

Introduction

Jumpers' Knee is a term used to describe tendonitis or tendinopathy of the patellar tendon (sometimes referred to as the patellar ligament).

The name derives from the mechanism associated with its onset, as it is most prevalent following participation in sports such as jumping, basketball, football and volleyball (Rudavsky & Cook, 2014; Visnes *et al.*, 2013).

Aside from athletes, those more at risk also include:

- Adolescent – 40 year olds;
- Males (2-4 times more likely compared to females);
- Those with a metabolic disorder or vascular disease (Dean *et al.*, 2017; Rudavsky & Cook, 2014).

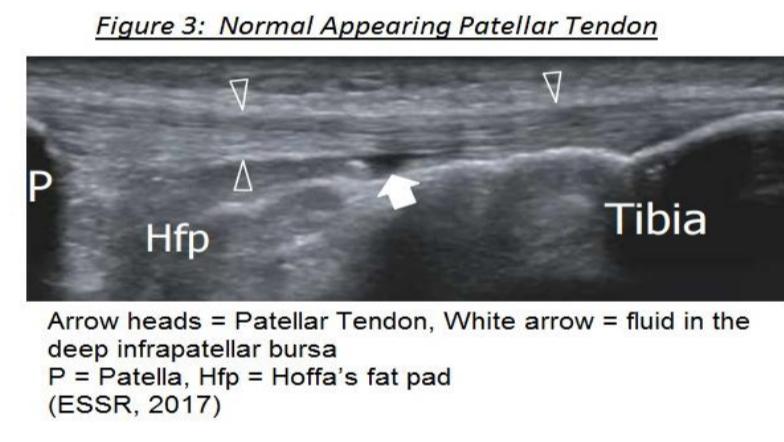
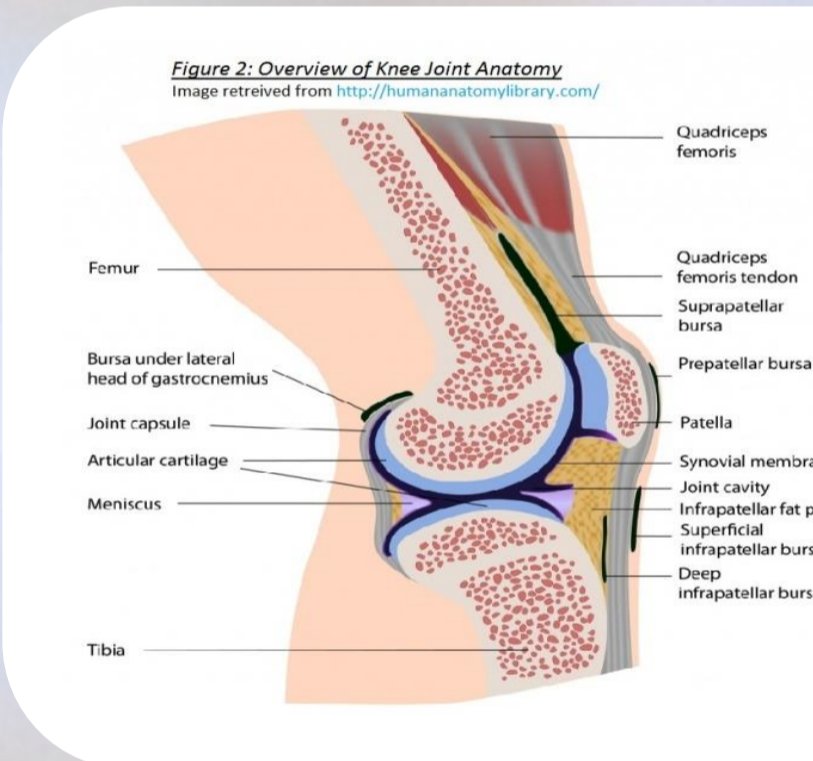
The Changing Perception of Tendinopathy

Tendonitis (inflammation of a tendon) is a phrase that has been in decline following a study by Maffulli *et al.* (1998). They suggested that inflammatory responses had little involvement in tendinopathic changes and, subsequently, the term tendonitis fell out of favour due to the scepticism surrounding the role of inflammation (Dean *et al.*, 2017).

