Lateral Extraarticular Tenodesis in Combined ACL and ALL Reconstruction

Case presentation

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The purpose of this paper was to evaluate the necesity of associating a lateral extraarticular tenodesis in patients that will undergo an anterior cruciate ligament reconstruction or revision and to briefly describe the surgical procedure. Multiple lateral extraarticular tenodesis techniques were described and also graft selection and fixation types are also important. In conclusion acute ACL tears with grade 3+ pivot shift can be succesfully treated by combined ACL reconstruction and LEAT association.

Keywords:anterior cruciate ligament, anterolateral ligament, knee instability

The main stabilizer of the knee and the anatomical structure that prevents the anterior translation of the tibia is the anterior cruciate ligament. Its secondary role is to prevent tibial internal rotation. Its origin lies in the femoral notch and its insertion is anterior to the tibial spines, where its fibers blend with the anterior horn of the lateral meniscus. The two bundles that compose the ACL are the postero-lateral bundle (it tensions in extension) and the antero-medial bundle (it tensions in flexion). The bundles are named after their insertion on the tibial plateau.

ACL tears are most frequently caused by a sudden change of direction and forced tibial internal rotation [1]. Non surgical treatment has poor results in young and active patients. Anatomical reconstruction (single bundle or double bundle) with autografts (BTB, quadriceps tendon, gracilis and semitendinosus tendon) remains the gold standard. In grade 3+ pivot shift test patients a combined LEAT (lateral extraarticular tenodesis**)** association might be necessary in order to prevent the internal rotation of the tibia [2]. Multiple LEAT techniques were described, such as: ALL reconstruction, Lemaire, MacIntosh, Andrews, Losee, Arnold and Coker, Ellison, Wilson and Scranton [3].

The anterolateral ligament is an important stabilizer of internal rotation in knee flexion greater than 35 degrees or more. The aim of the ALL reconstruction is to obtain rotation stability of the knee, and fixation devices are deemed important; bioabsorbable and PEEK screws are used for graft fixation [4].

Experimental part

Materials and methods

Surgical procedure

All patients are to be evaluated preoperatively and postoperatively using the same protocol: pivot-shift test, Lachman test, anterior and posterior drawer test, IKDC score and/or Lysholm score. Associated commorbidities are to be evaluated, especially cardiac pathology, which needs to be adressed correctly, and the treatment needs to be confirmed as effective pre-op [5,6].

The patient is placed supine. A tourniquet is used in the proximal thigh and the knee is flexed at 90 degrees. A diagnostic arthrocopy is first performed and the ACL is evaluated (fig. 1).

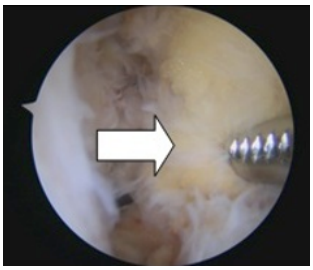

Fig. 1. ACL Lesion, as viewed during a diagnostic arthroscopy.

A 4 cm incision is performed on the antero-medial aspect of the leg, starting at aproximately 3 cm distal to the joint line and 3 cm medial to the tibial tubercle. The hamstrings tendons are identified and then harvested with a stripper and used for the ACL autograft (fig. 2).

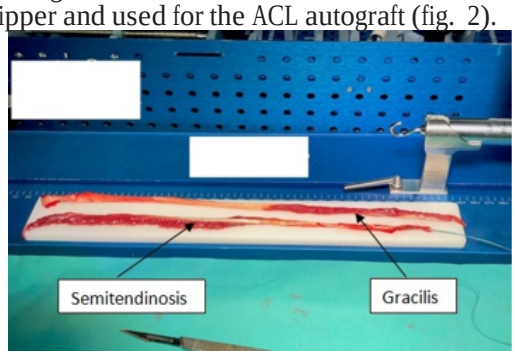

Fig. 2. Preparation of ACL graft

Outside-in femoral tunnel (fig. 3) and inside-out tibial tunnel (fig. 4) are then performed. The ACL graft is passed through the tunnel and fixed with 2 PEEK screws in 30 degrees of flexion and external rotation (fig. 5).

