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QUANTITATIVE MODELING TO EVALUATE ANKLE OSTEOARTHRITIS MORPHOLOGY

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INTRODUCTION: Our understanding and diagnosis of ankle joints typically come from 2D measurements[1]. High-resolution weight-bearing CT scans provide a more complete understanding of the joints by allowing 3D visualization[2]. By quantitatively analyzing bones & joints in 3D, average shape and location of osteophyte growth can be measured and reported[3]. Segmentation of weight-bearing CT scans from patients with end-stage osteoarthritis (OA) creates 3D bone reconstructions that can be used to create statistical shape models enabling quantification of morphology. Statistical shape modeling is used to analyze 3D morphological variations across a population of bones via mathematically distributed correspondence particles[4]. By quantifying morphological differences between healthy and osteoarthritic ankles, we can better understand the progression of OA and improve diagnosis.

METHODS: 81 participants with symptomatic end-stage OA underwent weightbearing CT scans (Planmed Verity; 0.4 x 0.4 x 0.4 mm voxels) with IRB approval. Mimics Innovative Suite from Materialise was used to complete their bone segmentations. Patient specific analyzable 3D bone reconstructions were then calculated from the segmentations. Once all bone reconstructions are complete, group wide morphology analyses may be performed.

RESULTS: The 3D bone reconstructions illustrate osteophyte growth and narrowed distance throughout the tibiotalar, subtalar, talofibular, and tibiofibular joints indicative of end-stage ankle OA.

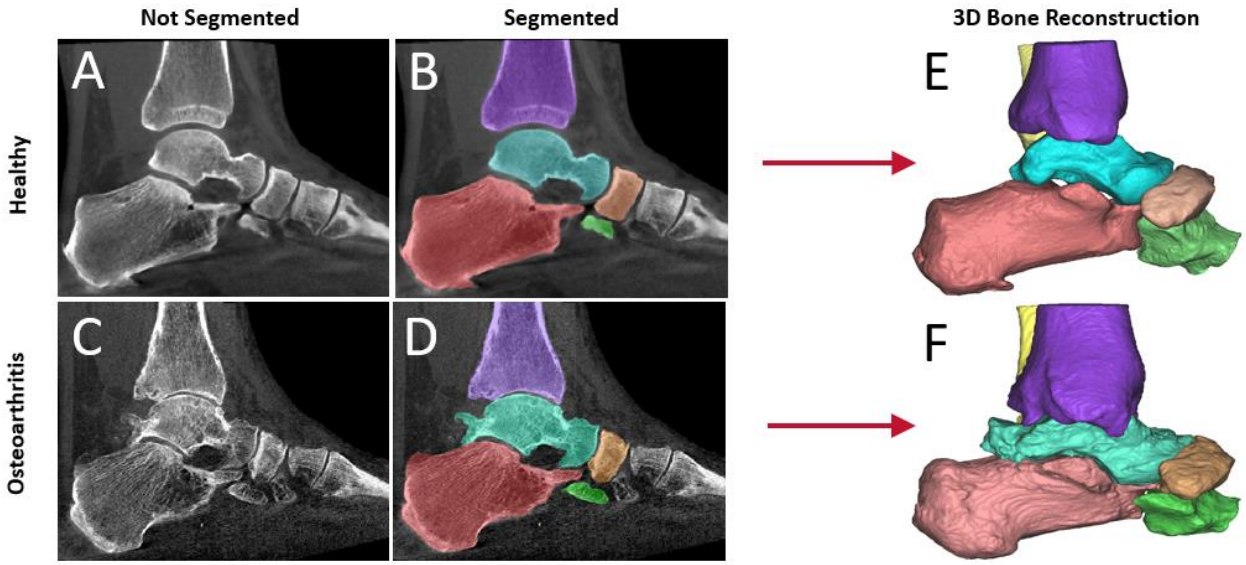

Figure 1: Weight bearing computed tomography sagittal view of ankle joints (A) Healthy not segmented, (B) Healthy segmented, (C) Osteoarthritis not segmented, (D) Osteoarthritis segmented, (E) Healthy 3D bone reconstruction, and (F) Osteoarthritis 3D bone reconstruction.

DISCUSSION: Comparison of ankles with OA to healthy asymptomatic ankles in terms of differences in joint relationships i.e., coverage, congruence, and distance may be performed as well as individual whole bone morphometric analysis. These results could be used to better diagnosis and treatment of pathological ankles improving patient outcomes. By increasing our understanding of ankle OA progression earlier diagnosis of OA is possible and can influence clinical decisions such as preventative care and surgery.

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