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Review article

Role of anterolateral reconstruction in patients undergoing anterior cruciate ligament reconstruction

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ABSTRACT

There is renewed interest in anterolateral reconstruction (ALR) for patients undergoing anterior cruciate ligament (ACL) reconstruction. This is the result of isolated ACL reconstruction and double-bundle reconstruction providing inadequate control over the pivot shift, and recent anatomical and biomechanical studies on the anterolateral ligament (ALL) and its role in the knee's rotational stability. From a technical point of view, ALR can be performed either as a continuity of the intra-articular ACL reconstruction or an independent procedure. The typical peripheral grafts (gracilis and semitendinosus tendons, iliotibial band) can be used. The femoral tunnel must be posterior and proximal to the lateral epicondyle, and the tibial tunnel on a line joining Gerdy's tubercle with the ALL's tibial insertion. Tensioning and fixation are done with the knee near full extension and the tibia in neutral rotation. The ALR complication rate reported in older studies (pain, hematoma, scar damage) has been reduced. Relative to isolated ACL reconstruction, ALR does not alter the infection or stiffness rate, and it reduces the re-injury rate and secondary meniscal damage rate. Analysis of the literature has not shown an increased rate of osteoarthritis after ALR. The objective and functional outcomes are equal to those after isolated ACL reconstruction. Control over rotation is improved by adding ALR and the return to pivot sports appears to be more successful. While the indications must still be refined, ALR can be proposed to young patients undergoing ACL reconstruction who participate in high-intensity pivot sports, have a high-grade pivot shift or who have a failed ACL reconstruction.

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1. Introduction

Convinced of the need to neutralize the pivot shift, Lemaire in 1975 [1] and then McIntosh in 1976 [2] proposed "lateral substitution reconstruction". After initial enthusiasm about its effectiveness on the pivot shift, this isolated reconstruction was found to be insufficient for controlling anterior tibial translation. Combined intra- and extra-articular reconstruction was developed as a consequence, mainly in Europe. Despite the good results in terms of knee stability, its invasive nature and complications at the time led to it falling out of favor, with preference for isolated intra-articular reconstruction (IAR). IAR became the gold standard for anterior cruciate ligament (ACL) reconstruction particularly following the development of arthroscopic surgery.

Recent studies on the anterolateral ligament (ALL) [3] and occasional poor results of isolated single- or double-bundle ACL reconstruction for controlling knee rotation [4,5] led to renewed interest in extra-articular tenodesis procedures, called

extra-articular reconstruction (EAR) and more recently anterolateral reconstruction (ALR). Modernization of the surgical technique and analysis of clinical outcomes and complications justify (re)defining the role of ALR in patients undergoing ACL reconstruction.

I will refer several times to the 2016 symposium of the SFA (Francophone Society of Arthroscopy) on ALR that is the subject of upcoming publications [6–8] in the journal, *Orthopaedics & Traumatology: Surgery & Research*. The number of patients in these multicenter retrospective, prospective and revision studies is summarized in [Table 1](#).

2. Why is ALR a topical issue?

2.1. Isolated or double-bundle ACL reconstruction does not control knee rotation

2.1.1. Prevailing opinion

Isolated ACL reconstruction and double-bundle reconstruction do not provide sufficient control over the pivot shift.

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Table 1
Number of patients enrolled in the prospective [6], retrospective [7] and revision [8] studies associated with the 2016 SFA symposium on anterolateral reconstruction.

Study	Number of patients enrolled
Prospective [6]	394
Retrospective [7]	478
Revision [8]	349

2.1.2. Evidence from literature

The residual pivot shift rate after isolated single-bundle ACL reconstruction ranges from 10% to 20% [5,9,10]. Double-bundle reconstruction, which also reconstructs the posterolateral bundle of the ACL, was expected to improve rotational control but published results are mixed. Suomalainen [4] and Karikis [10] compared the outcome of double-bundle reconstruction to single-bundle reconstruction and found no difference in the pivot shift. Zhu [11] reported better results in patients who underwent double-bundle reconstruction. The optimism associated with these reconstruction procedures was not confirmed. The contradictory results in published studies, technical complexity and risk of specific complications [12] led to a loss of enthusiasm for these reconstructions.

2.1.3. Summary

- The residual pivot shift rate after isolated ACL reconstruction remains high, typically between 10% and 20% in published studies.
- The results with double-bundle ACL reconstruction are not conclusive.

2.2. ALL anatomy and ALR biomechanics for controlling knee rotation

2.2.1. Prevailing opinion

The anterolateral region of the knee helps to control knee rotation, which theoretically justifies performing ALR.

