Weightbearing CT to Assess Rearfoot and Ankle Alignment in Patients with Advanced DJD being Considered for Total Ankle Replacement

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STATEMENT OF PURPOSE

MRI and CT is routine for patients with advanced ankle DJD being evaluated for TAR. Despite advanced imaging, alignment of the rearfoot and ankle is primarily assessed by clinical exam and standard weightbearing xrays. We routinely use weightbearing (WB) CT for this complex patient population which is particularly useful at evaluating how the talus sits in the ankle mortise while standing. The clinical utility of this technology has not been evaluated. This is a case series of 3 patients highlighting the clinical utility and therapeutic advantages of WB CT.

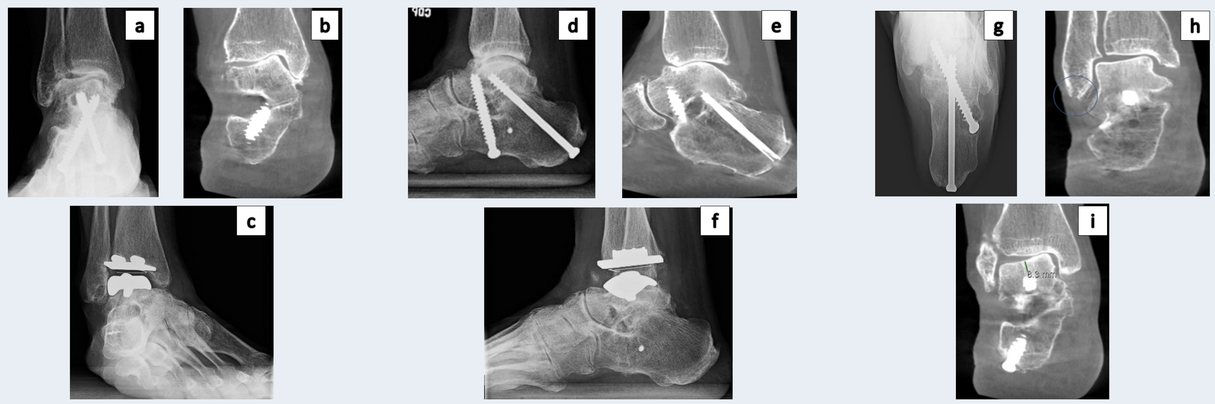
LITERATURE REVIEW

- Hirschmann et al prospectively reviewed ankle NWB CT and WB CT in 22 patients. They concluded that alignment of the hindfoot significantly changes in the upright WB CT position.
- Cody et al. used WB CT to analyze the anatomy of the talus and the alignment of the subtalar joint in 45 patients with adult type II acquired flatfoot and 17 volunteer controls. The subtalar alignment was assessed using the angles between the bottom facet of the talus, the ground and the angle between the upper and lower facets of the talus. Both of these angles were seen to differ significantly between the study groups. The researchers concluded that patients with flatfoot valgus deformity presented greater innate valgus in their talar anatomy and greater alignment of the subtalar joint in valgus.
- Brussens et al. used WB CT to introduce a clinically relevant and reproducible method to measure hindfoot alignment. 60 malalignments of the hindfoot were divided into 2 groups n=30 varus and n=30 valgus malalignment. They were able to observe a positive correlation between hindfoot alignment angles and concluded that WB CT can aid the surgeon in translation of a calcaneal osteotomy.
- Krähenbühl et al. reviewed 60 ankles 40 osteoarthritic patients and 20 healthy controls. The osteoarthritic ankles were divided into 4 groups: varus ankle joints with/without a tilted talus and valgus ankle joints with/without a tilted talus. The orientation of the subtalar joint was described using the subtlar vertical angle (SVA). The SVA was determined for every patient using weightbearing CT scans. Conclusion: The SVA [using WB CT] provided a reliable and consistent method to assess the varus/valgus configuration of the posterior facet of the STJ. In our cohort, varus osteoarthritis of the ankle joint occurred with varus orientation of the STJ, whereas patients with valgus osteoarthritis, valgus orientation of the STJ was found.

