

Pathology of the Dorsal Triangular Fibrocartilage (DTF) in Rheumatoid Arthritis Affecting Metacarpophalangeal Joints II-V: Structure, Function and Imaging Criteria in Joint Instability



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Introduction

Rheumatoid arthritis commonly affects metacarpophalangeal joints (MCPJ's) II-V and can impair function through joint subluxation and ulnar deviation of the extensor tendons over these joints. Disease modifying anti-rheumatoid drugs (DMARD's) have been effective in limiting the progression of disease, but their side effect profiles mandate careful titration of their use. Unfortunately, objective criteria to identify impending subluxation are lacking, making DMARD therapy problematic in affected patients. The dorsal triangular fibrocartilage (DTF) is a poorly characterized, meniscus-like structure that sits between the joint and the extensor tendon. We examined whether pathological changes in the DTF could contribute to this clinical picture, thereby permitting early diagnosis of impending subluxation and providing an objective reference tool to direct DMARD therapy before joint replacement becomes necessary.

Normal DTF Structure

Normal DTF structure was determined by cadaveric dissection of 100 MCPJ's (80 fingers and 20 thumbs for comparison)- see Figure 1. 6 specimens were decalcified for review by a specialist histopathologist to determine the composition of the DTF and T1 STIR and T2 fat saturated MRI sequences

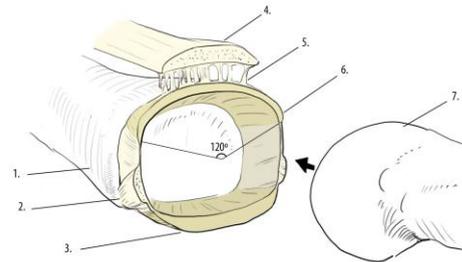
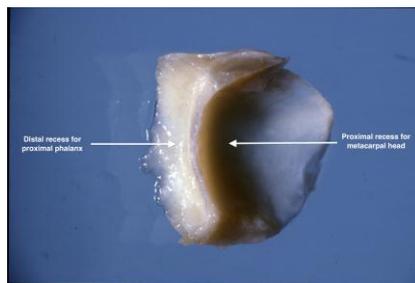


Figure 1- Volar view of cadaveric dorsal triangular fibrocartilage (DTF) of the metacarpophalangeal joint (left) and diagrammatic representation of the DTF's role in deepening the MCP joint and relationship to the surrounding structures (right- tendon relationship not to scale)

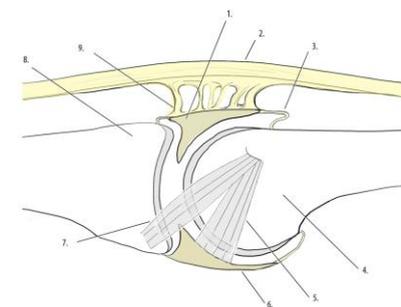
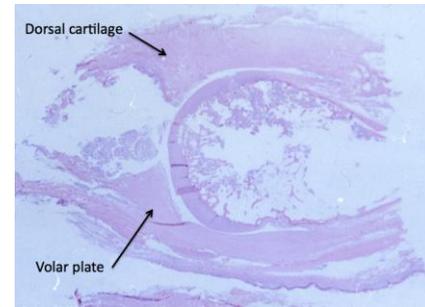


Figure 2- Lateral view of decalcified metacarpophalangeal joint demonstrating the nature and relationships of the dorsal triangular fibrocartilage (left) and diagrammatic representation of the same (right- tendon relationship not drawn to scale).

were used in unaffected hands to characterize the normal appearance of the DTF on MRI. The DTF is a crescent-shaped fibrocartilage with a triangular cross section that deepens the fossa for the metacarpal head and forms part of the joint capsule with attachments over 120 degrees of the joint circumference. It has an intimate attachment to the overlying extensor tendon. Disease of this structure would have obvious implications for joint stability and tendon alignment. Histology and MRI confirmed that unaffected DTF fibrocartilage is homogeneous in nature.

DTF in Rheumatoid Arthritis

MRI was used to develop putative diagnostic criteria for the severity of DTF pathology by comparing MRI hand images from healthy and affected individuals (n=3 each). Loss of DTF-tendon attachment, irregular DTF margins and marked signal heterogeneity within the DTF were identified as three potential diagnostic criteria associated with joint subluxation. These were then tested in 29 joints (9 individuals with a mixture of RA with and without subluxation, OA and normal healthy joints- 7 joints were either not scanned or did not meet quality criteria). All images were de-identified, randomized and then graded by two independent specialist radiologists.

The three diagnostic criteria were strongly associated with joint subluxation but loss of DTF-tendon attachment was the most significant (Spearman r=0.6882, p<0.0001) and was present in every RA joint with subluxation (n=9), one third of non-subluxed RA joints (n=6) and no normal joints (n=9).

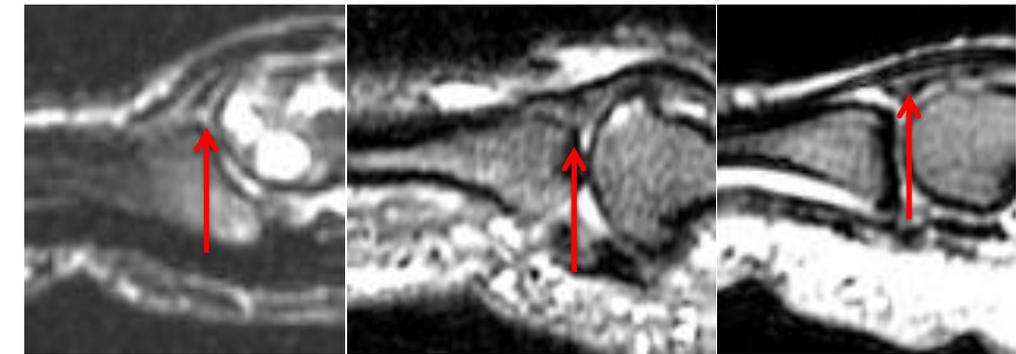


Figure 3- MRI images showing criteria consistent with impending or actual joint subluxation (arrows). Left- loss of DTF-tendon attachment. Center- Irregularity in the DTF margin with loss of crescentic shape and dorsal erosion. Right- Marked heterogeneity of the internal DTF signal.

Conclusion

Pathological changes in the DTF are strongly associated with joint subluxation in RA. Having established our criteria will now seek to validate them by performing a longitudinal study and we will adapt our MRI-based approach to simpler, ultra-sound-based screening to facilitate this. Our study improves the current understanding of MPJ mechanics, may lead to improved non-operative management in RA and facilitate the development of new surgical approaches to target DTF pathology.

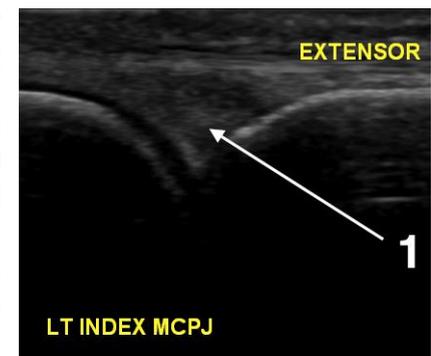


Figure 4- Ultrasonogram of the DTF