

## Abnormal Gutter Geometry as a Risk Factor of Chronic Ankle Instability

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**Introduction/Purpose:** Abnormalities in the tibial plafond geometry, such as varus deformity or insufficient talar anterior coverage, have been recognized as the congenital risk factors of chronic ankle instability (CAI) and eventual osteoarthritis (OA) development. Given that the gutter articulations are playing a substantial role in ankle stability, presumably, geometrical abnormality of these articulations also increases such risks, though this concept has not been well addressed to date. Our recent study (2016 AOFAS Annual Summer Meeting) revealed that OA ankles are frequently (>50%) marked by excessive anterior and/or inferior opening of the talar side-walls. The present study examined whether or not CAI cases share these geometrical characteristic, so as to identify a risk factor that predispose ankles to CAI and eventual OA development.

**Methods:** Clinical multi-detector computed tomography (MDCT) images, from 29 symptomatic CAI cases who were indicated for surgical repair or reconstruction of the lateral ligaments, and from 54 asymptomatic non-degenerative (control) ankles, were selected for 3-D morphometric evaluation of the talar dome side-wall geometry. Using a DICOM viewer, a local coordinate system for each ankle was established using talar landmarks. Then, on a transverse section at 3-5 mm distal to the superior aspect of the talar trochlea, the angle between the medial and lateral side-wall tangential lines (regressed from five cortical surface reference points for each) was measured as the “anterior opening angle.” Similarly, the “inferior opening angle” was measured on a mid-coronal section. Differences between groups were statistically tested using a t-test.

**Results:** The anterior opening angles in CAI cases (mean  $\pm$  SD:  $11.9 \pm 4.4$  degrees) were significantly larger ( $p < 0.001$ ) than in control cases ( $7.4 \pm 3.4$ ). Defining the range of mean  $\pm$  2SD in Control as “normal” (Figure 1), 9 out of 29 CAI cases (31%) had excessive anterior opening of the talar side-wall surfaces. Although the inferior opening angle did not exhibit significant difference between the groups ( $28.5 \pm 9.6$  in CAI versus  $25.5 \pm 5.9$  in Control,  $p = 0.082$ ). Defining the range of mean  $\pm$  2SD in Control as “normal” (Figure 1), 4 CAI cases (14%) had excessive inferior opening. In total, 12 out of 29 CAI cases (41%) had abnormal talar side-wall geometry.

**Conclusion:** These data suggest that a certain fraction of CAI ankles feature abnormal geometrical characteristics consistent with OA ankles, i.e. excessive anterior and/or inferior opening of the talar dome side-walls. Given that none of the CAI cases had remarkable degenerative or traumatic deformities, these characteristics are arguably congenital. Theoretically, the posteriorly narrower shape of the talar trochlea would reduce talocrural congruity in plantar flexion, while the inferiorly wider shape itself would reduce coronal plane stability. These geometrical abnormalities appear to predispose ankles to CAI. For such ankles, aggressive surgical stabilization may forestall OA development following lateral ligament injuries.

