular syndesmosis, the deltoid ligament and are predictive of ankle instability, early joint degeneration and long-term ankle dysfunction. Detection of ligamentous injuries and the need for treatment remain subject of ongoing debate. In the classic article of Boden it was made clear that injuries of the syndesmotic ligaments were of no importance in the absence of a deltoid ligament rupture. Even in the presence of a deltoid ligament rupture, the interosseous membrane withstood lateralization of the fibula in fractures up to 4.5mm above the ankle joint. Generally, syndesmotic ligamentous injuries are treated operatively by temporary fixation performed with positioning screws. But do syndesmotic injuries need to be treated operatively at all?

Methods: The purpose of this biomechanical cadaveric study was to investigate the relative movements of the tibia and fibula, under normal physiological conditions and after sequential sectioning of the syndesmotic ligaments. Ten fresh-frozen below-knee human cadaveric specimens were tested under normal physiological loading conditions. Axial loads of 50 Newton (N) and 700N were provided in an intact state and after sequential sectioning of the following ligaments: anterior-inferior tibiofibular (AITFL), posterior-inferior tibiofibular (PITFL), interosseous (IOL), and whole deltoid (DL). In each condition the specimens were tested in neutral position, 10 degrees of dorsiflexion, 30 degrees of plantar flexion, 10 degrees of inversion, 5 degrees of eversion, and externally rotated up to 10Nm torque. Finally, after sectioning of the deltoid ligament, we triangulated Boden’s classic findings with modern instruments. We hypothesized that only after sectioning of the deltoid ligament; the lateralization of the talus will push the fibula away from the tibia.

Results: During dorsiflexion and external rotation the ankle syndesmosis widened, and the fibula externally rotated after sequential sectioning of the syndesmotic ligaments. After the AITFL was sectioned the fibula starts rotating externally. However, the external rotation of the fibula significantly reduced when the external rotation torque was combined with axial loading up to 700N as compared to the external rotation torque alone. The most relative moments between the tibia and fibula were observed after the deltoid ligament was sectioned.

Conclusion: Significant increases in movements of the fibula relative to the tibia occur when an external rotation torque is provided. However, axial pressure seemed to limit external rotation because of the bony congruence of the tibiotalar surface. The AITFL is necessary to prevent the fibula to rotate externally when the foot is rotating externally. The deltoid ligament is the main stabilizer of the ankle mortise.

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