In 2009 Cook and Purdam proposed a three-tiered model of tendinopathy (Figure 1). Since then, this model has been well cited and largely adopted in the literature; introducing the concept that tendinopathy is a dynamic process, with areas of a single tendon in different stages at any given time.

More recently still, a large systematic literature review by Dean *et al.* (2017) suggested that the concept of absent inflammation in tendinopathy has not been scientifically backed, but based more upon opinion. In fact, Dean *et al.* (2017, p.5) consider the evidence of inflammation in tendinopathy to be "increasingly overwhelming in recent years". Could the theory that surrounds the aetiology and pathogenesis of tendinopathy, along with popular terms, therefore be about to change once more?

Normal Ultrasound Appearances



- The patellar tendon extends from the lower pole of the patella and inserts on the tibial tuberosity, making it easy to visualise with ultrasound due to its superficial location;
- The tendon should demonstrate a regular fibrillar pattern (Figure 3), with little or no flow when Doppler is applied;
- The tendon can be slightly wider at the proximal insertion, and small areas of reduced echogenicity can often be seen in a normal tendon (McNally, 2018; Docking *et al.*, 2015);
- Hoffa's fat pad (also referred to as the infrapatellar fat pad) can be seen deep to the tendon;
- A small amount of fluid in the deep infrapatellar bursa is also a normal finding (Figure 3) (European Society of Musculoskeletal Radiology, 2017).

Abnormal Ultrasound Appearances

Tendinosis of the patellar tendon appears as:

- A thickened tendon (Figure 4);
- Diffusely more hypoechoic due to an increase in bound water (Figure 4);
- Sometimes more heterogeneous in chronic cases;
- Neovascularisation can be a sign of tendinopathy, or a normal finding in active athletes (Docking *et al.*, 2015; McAuliffe *et al.*, 2016).

Figure 4: Hypoechoic Thickened Patellar Tendon

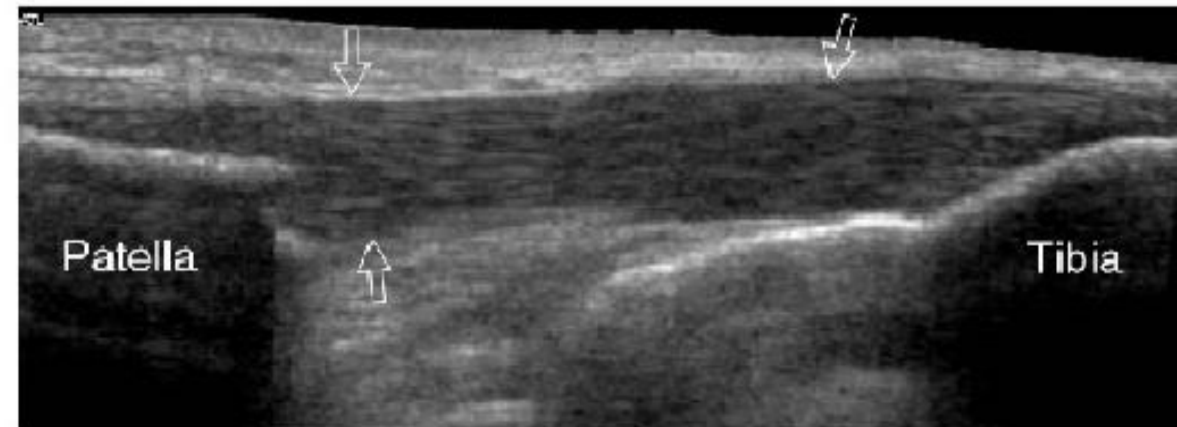


Image adapted from Bianchi and Martinoli (2007)

Current Role of Imaging

A literature review by Docking *et al.* (2015) found that both magnetic resonance imaging (MRI) and ultrasound have consistently been reported to have "good to excellent accuracy...but varying sensitivity"; however, the studies reviewed had consistently lacked a gold standard from which to measure, and failed to incorporate a good proportion of normal or control cases (Docking *et al.*, 2015, p.844).

