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Review Article

Surgical indications for anterior cruciate ligament reconstruction combined with extra-articular lateral tenodesis or anterolateral ligament reconstruction☆

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ABSTRACT

Recently described in the medical literature, the anterolateral ligament of the knee is already considered an important stabilizer against the anterolateral tibial rotation, affecting the pivot shift in the failure of the anterior cruciate ligament and behaving as an important secondary rotational stabilizer. The mechanism of anterolateral ligament injury combined with anterior cruciate ligament injury is similar to the mechanism of anterior cruciate ligament injury alone. Thus, the main objective of the joint reconstruction of anterior cruciate ligament and anterolateral ligament would be increased rotational control and prevention of anterior cruciate ligament re-rupture. In view of this importance, the aim of the present study is to summarize the evidence on the main surgical indications described for anterior cruciate ligament reconstruction combined with lateral extra-articular tenodesis or anterolateral ligament reconstruction. A review of the literature was conducted in April 2017, through a search of the PubMed, MEDLINE, Cochrane, and Google Scholar databases, with no date limits. After reviewing the main articles in the subject, it was concluded that the main surgical indications described for anterior cruciate reconstruction combined with extra-articular lateral tenodesis or anterolateral ligament reconstruction are: anterior cruciate ligament revision, physical examination with pivotal shift grade 2 or 3, practice of sport with pivot mechanism and/or high level mechanism, ligament laxity and Segond fracture; Secondly, the following may also be indications: chronic anterior cruciate ligament

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injury, age less than 25 years old, and radiological sign of lateral femoral condyle depression. However, it is worth mentioning that more studies are still needed to prove these trends.

Indicações cirúrgicas para reconstrução do ligamento cruzado anterior combinada com tenodese extra-articular lateral ou reconstrução do ligamento anterolateral

Palavras-chave:
Reconstrução do ligamento cruzado anterior
Joelho
Instabilidade articular

RESUMO

Recentemente descrito na literatura médica, o ligamento anterolateral do joelho já é considerado um importante estabilizador contra a rotação tibial anterolateral, afeta o *pivot shift* na falha do ligamento cruzado anterior e comporta-se como um grande estabilizador secundário rotacional. O mecanismo de lesão do ligamento anterolateral combinado com a lesão do ligamento cruzado anterior é semelhante ao mecanismo da lesão isolada do ligamento cruzado anterior. Assim, o principal objetivo da reconstrução conjunta do ligamento cruzado anterior e do ligamento anterolateral seria um maior controle rotacional e prevenção da rerruptura do ligamento cruzado anterior. Tendo em vista tal importância, o objetivo do presente trabalho é resumir as evidências sobre as principais indicações cirúrgicas descritas para reconstrução do ligamento cruzado anterior combinada com tenodese extra-articular lateral ou reconstrução do ligamento anterolateral. Foi feita uma revisão da literatura em abril de 2017, por meio de pesquisa nas bases de dados PubMed, Medline, Cochrane e Google Scholar, sem limites de data. Após revisão dos principais artigos no assunto, os autores concluíram que as principais indicações cirúrgicas descritas para reconstrução do ligamento cruzado anterior combinada com tenodese extra-articular lateral ou reconstrução do ligamento anterolateral são: revisão do ligamento cruzado anterior, exame físico com *pivot shift* grau 2 ou 3, prática de esporte com mecanismo de *pivot* e/ou de alto nível, frouxidão ligamentar e fratura de Segond. Secundariamente, as seguintes indicações são possíveis: lesão crônica de ligamento cruzado anterior, idade menor de que 25 anos e sinal radiológico de afundamento do côndilo femoral lateral. Todavia, vale ressaltar que mais estudos ainda são necessários para comprovar essas tendências.

