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The Segond Fracture: Just an X-Ray Clue for a Ruptured Anterior Cruciate Ligament?

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Summary:
Although the Segond fracture is mostly considered as nothing more than a pathognomonic X-ray feature for a ruptured ACL, this study has identified the Segond fracture as being a frank disruption of the newly described anterolateral ligament (ALL) itself.

Abstract:
Introduction:
In 1879 already, the French surgeon Paul Segond described the existence of a "pearly, resistant, fibrous band" at the anterolateral aspect of the human knee attached to the eponymous Segond fracture. The first correlation of the Segond fracture with the presence of significant knee instability was demonstrated in 1979 by Woods: in four acute cases with a positive "lateral capsular sign" on X-ray, a concomitant rupture of the anterior cruciate ligament (ACL) was demonstrated. This report, together with the work of Goldman and Hess, has founded the current belief of Segond fractures being pathognomonic for ACL tears. Strikingly, later authors have largely neglected Segond's "pearly band" and only scarce literature on the existence of a ligamentous structure connecting the femur with the anterolateral tibia can be retrieved. To date, the enigma surrounding this anatomical structure is reflected in various names like "(mid-third) lateral capsular ligament", "capsulo-osseous layer of the ITB", or "anterolateral ligament", and no clear anatomical characterization has yet been provided.

Methods:
In order to identify the soft-tissue structure causative for the Segond fracture, a study was set up to compare radiological data on Segond fractures with anatomic findings derived from knee dissections. Therefore, the presence and characteristics of Segond's "pearly band" (hereafter termed anterolateral ligament (ALL)) was investigated in 41, unpaired, human cadaveric knees. The tibial attachment of the ALL was studied in relationship with nearby anatomical landmarks (e.g. insertion sites of the ITB and LCL) Secondly, all imaging protocols released by our institution's Department of Radiology between 2006 and 2012, were searched for the term "Segond". MR images of these knees were subsequently analyzed with particular interest in the avulsed bony fragment and the structure(s) attached to it. Furthermore, measurement of the absolute distance between the center of the ITB insertion on the tibia (the middle of Gerdy's tubercle) and the center of the bony bed of the tibia from where the Segond fragment had avulsed (GT-Segond distance), was performed on calibrated slices.

Results:
In 40 of 41 cadaveric knees, a well-defined ALL was found as a distinct ligamentous structure, clearly distinguishable from the anterolateral joint capsule. The mean depth of the lateral recessus, measured as the distance from the cartilage surface to the proximal border of the ALL insertion was 6.5 ± 1.5 mm. The mean width of the tibial footprint of the ALL equaled 11.3 ± 2.8 mm. The mean distance of the center of the tibial ALL footprint to the center of Gerdy's tubercle (GT-ALL distance) measured 22.0 ± 3.9 mm. The imaging database search identified 26 subjects protocolled

with a Segond fracture. On MRI, the mean depth of the lateral recessus was 6.0 ± 1.1 mm. The mean GT-Segond distance measured 22.4 ± 2.6 mm. The observed difference of 0.4mm (95% confidence interval: -1.5mm;2.2mm) between the GT-ALL and GT-Segond distance, was neither statistically significant (p=0.70), nor clinically relevant.

Discussion:
Until now, the Segond fracture is merely considered as nothing more than a pathognomonic X-ray feature for a ruptured anterior cruciate ligament (ACL). As the newly described anterolateral ligament (ALL) is found to be a distinct anatomical structure at the anterolateral aspect of the knee, inserting at the exact spot on the proximal tibia from where Segond fractures avulse in a remarkably constant way, the results of this study imply that the Segond fracture represents a frank ligamentous avulsion itself. As growing knowledge on ALL biomechanics has attributed an important function with regard to the control of internal tibial rotation and the pivot shift, the Segond fracture should not merely be regarded as an X-ray clue for ACL ruptures, but as the tip of the iceberg of ALL lesions.