ESSR Sports Imaging Subcommittee - The interesting Paper 2021 Q4

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MR imaging of the quadriceps femoris tendon: distal tear characterization and clinical significance of rupture types

Falkowski AL, Jacobson JA, Hirschmann MT, Kalia V.
Eur Radiol. 2021 Oct;31(10):7674-7683. doi: 10.1007/s00330-021-07912-y. Epub 2021 Apr 16.
OPENACCESS
https://pubmed.ncbi.nlm.nih.gov/33860830/

The quadriceps tendon usually consists of 3 layers (figure 1): (i) superficial: rectus femoris; (ii) middle: vastus medialis & vastus lateralis; (iii) deep: vastus intermedius. The tendons blend approximately 3 cm proximal to the patella to form the layered tendon. However, there are also anatomical variations with unilaminar, bilaminar or tetralaminar structures. The superficial part continues as prepatellar quadriceps continuation over the patella to the patellar tendon. Peripherally the Vastus medialis and lateralis, respectively, blend with the patellar retinacula.

The authors of the paper retrospectively assessed n=53 quadriceps femoris (partial) tears on MRI regarding the affected tendons involved, partial versus complete tear, location of tear and retraction. They found an avulsion fracture of the patella in 49% of cases; these showed higher grade tears of the superficial and middle tendon layers. The percentages of tendon affection was as follows: rectus femoris: no tear 11%, partial tear 23%, complete tear 66%; vastus medialis: no tear 13%, partial 21%, complete 66%; vastus lateralis: no tear 8%, partial 28%, complete 64%; vastus intermedius: no tear 22%, partial 40%, complete 38%. Interestingly, two thirds of quadriceps tendon tears showed complete tears of the vastus medialis and lateralis muscles despite their insertion into the retinacula. Most tendons tore at (37-48%) or immediately proximal to (37-56%) the patella, with the vastus intermedius more frequently ruptured directly at the patella and the vastus medialis more frequently ruptured proximal to the patella. Gaps in retracted torn tendons measured between 0.5 to 5.9cm. The prepatellar quadriceps tendon continuation was abnormal (e.g., detached from the patella) in 43% of cases. The surgically treated patients had complete tears of at least 2 of the quadriceps tendon layers, however nearly half of complete tears of 2 tendons, a third of three tendon ruptures and one case with ruptures of all tendons were still treated conservatively. This underlines the importance of searching for the precise extent of affected tendons in case of quadriceps rupture and of clinical parameters such as remaining function of the quadriceps tendon and co-morbidities with respect to therapeutic decision making.

