Use of Simulated Weight-bearing for MR Evaluation of Ankle and Hindfoot Mechanics: A Feasibility Study

I. Elias[1], A. C. Zoga[2], A. Gopez[2], S. M. Raikin[1], and W. B. Morrison[2]

[1]Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University Hospital, Philadelphia, PA, United States, [2]Radiology, Thomas Jefferson University Hospital, Philadelphia, PA, United States

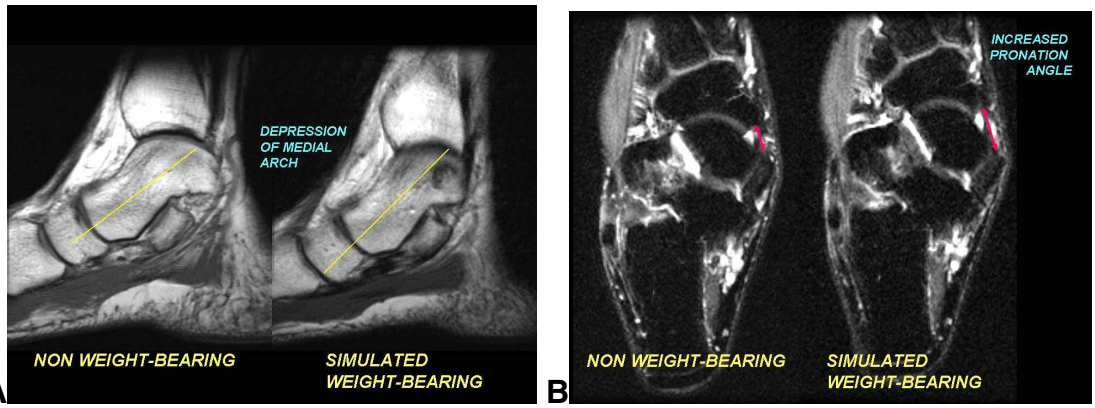
Objective: The purpose of our study was to determine observable effects of axial load on the ankle and hindfoot during MR imaging, which could potentially aid in diagnosis of posterior tibialis tendon (PTT) insufficiency.

Materials and Methods: 10 ankles of 10 patients with clinical findings suggesting PTT insufficiency were imaged at 1.5T (Horizon LX, GE Medical Systems, Milwaukee, WI). Patients were placed within a simulated weight-bearing MR-compatible axial compression device (Dynawell, Billdal, Sweden) with the leg to be scanned in full extension, the foot placed in the center of the platform. Three-inch surface coils were placed at each side of the ankle and the following protocol was performed without applied stress and after application of 25% total body weight across the affected ankle. Resultant MR images were evaluated for observable effect of the simulated weight bearing. MRI protocol was as following:

	Seq.	FOV	Matrix/ Nex	Slice	TR	TE	ETL	BW
1	Sag T1 SE Non FatSat	14	256 x 192 1	4/1	400-800	Minimal		16
2	Sag T2 FSE Non fat sat	14	256x256 3	4/1	>2000	40-60	8	16
3	Axial T2 FSE FatSat	14	256 x 256 2	4/1	>2000	40-60	8	16
4	Coronal T2 FSE FatSat	14	256 x 256 3	3/1	>2000	40-60	8	16

Apply 25-50% weight across scanned knee; repeat series #2 and #3

Results: All patients tolerated the exam; all were of diagnostic quality similar to a conventional high field MR exam. Observable effects were noted in 10/10 patients with suspected PTT insufficiency; deformities noted upon were new or increased pronation angle, uncovering of the medial talar head, depression of the medial longitudinal arch with decreased Meary's angle, and increased hindfoot valgus angle.



A B

Fig 1. Effect of application of axial load using 25% body weight in a patient with early stage posterior tibialis tendon dysfunction. A) Sagittal T1-weighted spin echo images; B) Axial T2-weighted fat suppressed FSE image.

Conclusion: High field MR imaging of the ankle and hindfoot is feasible under simulated weight-bearing conditions using small surface coils. The result yields diagnostic quality images with depiction of alteration in alignment of the bones, which may be an indication of mechanical dysfunction. Validation and evaluation of normal asymptomatic controls is necessary to determine the range of normal variation and deformity associated with pathology. Combination of anatomic and mechanical information regarding PTT dysfunction could help guide conservative versus surgical management.