CASE #1

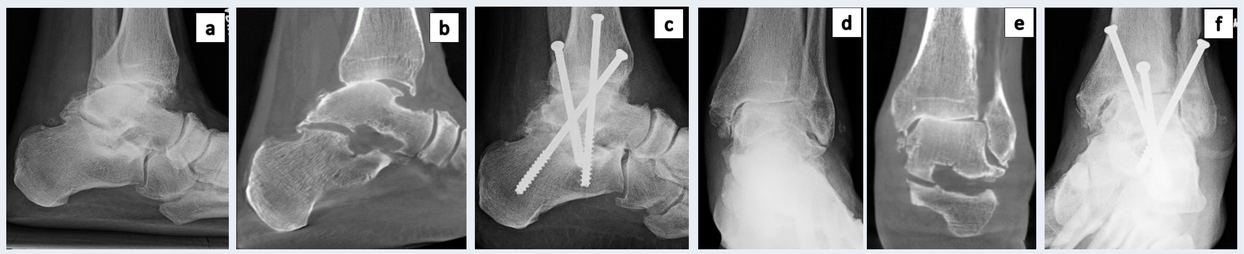
- 63 y/o healthy female with history of multiple surgeries for cavus reconstruction presents with recurrent chronic ankle pain. Exam findings consistent with advanced ankle DJD. Preop imaging **(Figure 1)** including WB CT demonstrated varus talar tilt despite previous ankle stabilization and STJ fusion for cavus deformity and peroneal dysfunction 3 years prior. Pre-op labs included Vitamin D, 25-OH of 35ng/ml, Hgb A1c of 6.8% and a Calcium of 10.5 mg/dl. She underwent successful TAR with restoration of alignment and pain free ankle ROM.

Figure 1. Case 1 with advanced ankle DJD including varus talar tilt and prior STJ fusion for cavus reconstruction



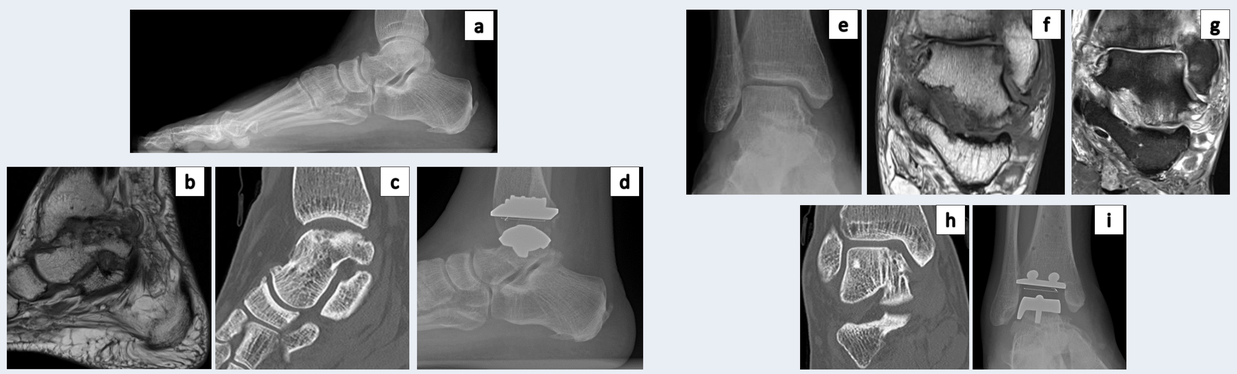
Preop (a) WB AP xray, (b) WB coronal CT, and (c) WB postop mortise view following TAR to compare coronal plane alignment. Note how the WB CT fully evaluates varus tilt associated with medial cartilage loss. Preop (d) WB lateral xray, (e) WB sagittal CT image, and (f) postop WB lateral xray. WB CT allows complete assessment of talar alignment in the mortise with anterior impingement and anterior loss of joint space. Preop (g) WB axial view and (h-i) WB coronal CT. Note how the WB CT allows preop assessment of heel alignment and how talar tilt impacts coronal plane foot alignment.