Introduction

The literature now features several publications on the anterolateral ligament (ALL) of the knee. The importance of this structure has been advocated, as it possibly plays a role in the anterolateral rotational stability of the knee. Its reconstruction, when combined with that of the anterior cruciate ligament (ACL), may be beneficial for some patient groups.[1]

The instability perceived by the patient after an ACL rupture is usually caused by the pivot shift of the knee. It is estimated that up to 25% of ACL reconstructions evolve with a residual pivot, indicative of the inability of current ACL reconstructive techniques to restore normal knee kinematics in many cases.[2]

ACL injuries are very common in Brazil, mainly due to the practice of sports.[3,4] In the United States alone, over 100,000 injuries are reported annually.[5] Many authors argue that the ALL contributes to knee stability, having a synergistic action with the ACL, mainly in rotational stability.[5,6] These authors support the thesis that a combined ACL and ALL injury may be responsible for a percentage of patients who do not progress satisfactorily after isolated intra-articular ACL reconstruction and advocate ALL reconstruction to restore knee stability.[5,7]

The present study is aimed at systematically reviewing the literature regarding clinical indications for ACL reconstruction combined with lateral extra-articular tenodesis or ALL reconstruction. The authors hypothesized that situations such as gross rotational instability, evidenced by an explosive pivot shift test, and the need for ACL revision are among the main indications.

Material and methods

In April 2017, the PubMed, MEDLINE, Cochrane, and Google Scholar databases were searched, with no date limits.

The following indexing terms were used: “anterolateral ligament reconstruction”; “lateral tenodesis combined with ACL reconstruction”; and “anterolateral ligament reconstruction combined with ACL reconstruction.” Titles and abstracts were

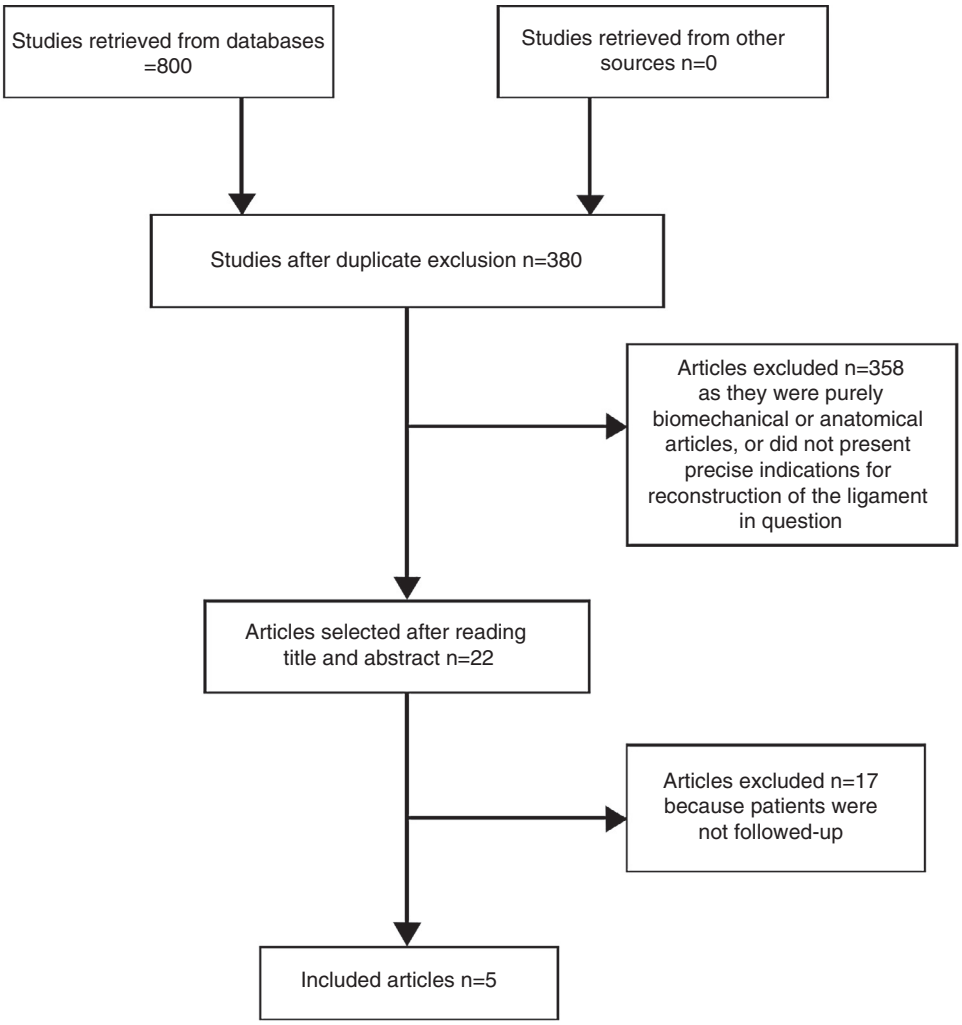

Fig. 1 – Flowchart of article selection.

used to select articles that met the search goal. Thus, only the articles that presented an indication or a protocol for surgical treatment of ALL reconstruction in their title or abstract were selected.

