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Case Report

The uncrossed-doubled patellar tendon: A novel imaging finding

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ABSTRACT

A spectrum of anatomic variants of the conventional single patellar tendon have been described however a double patellar tendon is a highly rare finding, which has only been described once before where a cross-over tendon morphology was illustrated. We report the case of a 46-year-old man with a 3 month history of left knee pain who was found to have an incidental double patellar tendon without cross-over, with one deep bundle demonstrating a more conventional patellar tendon course, paralleled by a second anatomically-distinct superficial bundle of differing morphology coursing anterolateral to the deep conventional bundle, explicitly connecting patella to tibial tuberosity. A comprehensive understanding of the anatomic variations of the patellar tendon is essential for both radiologist and clinician to deliver safe clinical practice. We present a rare case of an uncrossed-doubled patellar tendon, which to our knowledge, has never been reported.

Case report

A 46-year-old man with no significant past medical history was referred to the orthopaedic clinic with a 3 month history of left knee pain. The pain was exacerbated by climbing stairs and when performing sitting, standing and twisting manoeuvres. There was no history of knee locking, giving-way or swelling.

Clinical examination revealed a stable joint with no obvious effusion. Point tenderness was elicited on the medial side of the knee. The meniscal provocation tests were weakly positive.

Magnetic Resonance Imaging (MRI) revealed a complex tear of the body of the medial meniscus without displaced meniscal tissue. As an additional incidental finding 2 bundles of patellar tendon (PT) were identified separated by a slender fat plane. This finding was shown on all pulse sequences but best

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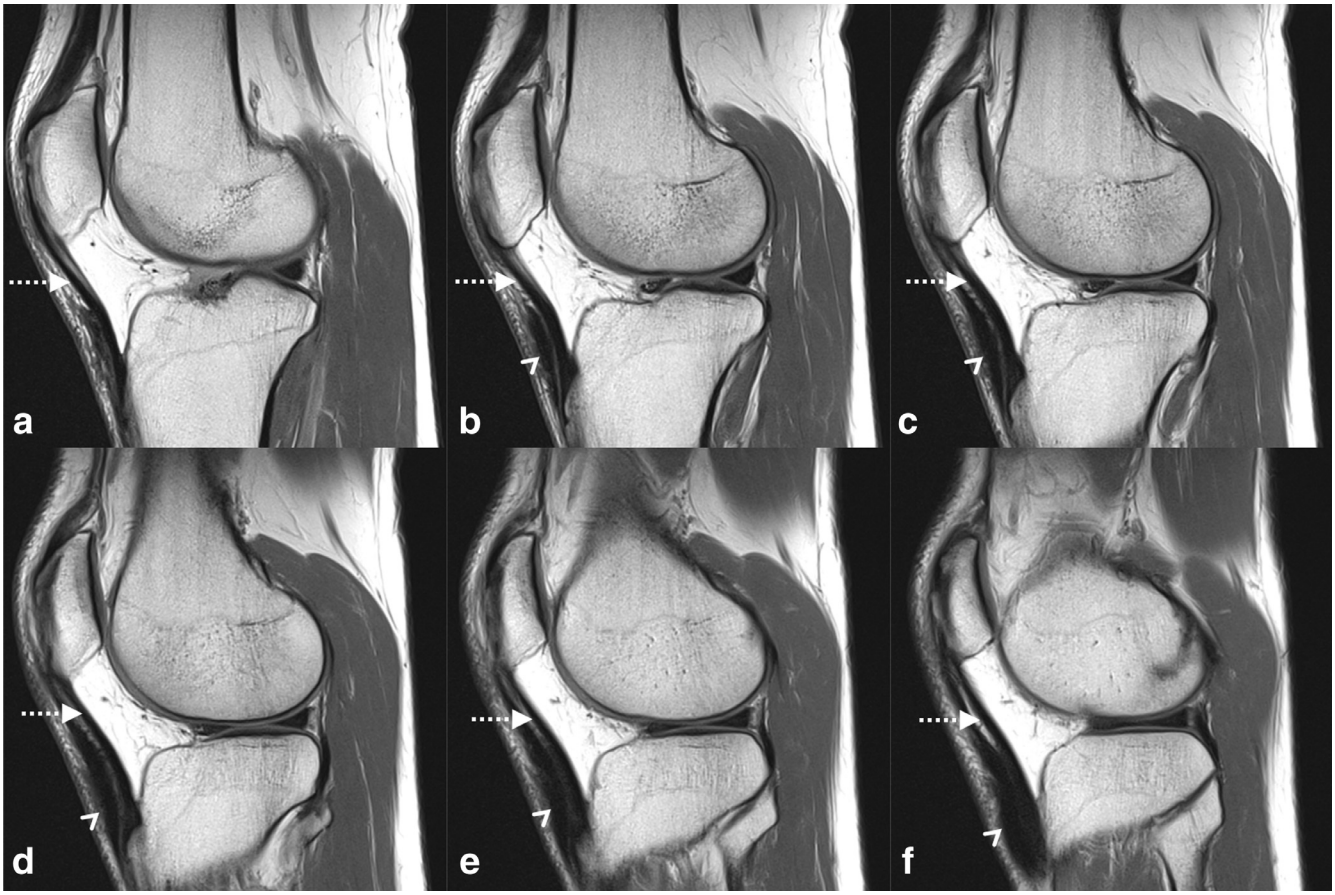