Currently, MRI is considered to be better at identifying differential diagnoses due to its greater overview of anatomy. However, tendon assessment is better with ultrasound due to its superior spatial resolution (Docking *et al.*, 2015). Interestingly, abnormal looking tendons are often seen in asymptomatic patients and vice-versa (Docking *et al.*, 2015). This does not stop bold claims in the literature, such as that by McAuliffe *et al.* (2017) stating that there is "at least a fourfold increased risk" of developing tendinopathy if abnormal ultrasound appearances are seen in asymptomatic patients (McAuliffe *et al.*, 2017, p.1). However, only 15% of these patients went on to develop tendinopathy, which is of little use in a real world setting.

The Role of Ultrasound in the Diagnosis and Management of Jumpers' Knee

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Diagnosis and Treatment

Classically sufferers of Jumpers' Knee will experience pain at the inferior pole of the patella, which increases when the knee extensors are under load. This can make movements such as climbing stairs or squatting uncomfortable.

A diagnosis of Jumpers' Knee can be made based on patient symptoms, along with findings on physical examination; however, diagnosis is not always straightforward (Malliaras *et al.*, 2015; Docking *et al.*, 2015).

Treatment usually consists of strengthening exercises with appropriate rest. Corticosteroid injections and shockwave therapy are also treatments that are frequently used; however, there is "limited evidence supporting their use" (Rudavsky & Cook, 2014, p.127).

Scanning Technique

- High frequency linear transducer;
- The knee is best imaged in mild flexion (20-30°);
- The patella tendon is easily visible in both transverse and longitudinal planes, and can easily be followed from the tibial tuberosity to the inferior pole of the patella;
- Careful attention should be taken when using colour or power Doppler to ensure neovascularisation is not overestimated due to poorly set scanning parameters;
- Scan with the transducer perpendicular to the tendon to avoid anisotropy (McNally, 2008).