The selected articles were read in their full version and their bibliographic references were searched manually for additional relevant publications. Only articles that had a full version or at least the abstract in English were selected.

The inclusion criteria were the presentation of indication for ALL reconstruction or extra-articular tenodesis, combined with the reconstruction of the ipsilateral intra-articular ACL. Studies in which patients were followed-up for less than one year and articles from purely biomechanical and anatomical studies were excluded.

A total of 336 articles were retrieved from PubMed, 296 from MEDLINE, 15 from the Cochrane Database, and 153 from Google Scholar. After deleting the articles that had been indexed simultaneously in more than one database, 380 articles remained.

Of the 380 articles, 358 were excluded as they were purely biomechanical or anatomical articles, or did not present precise indications for reconstruction of the ligament in question. Of the remaining 22 articles, only five[6,8–11] met the inclusion criteria (Fig. 1).

Results

All five articles selected presented a follow-up of ACL and ALL reconstruction techniques. Together, the studies included 807 patients, 429 of whom underwent ACL and ALL reconstruction. One article compared the reconstruction of ACL alone with ACL and ALL reconstruction.[9] Another study compared three ACL reconstruction techniques: single band reconstruction, double band reconstruction, and single band anatomical reconstruction associated with ALL reconstruction.[11] A third study also compared three anatomical techniques of ACL reconstruction: patellar tendon grafting, quadruple flexor tendon grafting, and flexor tendon grafting combined with ALL

Table 1 – Indication for ALL reconstruction associated to ACL reconstruction.

Group A	Pivot shift grade 3, sports practice with pivot mechanism, or Segond fracture
Group B	ACL revision, subjective rotational laxity, or Telos value >10 mm
Group C	Chronic ACL injury, high level of sports activity, or radiographic signs of lateral femoral condyle depression

reconstruction.[10] The remaining studies followed-up patients after ACL and ALL reconstruction, without comparing them with other techniques.[6,8]

Levels of evidence

None of the studies provided evidence level 1. Two studies reached evidence level 2, as they were prospective studies, one with randomization. The others presented evidence levels 3 and 4.

Patients

The five studies included 807 patients, most of whom were male, between 20 and 30 years of age, with injuries resulting from sports practice. All patients underwent a preoperative clinical evaluation (anterior drawer test, Lachman, and pivot shift) and imaging (radiography and magnetic resonance).

Indication of ALL reconstruction

Most of the articles used as an indication for ALL reconstruction the need for ACL reconstruction associated with at least one of the following factors: explosive pivot shift (grade 3), practice of sports with pivot movements, and Segond fracture.[9–11] In addition to those criteria, one article included ACL revision, subjective rotational looseness, and Telos value >10 mm as indicative of ALL reconstruction associated with ACL reconstruction.[8] Another article also indicated ALL reconstruction in cases of chronic ACL reconstruction, high level of sports activity, and radiographic lateral femoral notch sign[6] (Table 1).

Follow-up

The study that proposed Group A and B indications (Table 1) concluded that ACL reconstruction associated with anterolateral tenodesis suppresses the pathological acute tibial acceleration during pivot displacement.[8]

One of the studies with Group A indications (Table 1) concluded that the associated reconstruction was effective in improving subjective and objective outcomes. However, these results were not significantly superior to those of isolated ACL reconstruction, except for patients with large rotational laxity.[9]

In the article by Sonnery-Cottet et al.,[10] which indicated this treatment in Group A cases (Table 1), the rate of ACL + ALL reconstruction failure was 2.5–3.1 times lower than that of techniques without ALL reconstruction.

The study by Zhang et al.,[11] who also used the Group A indications (Table 1), concluded that a combined reconstruction plays a crucial role in knee stability and joint function, especially in rotational stability.

