■ INSTRUCTIONAL REVIEW: KNEE

The anatomy of the anterior cruciate ligament and its relevance to the technique of reconstruction

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Anterior cruciate ligament (ACL) reconstruction is commonly performed and has been for many years. Despite this, the technical details related to ACL anatomy, such as tunnel placement, are still a topic for debate. In this paper, we introduce the flat ribbon concept of the anatomy of the ACL, and its relevance to clinical practice.

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For more than 30 years, the anatomical features of the anterior cruciate ligament (ACL) and its bony attachments have been investigated and the findings have resulted in modifications in the techniques of reconstruction following rupture.[1] For example, when the trans-tibial femoral tunnel drilling technique was the primary technique, a tunnel drilled on, the so-called "resident's ridge"[2] was believed to be malpositioned. It has subsequently become an important landmark for anatomical reconstruction.[3-7] With regard to the soft-tissue arrangement of the ACL, the concept of the ligament tissue being arranged in two bundles (anteromedial and posterolateral) has been demonstrated in literature,[8-11] and hence double-bundle reconstruction techniques were developed. These techniques are less commonly practiced now as some of its proponents reported problems with their use and have moved to the so-called 'anatomical' technique, which employs a femoral tunnel placed in the centre of the soft-tissue 'footprint' of the native ACL. The justification for this change is that a central tunnel between the two bundles seems logical.[10,12-14] This is comparable with the double-bundle technique on biomechanical grounds, but is simpler and more reliable. However there are reports of increased graft re-rupture rates when using the anatomical technique.[10,12-14]

Recently, a different concept of the pattern of insertion of the ACL on the femur and tibia and a flat, 'ribbon-like' shape to the ligament is gaining popularity (Fig. 1).[1,2] this may explain the problems relating to the techniques of reconstruction of the ACL used hitherto, potentially offering some advantages. This paper presents a review of the available literature concerning, and our anatomical work demonstrating, this concept.

Femoral insertion

The femoral footprint of the insertion of the ACL is crescent shaped. Its anterior border is formed by the lateral intercondylar ridge (resident's ridge). The posterior articular margin of the lateral femoral condyle forms its posterior border.[1,5,14] In our anatomical study, 111 human fresh-frozen cadaver knees were dissected and it was confirmed that the femoral insertion of the ACL was in continuity with the posterior femoral cortex (Fig. 2).[3]

Two types of insertion of the fibres of the ACL at their femoral attachment were described by Iwahashi et al[5] a 'direct type' with characteristic zonal architecture, allowing for the gradual dissipation of forces, and an 'indirect type' in which the ligament is inserted into bone by collagen fibres without a transitional zone. We also noted a direct type of insertion where fibres entered the bone almost at a right angle (Fig. 3), and microsopic examination revealed a double tidemark. This may be interpreted as a site within the ACL 'footprint' through which most force passes, or where 'micro-injuries' might arise.[15] This is supported by a number of other studies.[16,17] We would suggest, therefore, that the femoral tunnel for ACL reconstruction should be placed here, i.e. deep (proximal) and high (anterior) in the intercondylar notch within the region of the anteromedial bundle of the femoral footprint of the ACL. The fibres comprising the remainder of the femoral footprint (i.e. the 'indirect fibres') have a weaker attachment and take less of a load. They represent a 'fanning out' of tissue away from the more important direct insertion of fibres.

We recorded that the mean width of ACL, 2 mm from its femoral insertion was 16 mm (12.7 to 18.1) and its mean thickness was 3.54 mm (2 to 4.8).[3]

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