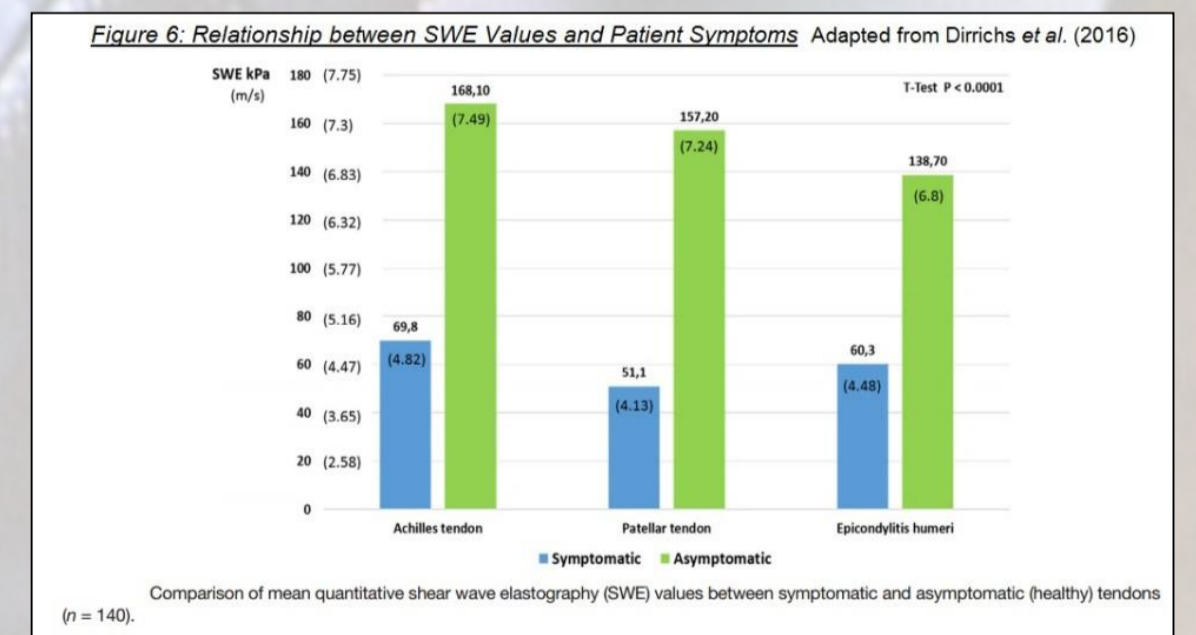
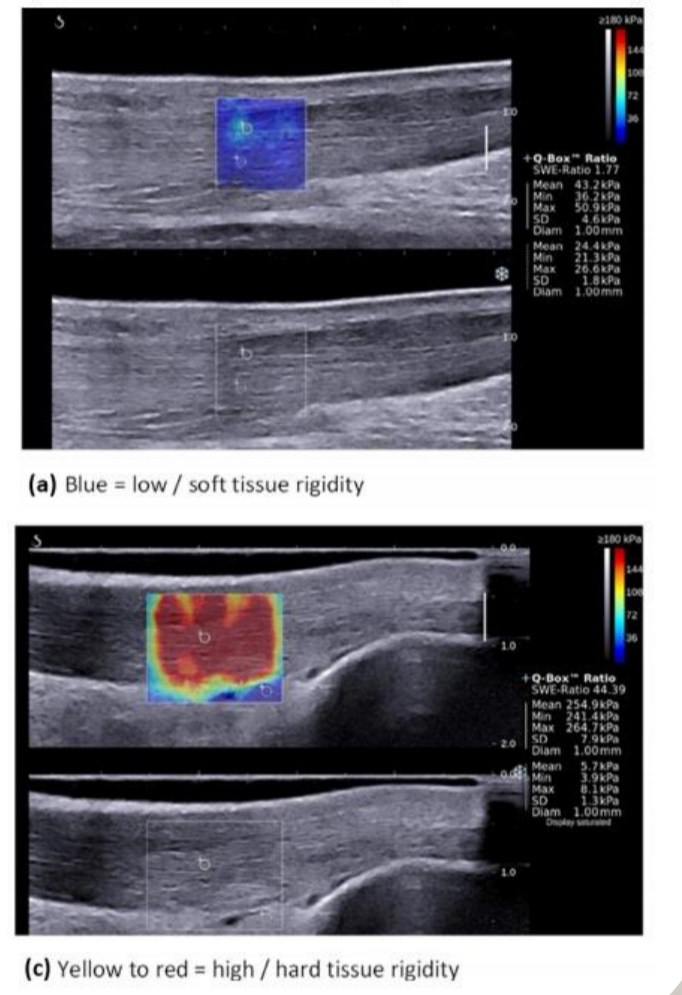
Future Role of Ultrasound

Perhaps the best chance of an imaging modality accurately diagnosing or even predicting tendinopathy lies with Shear Wave Elastography (SWE). De Zordo *et al.* (2009) found a correlation between tendon stiffness and normal B-mode appearances. A further study by Ooi *et al.* (2015), also found a correlation between SWE strain mapping and tendon thickness.

More recently, Dirrihs *et al.* (2016) performed a prospective study on 112 patients, scanning both the symptomatic and asymptomatic sides in a blinded manner, on Achilles tendons, patellar tendons and epicondylitis humeri. Importantly, the study design ensured a good proportion of normal tendons were included.

Soft tendons appeared blue in the region of interest (Figure 5), and were very closely matched with symptomatic tendons (Figure 6). The correlation between symptomatic tendons and low SWE values was found to be highly significant ($P < 0.001$).

Figure 5: SWE Demonstrating 'Soft and Hard' Tendon Architecture (Dirrihs *et al.*, 2016)



Conclusions

Diagnosing Jumpers' Knee or patellar tendinopathy can prove difficult in some cases. Ultrasound plays an important role in aiding a clinical diagnosis by correlating B-mode and Doppler findings to patient symptoms. Despite some claims, there seems little evidence that ultrasound findings can reliably predict the onset of Jumpers' Knee at this moment in time.

In a select few studies, SWE has demonstrated the potential to become the most sensitive imaging tool yet; however, it remains to be seen if its use can be more reliable in predicting the onset of tendinopathy when compared to B-mode and Doppler ultrasound.

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