Finally, the study that adopted Group A and C indications (Table 1) demonstrated that a combined reconstruction can be an effective procedure without specific complications in a minimum two-year follow-up.[6]

Discussion

Currently, the ALL has been receiving more attention.[12] It is described as a triangular structure in the anterolateral topography of the knee and found deep into the iliotibial tract.[13,14] It measures between 34 and 59 mm in length, with approximately 2 mm of thickness in men and 1 mm in women. Its origin is near the lateral epicondyle in the femur and its insertion is located between Gerdy's tubercle and the fibula, with an extension toward the lateral meniscus.[5,15]

Biomechanical studies have shown that the ALL is an important stabilizer during anterolateral tibial rotation and affects pivot shift in cases of ACL failure.[6,16–18] On average, the ACL is 11 mm thick.[19] Even with only 10–20% of the thickness of the ACL, the ALL behaves as a major secondary rotational stabilizer.[12,16] The mechanism of combined ALL and ACL injury is similar to the mechanism of ACL injury alone.[12]

According to the preceding explanation, the main aim of the associated ACL and ALL reconstruction would be a greater rotational control and prevention of ACL retear.[12] Thus, it can be inferred that the best indications for joint reconstruction would be clinical conditions that present greater rotational instability and greater risk of retear.

Among the main conditions found, the most commonly mentioned were: explosive pivot shift (grade 3), sports practice with pivot movements and/or high-level sports practice, and reconstruction revision surgery. Other indications, such as chronic ACL injury, subjective rotational laxity, and radiological signs of Segond fracture and lateral femoral condyle notch were also found.[6,8–11] The pivot shift test assesses instability, as well as internal rotation and anterior tibiofemoral translation. The mean specificity of the test is very high: 98%.[20] This test is used not only to diagnose ACL insufficiency but also to assess whether there is still post-reconstruction instability. However, its sensitivity is considered low (mean of 49%)[20] due to the poor technique of involuntary muscular blockade at the time of examination.[12,20] The test can be divided into four degrees: no instability (Grade 0), glide or "slip" (Grade 1), clunk or "thump" (Grade 2), and gross or "explosive" (Grade 3), according to the magnitude of the phenomenon subjectively determined by the examiner.[21] Objectively, it is still difficult to quantify rotational laxity, despite the fact that anteroposterior instability can be measured by arthrometers such as the Telos and KT-1000[8,22]

Long-term results of ACL reconstruction are good regarding joint stability, symptom improvement, and return to pre-injury activities. However, 0.7–20% of patients present

Fig. 2 – Segond fracture.

recurrent instability due to graft failure,[23,24] and the overall revision rate is close to 8.4%.[25]

Undoubtedly ACL revision surgery is a technical challenge for the knee surgeon and a source of distress for the patient, who is always apprehensive about the return to pre-injury activities. The conditions that increase the risk of ACL retear include sports practice with pivot movements and/or high-level sports practice. Furthermore, the younger the patient who presents the ACL injury, the higher the risk of recurrent rupture.[25–27] In 1879, Segond[28] described a fracture-avulsion pattern of the anterolateral proximal tibia as a result of a forced internal rotation of the knee (Fig. 2). Subsequently, this fracture was considered a pathognomonic sign of an ACL injury.[29,30] In 2014, Claes et al.[31] concluded that this fracture is an ALL bone avulsion, representing a predictor for anterolateral instability of the knee.[32]

The lateral femoral notch is usually a shallow groove, not too deep, in the center of the lateral femoral condyle. This notch can be seen on lateral radiographs and on sagittal knee MRIs (Fig. 3A). The increased depth of this notch is closely related to ACL rupture.[33] In 1992, Cobby et al.[34] reported that a notch larger than 1.5 mm was a reliable indirect sign of ACL rupture and suggested that the increased notch size was due to bone compression during knee trauma (Fig. 3B). In 2015, Herbst et al.[35] found an association between lateral meniscus injury and a notch greater than 2 mm. Similar to a Segond fracture, the lateral femoral condyle notch sign is a useful radiological sign for the diagnosis of ACL injury.

