# *In vivo* Kinematics of the Ankle with Lateral Instability

Chosun University Hospital, Duke University Medical Center*

Jun Young Lee, James A Nunley* Louis Defrate* Adam Caputo*

## ❖ Introduction

The objective of this study was to measure the motion of the talocrural joint in patients with chronic lateral ankle instability.

## ❖ Materials and Methods

Seven subjects (4 males, 3 females, aged 19-57 years) participated in this study. Subjects recruited had unilateral ankle sprains which had been treated conservatively for at least 6 months and were diagnosed with chronic lateral ankle instability by an orthopaedic surgeon. Rupture of the ATFL was confirmed via MRI. Patients with osteochondral lesions were excluded from the study.

Subjects were imaged using a 3.0T magnet (Trio, Siemens, Germany) and an 8 channel receive-only foot and ankle coil (*In vivo*, Orlando FL).

For each subject, each ankle was imaged separately using a 3D double echo steady state sequence (DESS, Flip angle: 25°, TE: 6 msec, TR: 17 msec) with a 15 cm by 15 cm field of view. The resulting sagittal plane images had a resolution of 512 by 512 pixels and a slice thickness of 0.7 mm. In each image, the anatomy of the tibia and talus were outlined using solid modeling software. Each contour was then placed in the appropriate plane in space, and the curves were used to generate a 3D surface model of the tibiotalar joint.

Next, each patient was imaged using two fluoroscopes (Pulsera, Philips, The Netherlands) positioned orthogonally above a platform. The fluoroscopes recorded images simultaneously with a resolution of 1024 by 1024 pixels. Subjects stood on the platform and stepped onto a level surface within the beams of both fluoroscopes. Subjects stepped onto the platform while increasing the load from 0 to 100% of their body weight.

These images and the 3D model of the talocrural joint were used to reproduce the in vivo motion of the each subject's ankles, using a manual model-based matching technique4. From these models, the six degrees-of-freedom kinematics of the talocrural joint were recorded.

The anteroposterior translation and internal rotation of the talus of each patient's intact and injured ankle was compared using the Wilcoxon Signed Rank Test.

❖ Results

In both the intact and injured ankle, the talus translated anteriorly with increasing load. However, the ATFL deficient ankle had increased anterior translation of the talus compared to the intact ankle at 100% body weight ($p$<0.05). The talus in the unstable ankle was 0.9±0.5 mm (mean±standard deviation) anterior to the talus in the intact ankle.

In the intact ankle, there was a slight external rotation of the talus with increasing body weight. However, the ATFL deficient ankle rotated internally. For example at 100% body weight, the talus in the deficient ankle was 6.7±2.8° internally rotated relative to the talus in the intact ankle ($p$<0.05).

❖ Conclusion

This study demonstrated that injuries to ATFL are associated with increased anterior translation and internal rotation of the talus under *in vivo* weight-bearing conditions. These data may be useful for evaluating and improving reconstruction techniques aimed at restoring normal ankle joint motion.

색인단어 | *In vivo* kinematics, Lateral ankle instability