The Deltoid Ligament: The Gatekeeper to Midfoot Collapse in Adult Acquired Flatfoot Disorder

Neal Ormsby, MBChB (Hons) MRCS, Simon Platt, MB ChB,FRCR, Gillian Jackson, MB ChB, Paul Evans, MB ChB,FRCR

Category: Basic Sciences/Biologics,Hindfoot,Midfoot/Forefoot

Keywords: Adult acquired Flatfoot deformity, AFFD, PTTI, PTTD, Planovalgus

Introduction/Purpose:
The medial ligaments are integral in stabilising the medial column. Failure of these structures causes adult acquired flatfoot deformity (AAFD). The superomedial-cancaneonavicular component of the spring ligament(SLC) includes the medial capsule of the talonavicular joint and merges with the anterior superficial component of the deltoid complex, stabilising the talonavicular joint. However, when disrupted, it does not cause planovalgus deformity until the foot is cyclically loaded. We hypothesise that the next structure in the sequential failure cascade is the tibionavicular component of the Deltoid complex(TN) . With the failure of the SLC and the secondary effect of the posterior tibial tendon this ligament is the gatekeeper to stability of the midfoot, preventing plantar subluxation of the talus, and maintaining the radiographic lateral talo-first metatarsal angle.

Methods:
A prospective case control study using a novel MRI technique to image the TN. We scanned 20 consecutive normal feet and 20 with clinical and radiological AFFD. The AFFD group was subdivided into normal or abnormal TN. 
We assessed for pathology in the SLC, deltoid ligament (with conventional sequences) and posterior tibial tendon (PT). Imaging of the TN was performed using a novel sequence, which was an oblique view in both T1 and T2 sequence in the plane of the TN ligament to identify the normal ligament in the control group, and compare it to the patients with clinical AAFD.
All patients had weight bearing AP and lateral radiographs in order to measure the calcaneal pitch, lateral talo-first metatarsal angle, and talo-calcaneal angle. We followed up patients, the end point being surgery or definitive conservative management and discharge.

Results:
2 distinct groups of patients were identified.
Normal TN(11/20)
A mixture of medial ligament pathology was associated with this. All were managed conservatively and discharged from follow-up. The mean Meary's angle was 6.8°.
Abnormal TN(9/20)
The ligament was thickened proximally, with distal attenuation and intrasubstance oedema. On sagittal sequence it had the appearance of an omega (O), with dorsal bulging and high signal on T2. The mean Meary's angle was 13.2°(p 0.013). All patients had PT dysfunction and 8 had SLC attenuation. 5 of these patients have undergone corrective surgery. None had been discharged.
The prevalence of the omega in AFFD was 30%. We confirm that the prevalence of deltoid involvement in AFFD is high, particularly in patients with more severe disease.

Conclusion:
Imaging of the TN is valuable in AFFD, and adds no cost or risk. There is no doubt that sequential failure of the medial ligaments occurs in AFFD. We have shown that the deltoid is involved more often than previously reported. In those with normal TN, our preliminary findings suggest that management can focus on protecting the medial structures. When the TN is attenuated('O' on MRI), this represents a foot transitioning to a more severe deformity, both clinically and structurally. From our experience, these patients are more likely to have a progressive, less flexible planovalgus deformity, often requiring corrective surgery.

Foot & Ankle Orthopaedics, 2(3)
DOI: 10.1177/2473011417S000066
©The Author(s) 2017

This open-access article is published and distributed under the Creative Commons Attribution-NonCommercial 3.0 License (http://www.creativecommons.org/licenses/by-nc/3.0/) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).