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Weightbearing CT and MRI findings of Stage II Flatfoot Deformity: Can We Predict Patients at High Risk for Foot Collapse?

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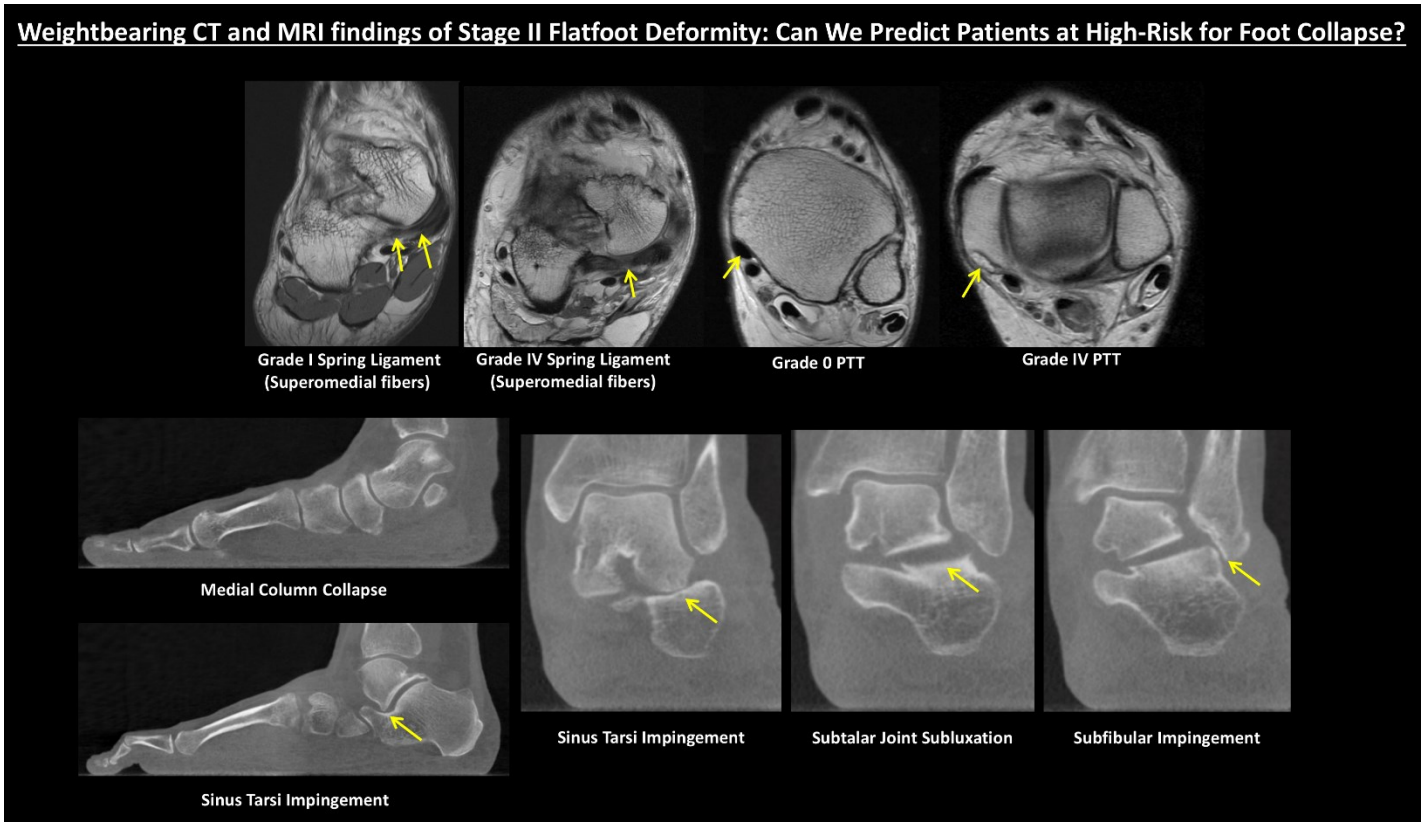
Introduction/Purpose: Adult acquired flatfoot deformity (AAFD) is characterized by concurrent bony deformities, tendinous and ligamentous insufficiencies. Weightbearing CT (WBCT) is a new imaging technique that allows excellent evaluation of the relative three-dimensional positioning of the tarsal bones in dynamic deformities such as AAFD. MRI, on the other hand, provides an accurate evaluation of soft tissue integrity in the unloaded foot. The objective of this study was to evaluate the correlation between bone deformity and soft tissue insufficiency in patients with stage II AAFD, using WBCT and MR images. We hypothesized that a significant correlation would be found between WBCT measurements of increased longitudinal arch collapse, hindfoot valgus, peritalar subluxation and forefoot abduction, with MRI findings demonstrating degree of involvement of ligaments and posterior tibial tendon (PTT).

Methods: This retrospective comparative study included 55 patients (56 feet) with stage II AAFD, 20 men and 35 women, mean age of 52.5 (range, 20 to 78) years. Multiple WBCT and MRI variables related to the severity of the deformity were evaluated by four blinded and independent readers (two radiologists and two foot and ankle surgeons), including: arch collapse (navicular-floor distance and forefoot arch angle), hindfoot alignment angle (HAA), forefoot abduction (talonavicular uncoverage angle), subtalar joint subluxation, sinus tarsi and subfibular impingement, and soft tissue insufficiency (posterior tibial tendon, spring and talocalcaneal ligaments). Tendinous and ligamentous involvement on MRI were graded from zero (normal) to four (complete tear). Intra- and interobserver reliabilities were assessed by Pearson/Spearman's and intraclass correlation coefficient, respectively. A multiple regression analysis was used to evaluate the relationship between bone alignment (WBCT variables) and soft tissue injury (MRI variables). P-values of less than 0.05 were considered significant.

Results: We found overall good to excellent intra (range, 0.83-0.99) and interobserver reliability (range, 0.71-0.97) for WBCT measurements and MRI readings. Spring ligament superomedial component involvement was the only finding to correlate with medial column collapse and decreased navicular-floor distance ($p=0.03$). Superomedial spring ligament and PTT degeneration were also significantly correlated with increased HAA ($p<0.01$). Involvement of the talocalcaneal interosseous ligament significantly correlated with increased forefoot abduction as measured by the talonavicular uncoverage angle. Spring ligament degeneration, of both superomedial and inferior components, and talocalcaneal interosseous ligaments significantly correlated to subtalar joint subluxation ($p<0.001$). Involvement of the talocalcaneal interosseous ligament was the only one to significantly correlate to the presence of subfibular impingement ($p=0.02$). Degeneration of the PTT was significantly associated with sinus tarsi impingement ($p=0.04$).

Conclusion: This study is the first to evaluate correlation between bone, tendinous and ligamentous involvement in AAFD patients, using WBCT and MR images. Our results demonstrated that progressive bone deformity in WBCT is significantly correlated to MRI involvement of the PTT and other important restraints such as the spring and talocalcaneal ligaments. The implications are that WBCT can predict ligamentous injuries and that MRI can predict dynamic bone deformity in AAFD patients. Furthermore, the correlation of bone and soft tissue involvement could impact surgical planning of flatfoot patients, decreasing thresholds for additional soft tissue procedures such as a spring ligament reconstruction.

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