More recently, in 2017, Vundelinckx et al.[32] recommended extra-articular lateral tenodesis for patients who present a combination of specific risk factors, due to the high risk of failure: pivot shift grade 2 or 3; age under 25 years; generalized ligament laxity; genu recurvatum >10°; and return to sports with pivot movements (*e.g.*, soccer and basketball). However, Noyes et al.,[36] in a robotic analysis of the rotational stability of the knee, questioned the increase of the stability provided by ALL reconstruction. In their study, these authors reported only a small increase in rotational stability; they did not routinely use ALL reconstruction, which was indicated only in cases of pivot grade 3 or ACL revisions.

The ALL lesion can be visualized by MRI, especially in T2-weighted sequences in a coronal section. These lesions are usually seen with fiber discontinuity or periligamentous edema, and are more frequent in the distal portion of the ligament.[37,38] However, it is difficult to consistently diagnose ALL injuries in the standard MRI sequences; special sequences may eventually be required. Currently, MRI is only an auxiliary method in the identification and clinical decision-making of ALL lesions.[12,39,40]

In 2017, a group of ALL experts,[12] in a consensus statement, indicated that an ALL reconstruction should not be routinely performed for patients undergoing ACL reconstruction. Combined ALL and ACL reconstruction should be considered for patients in the following situations: the presence of postoperative residual pivot shift; the presence of one main criterion or two secondary criteria. The main criteria are: ACL revision, pivot shift grade 2 or 3, Segond fracture, sports practice with pivot movements and/or high-level sports

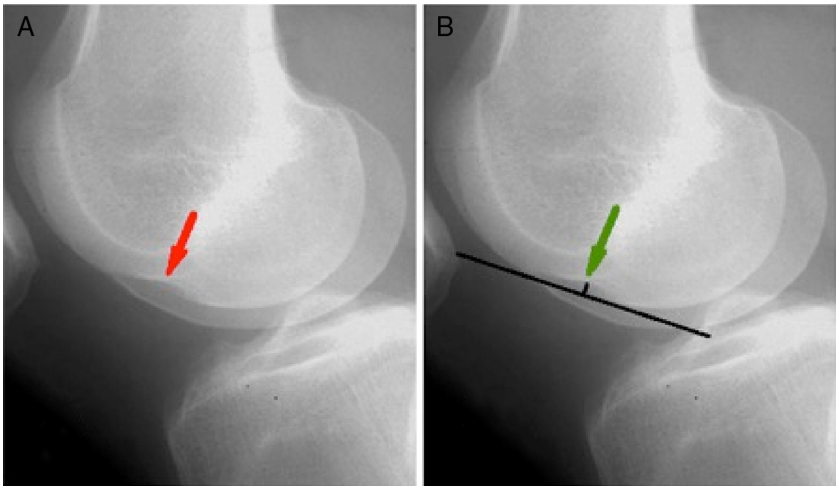

Fig. 3 – Lateral femoral notch. (A) Red arrow indicates the location of the notch; (B) green arrow indicates how to measure the depth of the notch.

practice, and hyperlaxity. The secondary criteria are: contralateral ACL rupture, Lachman's test greater than 7 mm, lateral femoral condyle notch sign, and patient aged less than 25 years.[12]

One of the limitations of the present review study was that a small number of studies had been selected regarding the subject in question, despite the great volume of recent literature on ALL. This is due to the fact that only a few clinical studies have been conducted regarding this topic; most of the literature on the subject consists of anatomical or biomechanical studies. The authors believe that as the knowledge on the basic science of this structure increases, more clinical studies will be published in the near future. However, among the articles available, it was possible to identify the most important points and the most usual indications of combined extra-articular reconstruction in current clinical practice.

Final considerations

After reviewing the main articles on the subject, the authors came to the conclusion that the main surgical indications described for ACL reconstruction combined with lateral extra-articular tenodesis or ALL reconstruction are: ACL revision, physical examination with pivot shift grade 2 or 3, sports practice with pivot movements and/or high-level sports practice, ligament laxity, and Segond fracture. Secondary indications include chronic ACL injury, age less than 25 years, and radiological lateral femoral condyle notch sign. However, more studies are still needed to prove these findings.

Conflicts of interest

The authors declare no conflicts of interest.

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