Fig. 1 – Selected para-midline sagittal PD-weighted MRI images, medial (a) to lateral (f), demonstrates a deep patellar bundle (dotted arrow) on all selected images (a-f), which conforms to a more conventional PT. A superficial patellar bundle (arrowhead, b-f) separated by a fat plane is demonstrated lateral and anterior to the deep bundle, almost running in parallel (d) to the deep bundle.

appreciated on sagittal proton density (PD)-weighted (Fig. 1) and axial PD-weighted fat-saturated fluid-sensitive sequences (Fig. 2). The deep bundle appeared to conform to a more conventional PT in terms of transverse and anteroposterior (AP) diameter but also in its origin from the anterior inferior patellar apex and insertion onto the proximal medial tibial tuberosity (TT). A separate superficial bundle was also demonstrated with a different morphology in AP dimension of the proximal and distal components. Specifically, it demonstrated a thinner morphology at its proximal end (smaller AP dimension) and a wider and thicker morphology at its distal end (greater AP dimension, Fig. 2). The superficial bundle also differed in its origin (ie, from the anterolateral aspect of the lower third of patella); descending anterolaterally to the deeper bundle, to insert on to the lateral aspect of the anterior distal TT. No tendon cross-over was demonstrated. There was no evidence of patellar tendinopathy or tearing of either moiety. The patellofemoral cartilage was normal and there were no features of trochlear dysplasia, transient patellar dislocation or patellofemoral impingement.

On follow-up outpatient clinic assessment, it was agreed that the clinically relevant finding (medial meniscal tear) would be treated conservatively as the symptoms had considerably settled over the interval period. The doubled patellar tendon was felt to represent a completely incidental finding on imaging of no clinical significance on the patient's investigative pathway.

Of note, the superficial patellar bundle gradually increases in AP and transverse (TS) dimension as it courses craniocaudally – particularly apparent as it descends inferior to the tibial plateau (d) – in contrast to the deep bundle which appears relatively uniform in AP and TS dimension throughout its course. For example, the superficial bundle measures 9 (TS) x 2 (AP) mm proximally and 26 (TS) x 6 (AP) mm distally; in contrast to the deep bundle which measures 31 (TS) x 1 (AP) mm proximally and 29 (TS) x 4 (AP) mm distally. Proximal and distal measurements performed at axial slices 'b' and 'f' respectively.

Discussion

The patellar tendon (also referred to as the patellar ligament predominantly in the anatomic literature) represents the continuation of the quadriceps femoris tendon. These tendinous

