Comparison of Deformity with Respect to Talus in Adult Acquired Flatfoot Patients and Controls Using Multi-Planar Weight-Bearing Imaging vs Conventional Radiography

Foot & Ankle Category: Hindfoot

Author(s):
Amgad M. Haleem, MBBCh, MS (Orth)
Elizabeth Young, BS
Helene Pavlov, MD
Eric Bogner, MD
C. Sofka, MD
Nina Geatrakas
Kristi Leggett
Jonathan T. Deland, MD
Scott J. Ellis, MD

Introduction
Adult Acquired Flatfoot Deformity (AAFD) varies in location and severity, particularly with respect to the talus. Though conventional, weight-bearing radiographs (XR) have been validated to assess AAFD(1), their two dimensional nature and the inability to sometimes achieve full weight-bearing during acquisition may limit their ability to define this complex deformity. Three dimensional (multi-planar) weight-bearing imaging (3D-MP) is a novel modality yielding computed tomography (CT)-like images compared to XR(2), yet with 100% weight-bearing. It requires shorter acquisition time and lower radiation compared to standard CT. The aim of this study is to test the hypotheses that; firstly, 3D-MP localizes deformity with respect to talus in a cohort of AAFD patients compared to controls. Secondly; 3D-MP correlates with XR in assessing radiographic parameters of AAFD.

Methods
From 2009 to 2011, XR and 3D-MP of the foot and ankle were obtained for 23 consecutive patients with flexible (Stage II) AAFD (10 males, 13 females, mean age 63±8.3 years) scheduled to undergo reconstruction. Ten consecutive patients who underwent imaging for unrelated forefoot pathology (8 females, 2 males, mean age 48.5+14.3 years) from the same time period served as controls. Thirteen radiographic parameters on the axial, sagittal, and coronal views of the 3D-MP were compared between the two groups by blinded, musculoskeletal radiologists. Similarly, AP and lateral foot/ankle views on XR were compared between groups for all parameters except lateral gutter distance and talofibular impingement, not possible to assess on XR. Parameters were compared between groups with a Wilcoxon rank sum test (p < 0.05). Correlation between XR and 3D-MP parameters were performed using ICC/Kappa analysis. Values > 0.8 were considered to demonstrate excellent agreement, 0.7 to 0.8 very good agreement and 0.5 to 0.6 good agreement(2).
Results
Statistically significant differences between study and control groups were found on 3D-MP in six out of 13 radiographic parameters; axial talar-first metatarsal (1TMT) angle and talonavicular uncoverage percent, and sagittal 1TMT angle, talonavicular angle, talocalcaneal angle and the angle of the talus with respect to the floor (p < 0.05). However, only one parameter on XR (lateral 1TMT angle) reached significance (p < 0.05). ICC/Kappa analysis showed excellent agreement between both imaging modalities for 3 parameters; lateral 1TMT angle, naviculocuneiform angle, and the angle of the talus with respect to the floor (0.815, 0.855 and 0.828, respectively) and good agreement for 3 parameters; talonavicular coverage angle, naviculocuneiform angle and talocalcaneal angle (0.571, 0.603 and 0.664, respectively).

Conclusion
These results show that deformity with respect to the talus in AAFD is multifactorial, but was notably seen at the talonavicular joint in the sagittal plane with both modalities. Good to excellent agreement was found between XR and 3D-MP for many parameters, yet more significant differences were found between the flatfoot and control groups for the 3D-MP modality. This implies a potential role for 3D-MP as a more reliable and informative tool to assess AAFD. However, testing this modality with larger number of study patients and normal controls is still required for further validation.