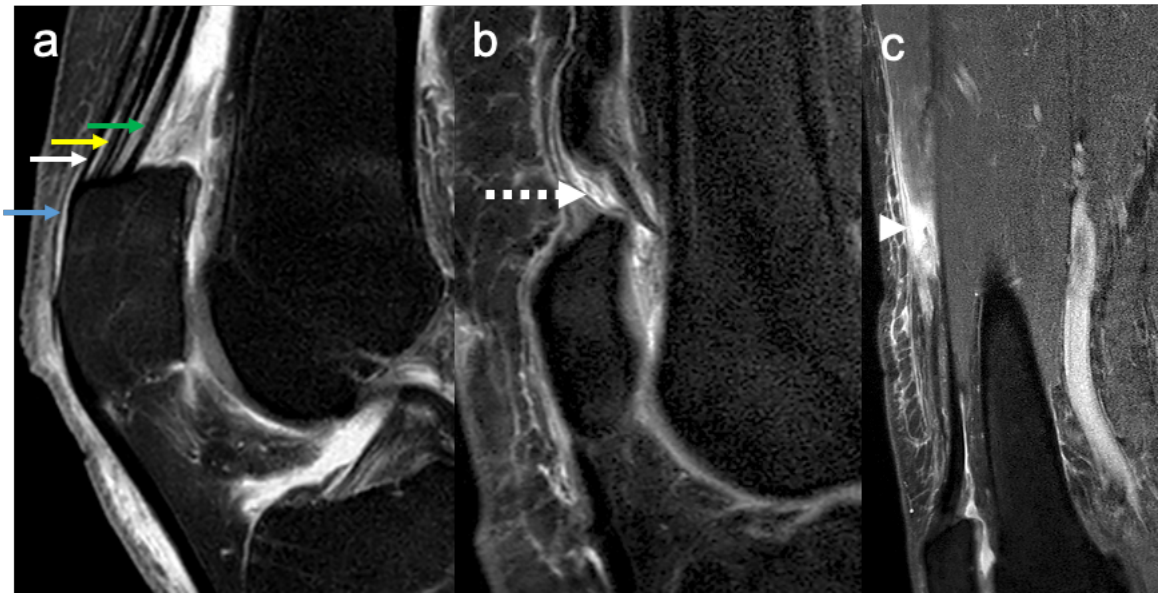

Figure 1: A: Trilaminar structure of the quadriceps tendon. Superficial layer: rectus femoris (white arrow); middle layer: vastus medialis and lateralis (yellow arrow); deep layer: vastus intermedius (green arrow). The superficial layer continues as prepatellar quadriceps continuation (blue arrow). B: Total rupture of all quadriceps tendon layers directly at the patella (dotted arrow). C: very rare rupture of the rectus femoris at the distal myotendinous junction. Only in these cases end-to-end tendon repair is possible.

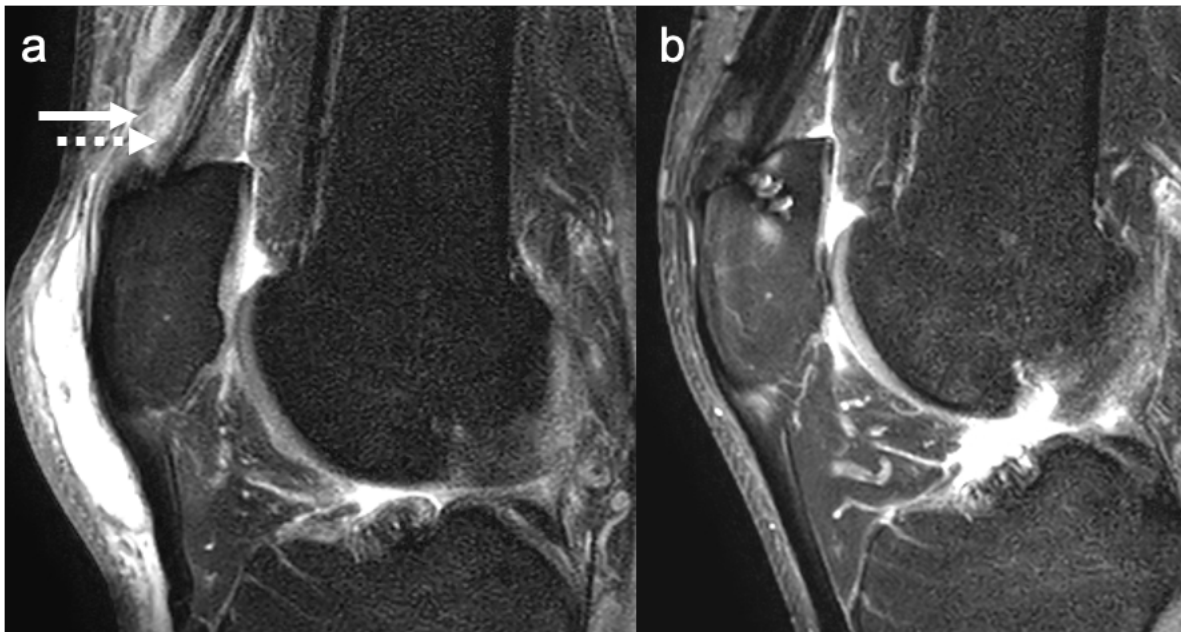

Figure 2: A: Complete tendon tear of the superficial layer (arrow) and of the middle layer (dotted arrow). The deep layer remained intact. B: Postoperative MRI after refixation of the distal quadriceps tendon at the patella.

Plus:

- The typical pattern of three different layers of the quadriceps tendon is described.
- The importance of describing partial/ complete tears of these layers and individual muscles is pointed out.
- It is highlighted, that most ruptures happen directly at or proximal to the patella, which requires tendon fixation at the patella in case of surgical treatment.

Limitations:

- Relatively high rate of patella avulsion fracturs are described, partially with small fragments down to 3mm, however mean sizes of 10mm are mentioned. Possibly this was a special patient cohort?
- The parts of the vastus medialis and lateralis that insert into the retinacula were not evaluated and nearly only midsagittal images are presented. It remains unclear if total ruptures also involved the retinacula insertions.
- Some percentage numbers are confusingly written, for example in the discussion “In our investigation, the superficial (25.7%) and middle layers (25.1–26.8%) of the quadriceps tendon ruptured more frequently than the deep layer (22.4%)“. These are the percentage of the layer ruptures with respect to the sum of all layer ruptures.
- No consideration was given to the different anatomical variations of the quadriceps tendon layers.
- Relatively small cohort considering the search through the entire database.