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Update article

Anterior cruciate ligament – updating article☆

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ABSTRACT

This updating article on the anterior cruciate ligament (ACL) has the aim of addressing some of the most interesting current topics in this field. Within this stratified approach, it contains the following sections: ACL remnant; anterolateral ligament and combined intra and extra-articular reconstruction; fixation devices; and ACL femoral tunnel creation techniques.

Ligamento cruzado anterior – Artigo de atualização

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RESUMO

Este artigo de atualização sobre ligamento cruzado anterior (LCA) visa abordar alguns dos tópicos mais interessantes e atuais sobre o tema. Dentro dessa abordagem estratificada incluem-se as seguintes seções: remanescente do LCA; ligamento anterolateral e reconstruções extra-articulares combinadas a intra-articulares; dispositivos de fixação; técnicas de confecção do túnel femoral.

☆ Study conducted at the Universidade Federal de São Paulo, Escola Paulista de Medicina, Departamento de Ortopedia e Traumatologia, Grupo do Joelho, São Paulo, SP, Brazil.

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Introduction

The anterior cruciate ligament (ACL) is one of the most studied topics in orthopedics nowadays. Due to new trends, such as the concept of anatomical reconstruction, which gained power in the last decade, new motivation has been given to the study of this ligament, with important advances and innovations. Supported by basic science, the ACL remnant is increasingly gaining prominence in reconstructive surgery, but there is still no consensus regarding the various reconstructions techniques and its preservation, a topic that will be addressed in this article. The so-called new ligament of the knee, the anterolateral ligament, has recently gained prominence and explains old concepts and theories that justify its increased restrictive effect on pivoting due to the greater lever arm relative to the central position of the ACL. This elucidates part of the biomechanics of reconstruction and extra-articular reinforcements. Orthopedics follows the advancement of medicine and currently, a myriad of fixation devices are available for surgeons, who, in light of such diversity, must improve their knowledge of the peculiarities, advantages, disadvantages, and comparisons between each one. Finally, also driven by the rediscovery of ACL anatomy, different techniques of femoral tunnel preparation have been developed, each with its own characteristics, turning necessary a detailed analysis of the most used options.

Therefore, this update on the ACL aimed to address some of the most interesting and current topics on the subject. In this stratified approach, the following sections are: ACL remnant; anterolateral ligament and extra-articular combined with intra-articular reconstructions; fixation devices; and techniques for creating the femoral tunnel.

ACL remnant

Partial ACL lesions are common (5–38%); recently, the remnant fibers have received more attention, aiming to preserve and incorporate them in ACL reconstruction (ACLR). Remnant-preserving ACLR should optimize ligamentization, since the functional remnant fibers biomechanically protect the graft, the vascularized synovial envelope of the remnant ligament contributes to the vascularization of the graft, the valve mechanism created by the tissue remnant in the tunnel prevents the entry of synovial fluid and decreases the enlargement of the tunnel, and the mechanoreceptors present in the remnant assist in proprioception, as demonstrated in histological studies.[1–12]

The definition of ACL remnant-preserving reconstruction surgery is controversial because it involves three different procedures grouped under the same terminology: selective bundle augmentation (SBA; ACLR in a partial lesion involving only the posterolateral or anteromedial bundle); augmentation (AG; ACLR in a partial lesion involving one or both bundles with remnant functional tissue); non-functional remnant preservation (NFRP; ACLR in a complete lesion involving both bundles with non-functional remnant tissue). The definition of functional or non-functional remnant fiber should be made arthroscopically, by palpation with the probe, with the knee in 90° flexion and also in the "figure-of-4" position.[1]

For the arthroscopic classification of ACL injuries involving the remnant, a staged approach that evaluates the presence or absence of remnant tissue morphology and functionality is recommended. This staged approach involves (Fig. 1):

1. Remnant tissue: absent, present.
2. Morphological type of remnant: tibial stump (I), scarring to the PCL (II), scarring to the intercondylar roof (III), unidentifiable pattern scarring to the lateral femoral condyle (IV), anteromedial bundle (V), posterolateral bundle (VI).
3. Remnant functionality: functional, non-functional.

After ACLR, steps 1–3 should be repeated, since, during the reconstruction, part of the remnant tissue may be damaged, changing its initial status. Then, the type of reconstruction that preserves the remnant is determined: SBA, AG, or NFRP. Once the final pass of the graft is made, the percentage of graft coverage by the remnant tissue must be estimated and documented. It is important to document the estimated percentage of graft coverage to assess its possible role in the stability and postoperative function, since some studies have shown that higher coverage is related to better outcomes[13] (Fig. 2).

The passage of the graft with preservation of the remnant can be performed in two main ways. The graft can be passed along the periphery of the tibial footprint, preserving the remnant tissue and being passed alongside it, thus maintaining the functional remnant fibers and their inserts (Fig. 3A and B). Another possibility is to pass the graft through the center of the tibial footprint, surrounding it with the remnant tissue, which will act as a biological sleeve, whether through the remnant synovial sheath, the remnant ligament tissue, or both (Fig. 3C and D). In this latter approach, it is recommended to gradually widen the tibial tunnel with successively larger drill bits until the final diameter is reached; care must be taken to stop the progression of drills when they breach the tibial plateau, so that the drill remains inside the remnant. When this happens, there is the impression that the ACL remnant tissue is "dancing" due to the drill action within the remnant enclosure. Then, a path is created inside the remnant enclosure with a shaver that opens it proximally, maintaining the entire peripheral tissue and creating only a central path to pass the graft.[14]

The placement of the femoral tunnel is more difficult in any of the three remnant-preserving techniques when compared with conventional surgery, in which the tunnel is debrided; sometimes, intraoperative fluoroscopy is recommended to confirm proper positioning of the tunnel.[2,15,16] Biomechanical protection of the graft by the intact functional remnant fibers is an advantage in SBA and AG, but not in NFRP.[3,17] Several studies have assessed the potential for better stability with remnant preservation, either through direct mechanical protection by the functional fibers or through better vascularization of the graft and improvement of the ligamentization process. It is believed that SBA provides better stability, followed by AG; NFRP is in last place in this regard.[1–12] Tunnel enlargement is caused by inflammatory cytokines and agents present in the postoperative synovial fluid; it is more common in the tibia, due to severity. Remnant-preserving ACLR was