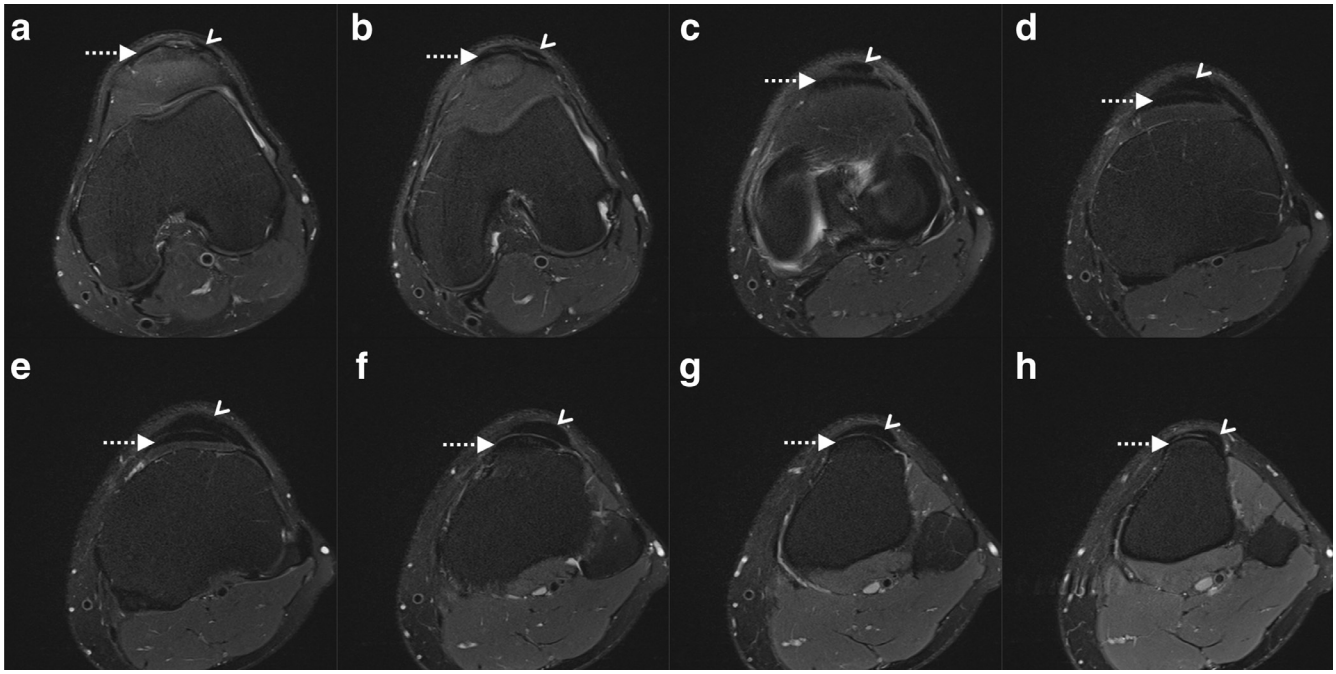

Fig. 2 – Selected axial PD-weighted fat-saturated fluid-sensitive images from the patellar apex (a) to the tibial tuberosity (h), demonstrating a thin superficial patellar bundle proximally (arrowhead, with origin from the anterior inferior lateral patella (a), which courses anterior to the deep bundle (menisci/mid-segment level, c), to insert onto the inferior tibial tuberosity laterally (h). The deep patellar bundle (dotted arrow) demonstrates a more conventional origin and insertion. No bundle cross-over is shown.

fibres descend anterior to the patella (the largest sesamoid bone in the body) forming the prepatellar quadriceps continuation (or expansion); a band of fibrocartilage connecting to the inferior PT. The PT originates from the patellar apex and inserts onto the TT. The PT does not have a tendon sheath, but is contained within a paratenon: a sheath of flexible connective tissue. The PT is in continuity with the prepatellar quadriceps continuation and the quadriceps tendon, thus forming an integral component of the knee extensor mechanism [2].

MRI is the modality of choice when investigating internal derangement of the knee. Recent advances in imaging techniques with the advent of new sequences and increasing access of higher field strength magnets (3T) allows for better soft tissue resolution, thus enhancing the radiographic evaluation of smaller structures within the knee. Multiple tendons and ligaments are found within the knee, many of which may present as anatomic variants [1]. A wide variety of anatomic variation of the single conventional PT has been outlined, particularly in the anatomic literature. This extends from one extreme in which the PT was reported to be aplastic in a handful of cases, to subtle variations in origin and insertional anatomy [3–5]. The PT origin has been conventionally described as the anterior aspect of the patellar apex, however this is not universally seen. An MRI-based case-control study performed by Schid et al interrogating whether patellar apex and tendon morphology was a contributing factor to patellar tendinopathy (sometimes referred to as 'Jumper's knee') revealed distinct variability in PT origin [4]. In particular, tendon origin was described as either anterior to, posterior to, or at the inferior patellar pole (apex). Interestingly, there was a significant difference between the 2 groups, with a posterior origin being more common in the symptomatic knees, thus raising the clinical importance of a presumed clinically-insignificant normal variant. Similarly, the insertion of the PT also has slightly variable anatomy. Conventionally described as inserting onto the superior smooth area of the TT, other descriptions of PT insertion in the anatomic literature include; inserting onto the distal roughened half of the tuberosity; and inserting onto the proximal smooth area with prolongations extending down to the roughened area [5].

