Metal Artifact Reduction MRI for Sagittal Balance Evaluation of Total Ankle Arthroplasty

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Introduction/Purpose: Surgical restoration of the anatomical relationship between talus and tibia is considered crucial for longevity of total ankle arthroplasty (TAA). Weight-bearing (WB) radiographs are the current standard for evaluating the sagittal balance alignment, which are, however, prone to rotational misalignment and potentially altered measurements. Metal artifact reduction sequence (MARS) MRI is a cross-sectional technique that minimizes implant-induced artifacts and affords the visualization of bone-implant interfaces and periprosthetic bone without distortions. Although not weight-bearing, MARS MRI offers the ability to align the image plane to the true sagittal axis of the talar implant and anatomically correct measurements. Therefore, the purpose of this study was to compare sagittal balance alignment measurements on MARS MR images and standard WB radiographs in patients with TAA.

Methods: In this IRB-approved, prospective study, 23 subjects [10 men/13 women, age 60(41-73) years; 13(3-24) months post-op] underwent MARS MRI and standard lateral WB radiographs. Standardized MARS MR images were obtained in alignment to the sagittal talar component axis and use of a boot-shaped MRI coil. Maximum-intensity-projection MR images that resemble lateral radiographs were created to bring anatomic landmarks, such as lateral talar process, talonavicular joint line, talar implant, tibial shaft, and posterior talus into one single image. Three board-certified foot ankle surgeons performed sagittal balance alignment measurements twice in an independent, random and blinded fashion. The second set of measurements was obtained 1 months after the first assessment. In accordance with published measurements, lateral talar station (LTS), tibial axis-to-talus (T-T) ratio, and normalized tibial axis-to-lateral-process (T-L) distance were measured. Pearson correlation coefficient (r), Concordance-Correlation-Coefficient (CCC) and Intraclass-Correlation-
Coefficient (ICC) were used for statistical analysis. Bonferroni-corrected p-values ≤ 0.01 were considered significant.

**Results:** The intra-observer agreement was excellent for radiographic (CCC = 0.93 - 0.97) and MRI (CCC = 0.90 - 0.97) measurements. Inter-observer agreements were good-to-excellent with overall higher agreements for MRI (ICC = 0.76 - 0.93) than for radiography (ICC = 0.58 - 0.95) measurements. There was statistically significant inter-method correlation between radiographic and MRI measurements including LTS (r=0.83, p < 0.001), T-T ratio (r=0.86, p < 0.001) and normalized T-L distance (r=0.72, p < 0.001). The T-T ratios of radiographs and MRI were statistically not different (p=0.36), whereas LTS and normalized T-L distance were significantly lower on MR images when compared with radiographs (p < 0.001).

**Conclusion:** Sagittal balance measurements performed on standardized weight-bearing radiographs and standardized MARS MR images demonstrate substantial correlation and similarity. Given its high inter- and intra-observer agreement, MARS MRI may be helpful for the evaluation of sagittal balance following TAA.