Figure 2. Case 2: Severe degenerative joint disease of the ankle and STJ with posterior displacement of the talus



Preop (a) lateral xray and (b) WB sagittal CT images demonstrate advanced degenerative osteoarthritic changes present at the tibiotalar joint with complete obliteration of the joint space and posterior translation of the talus relative to the tibia. (c) WB lateral xray post tibiotalocalcaneal (TTC) fusion with proper alignment. (d) Preop AP ankle xray with advanced DJD but no talar tilt. (e) Preop WB coronal CT image allows better appreciation for how the talus sits in the mortise including significant lateral and medial impingement. (f) TTC fusion is shown here on ankle mortise xray.

Figure 3. Case 3: TAR for failed arthroscopic treatment of >3 cm shoulder lesion of the talus with MRI and NWB preop CT



Preop (a) WB lateral xray, (b) MRI, (c) NWB sagittal CT image, and (d) WB postop lateral xray following TAR. Note how the talus was plantarflexed in the mortise during CT imaging which does not represent sagittal plane alignment or how the lesion articulates with the distal tibia. Similar issues are seen with MRI imaging. Preop (e) WB ankle mortise xray, (f-g) MRI, (h) NWB coronal CT image, and (i) WB postop mortise xray. The plantarflexed talus associated with NWB CT impacts how the more narrow posterior talus appears in the mortise.

CASE #2

- 71 y/o very active and healthy male with a history of rearfoot and medial ankle pain for past 7 years. Instability on exam with crepitus and very limited dorsiflexion associated with chronic sprains from many years of basketball. Patient failed conservative treatment, therefore was sent for surgical consult. Plain films as well as advanced imaging is shown in **Figure 2** to highlight benefits of WB CT. Pre-op labs included Albumin of 3.7 g/dl and Calcium of 9.3 mg/dl. Posterior talar translation with respect to the tibial plafond combined with DJD of the ankle and STJ. Deformity was corrected with TTC fusion after 1 year of failed non-operative treatment.

CASE #3

- 53 y/o nondiabetic sedentary female referred for TAR. Ankle arthroscopy 2 years prior for medial shoulder lesion without pain relief. Patient related to grinding, catching and locking of her ankle joint with increased disability as a result. Advanced imaging including MRI and NWB CT **(Figure 3)** was performed at OSH demonstrating significant osteochondral defect on the posterior half of the medial shoulder of the talus. Preop labs included Vitamin d, 25-OH of 37 ng/ml, Hgb A1c of 6.2% , Calcium of 9.5 mg/dl. TAR was successfully performed as the patient did not want to risk potential complications associated with block allograft and malleolar osteotomy.

ANALYSIS & DISCUSSION

- Obtaining WB CT imaging is particularly helpful with assessment of rearfoot and ankle alignment in patients being considered for TAR. Alignment of the talus within the ankle mortise has significant impact on surgical decision making, which is best evaluated while standing.
- In 2017, Lintz et al (7) evaluated hindfoot alignment in 135 patients. The findings of this study suggest WB CT measurements of the foot and ankle can be used as a tool to assess hindfoot alignment.
- Hirschmann et al prospectively reviewed ankle NWB CT and WB CT in 22 patients. They concluded that alignment of the hindfoot significantly changes in the upright weightbearing CT position. Differences are visualized and measured using WB CT
- This case series highlights the benefits of WB CT imaging in advanced DJD which is our standard approach for patients being evaluated for TAR. Analysis of this imaging modality would benefit largely from a larger prospective cohort study. As there are inherent limitations to case studies.

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