Aside from the myriad of origin and insertional anatomic descriptions, variation has also been highlighted in PT anatomy derived from its prepatellar component. Testut in his anatomic text in 1928 confirms the anatomic dogma that the patellar ligament represents the continuation of the prepatellar quadriceps expansion, however also illustrates that on either side of the patellar ligament the expansion is reinforced by strips (primarily originating from rectus femoris fibres) extending from the patellar to the tibia, specifically accessory patellar ligaments [6].

The above described anatomic variants exclusively refer to the single patellar tendon. A double patellar tendon is a remarkably rare finding, with only one reported case in the medical literature. Loizides et al illustrated a PT composed of 2 distinct bundles originating from the anterior surface of the inferior pole of the patella, with a double insertion onto the TT. The bundles demonstrated cross-over, that is the medially originating bundle inserting onto the lateral TT, and vice-versa for the contralateral bundle [7].

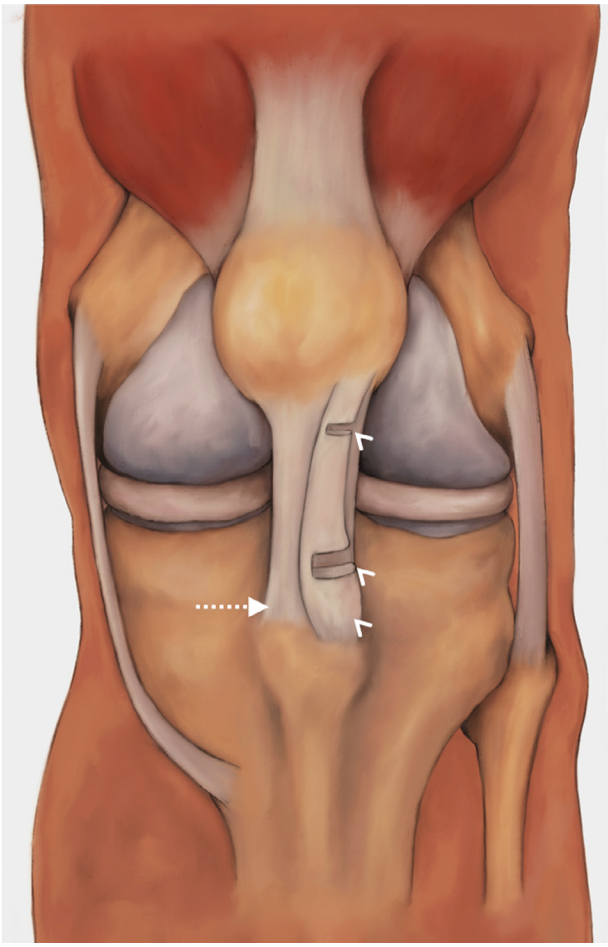

Fig. 3 – Schematic illustration of the uncrossed-doubled patellar tendon. Of note, the superficial patellar bundle – or the uncrossed-doubled patellar tendon (arrowheads) – has differing morphology in its proximal and distal segments as illustrated by the 'cut-outs' (thinner at its proximal end, and wider and thicker at its distal end - arrowheads). The deeper, more conventional PT bundle (dotted arrow) is also visualised through the two 'cut-outs'.

In this case we demonstrate 2 moieties; 1 deep and 1 superficial separated by a fat plane. When compared to the imaged contralateral knee (which demonstrates normal PT anatomy), the deep moiety follows a more conventional PT trajectory in terms of origin at the anterior inferior patellar apex; has comparable length (left PT = 6.2cm, right PT = 6.2cm); and inserts onto the proximal smooth surface of the medial TT. Additionally, the deep bundle is in continuity with the prepatellar quadriceps continuation, thereby supporting the notion that the deep bundle is the patellar tendon proper. Comparable PT anatomy is also demonstrated on the contralateral knee when evaluating the deep moiety. The superficial moiety follows a different trajectory thus representing a distinct patellar tendon band. This is of similar signal characteristics to the conventional PT but of different morphology connecting patella to tibial tuberosity. Crucially, this superficial moiety does not cross-over but courses anterolateral to the deep bundle through its entire trajectory, thereby representing an uncrossed-doubled patellar tendon: a never previously described entity (Fig. 3).

In conclusion, there is a large spectrum of anatomic variation affecting the patellar tendon. An awareness of its aberrant bundle anatomy is therefore of significant clinical importance to both clinician and radiologist, largely in the context of surgical planning, but also potential patellofemoral instability and other patellar tendon pathologies. More importantly however these anatomic variants should not be misinterpreted as pathologic, thus potentially preventing over-investigation and unnecessary intervention. We present a rare case of an uncrossed-doubled patellar tendon, which to our knowledge, has never been described before.

Declaration of Competing Interest

None.

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