Hindfoot Alignment of Adult Acquired Flatfoot Deformity: A Comparison of Clinical Assessment and Weightbearing ConeBeam CT Examinations

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Introduction/Purpose: Assessment of hindfoot alignment in adult acquired flatfoot deformity (AAFD) can be challenging. Clinical judgment and radiograph studies while important may not represent the accurate valgus alignment of the affected patients. Weightbearing (WB) ConeBeam CT (CBCT) is an emerging imaging modality that may potentially better demonstrate the three-dimensional (3D) deformity, facilitating visualization of important soft-tissue and bony landmarks and helping in surgical planning. Based on the relative position of bone and soft-tissue axes, different measurements of hindfoot alignment can be obtained with CT images. Therefore, we compared clinical assessment of hindfoot valgus alignment in AAFD patients with different possible measurements performed on WB CBCT images.

Methods: In this prospective, IRB-approved study, 20 patients (20 feet, 15 right and 5 left) with clinical diagnosis of flexible AAFD were included. There were 12 males and 8 females, with a mean age of 52.2 years (range, 20 – 88 years of age), and average BMI of 30.35 kg/m² (range, 19.00 – 46.09 kg/m²). Patients underwent clinical assessment of hindfoot alignment as well as WB CBCT. Two independent and blinded foot and ankle board-certified surgeons performed different hindfoot alignment measurements on the WB CBCT images that included: 3D “clinical” alignment; Achilles tendon axis/calcaneal tuberosity angle; angles formed between the tibial axis and the calcaneal tuberosity, calcaneal axis and line connecting midpoint of subtalar joint and most inferior part of calcaneal tuberosity. Positive values were considered valgus alignment. Mean differences between the measurements modalities were compared by paired T-test. Intra- and Inter-observer reliability for the WB CBCT measurements were calculated using Pearson correlation.

Results: The mean clinical hindfoot valgus measured was 15.15° (SD 7.7°). It was found to be significantly different from the mean values of all WB CBCT angles modalities: 3D “clinical” alignment (10.42°, p < 0.015); Achilles tendon/calcaneal tuberosity angle (2.96°, p < 0.0001); tibial axis/calcaneal tuberosity angle (5.42°, p < 0.0001); tibial axis/subtalar joint angle (7.52°, p < 0.0001) and tibial axis/calcaneal axis angle (20.39°, p < 0.017). We found an excellent intra-observer agreement for all WB CBCT 3D measurements (range, 0.8863 – 0.9713, p < 0.0001). There was also good to excellent inter-observer reliability, with the exception of the 3D “clinical” alignment (r=0.450, p < 0.04), that showed moderate correlation.

Conclusion: The use of 3D WB CBCT imaging can help characterize the valgus hindfoot alignment in patients with adult acquired flatfoot deformity. We found the different CBCT measurements modalities to be reliable and repeatable, and to significantly differ from the clinical evaluation of hindfoot valgus alignment.