2.2.2. Evidence from literature

2.2.2.1. Biomechanics of ALR. The first evidence of the mechanical benefit of ALR was provided by Monaco’s computer navigation study [13]. It showed that ACL reconstruction combined with ALR provided more control over medial tibial rotation, and thereby the pivot shift, than isolated ACL reconstruction. Imbert [14] then showed that after an ACL tear, the knee’s center of rotation moves medially; a lateral ALR away from this center of rotation is highly effective because of its large moment arm (Fig. 1). Engrebeten [15] showed that adding ALR to ACL reconstruction could protect the latter as the forces were reduced by 43% on the intra-articular portion of the reconstruction. The biomechanical results of ALR are described in detail in the systematic review of literature published by Slette [16] in 2016.

2.2.2.2. Anatomy of ALL. The recent description of the ALL [3] has allowed us to draw a link between the mechanical effectiveness of ALR, as described previously, and the existence of an anatomical, anterolateral structure that plays a role in controlling medial tibial rotation and is often damaged during ACL tears.

The ALL’s insertion on the femur is posterior and proximal relative to the lateral epicondyle, is angled down and forward to insert on the tibia mid-way between Gerdy’s tubercle and the fibular head, 5 to 10 mm below the joint line [3,17,18] (Fig. 2). The ALL is placed under tension and elongated during medial tibial rotation [18]. Its role in controlling this rotation, in synergy with the ACL, has been demonstrated [17,19,20].

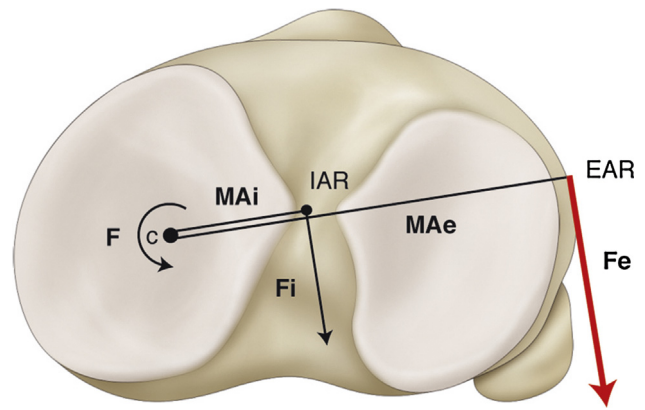


Fig. 1. Biomechanical advantage of anterolateral reconstruction. After an ACL tear, the knee’s center of rotation (c) is shifted medially; ALR (Fe - red arrow) located away from the center of rotation has a larger mechanical effect due to its moment arm (MAe) than reconstruction at the center of the joint (Fi - black arrow) [14].

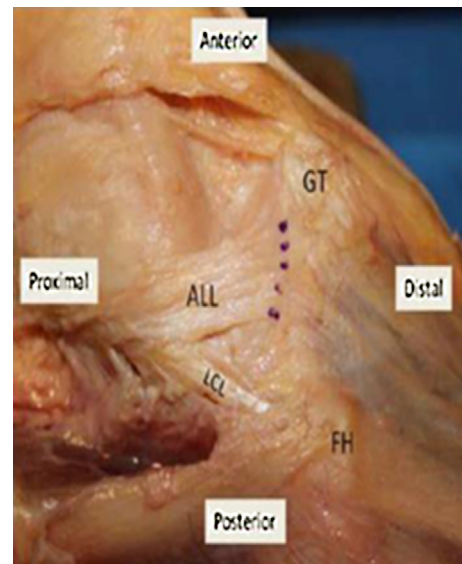


Fig. 2. Anatomy of the anterolateral ligament (ALL) (GT: Gerdy’s tubercle; FT: fibular head; LCL: lateral collateral ligament) [18].

In recent ACL tears, the ALL has been found to be damaged in 90% of cases based on intraoperative observations [21]. This validates its synergistic action with the ACL and means that both the ALL and the ACL are loaded during injury events with a forced medial rotation component.

2.2.3. Summary

- Biomechanical studies confirm the benefit of ALR in controlling medial tibial rotation.
- The ALL is an anatomical structure that provides a link between the pivot shift and the possibility of controlling it through the mechanical action of ALR.

3. How is anterolateral reconstruction performed?

3.1. Prevailing opinion

There is some confusion between the term “anterolateral reconstruction” and “anterolateral ligament reconstruction” in the minds of many orthopedic surgeons and in the literature. While both procedures have the same mechanical outcome—improved

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