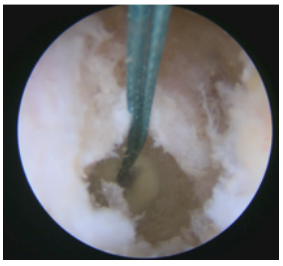

Fig.3. Preparation of the femoral tunnel

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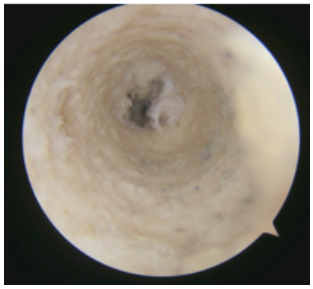

Fig. 4. Preparation of the tibial tunnel

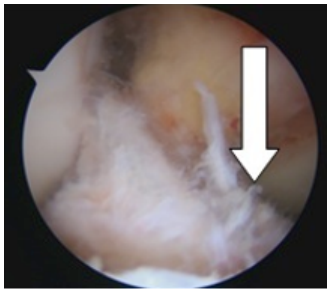

Fig. 5. Insertion of the ACL graft

A Lachman test and pivot shift test are then performed. If there is any residual internal rotation we standardly perform an antero-lateral ligament reconstruction. A 5 cm incision is performed starting at the lateral epicondyle of the femur and running midway between Gerdys tubercle and the fibular head. A 14 cm graft of the ilio-tibial tract is harvested using a tendon stripper. The anatomical footprints of the ALL are then exposed. Two guide wires are inserted into the footprints and, using fiberwire, proper tension is checked (they should tension in extension and relax in flexion). Two tunnels are created in thefootprints and the graft is fixed using two PEEK anchors. The graft tension is then checked one more time [7,8].

Case presentation

We present the case of a 17 year-old male professional soccer player who presented in our clinic with instability in his left knee after an ACL reconstruction (hamstrings tendon graft), performed 1 year ago. Upon clinical examination we found a grade 3 Lachman test, positive anterior drawer sign and a grade 3 pivot shift test. We analyzed the Lysholm score [9] that is based on the following : limping, necesity of canes/crutches, locking sensation in knee, giving way sensation in knee, pain, swelling, climbing stairs and squating; and the Tegner activity score [10] that is based on the kind of lifestyle the patient has (from sick leave or disability pension to competitive sports). The Lysholm score was 61, and the Tegner activity score concurred that the patient was a level 9. We performed a series of radiographs on his left knee A-P, L and an MRI (fig. 6 and fig. 7) showing a tear in the ACL graft. We decided to perform an ACL revision using BTB graft (fig. 8) and an ALL reconstruction as shown in the technique previously presented. At the conclusion of the surgery the Lachman test, the anterior drawer sign and the pivot shift tests were negative. The drain was removed the next day after surgery and a hinged knee brace was applied for three weeks. Passive and active range of motion exercises were allowed the second day postoperative.

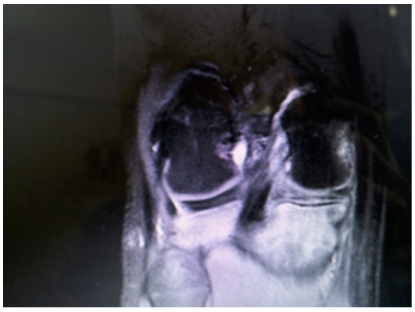

Fig. 6. MRI frontal view showing a complete ACL graft tear

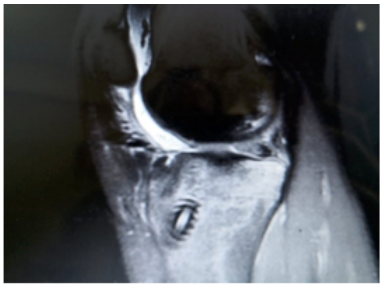

Fig. 7. MRI sagital view showing a complete ACL graft tear.

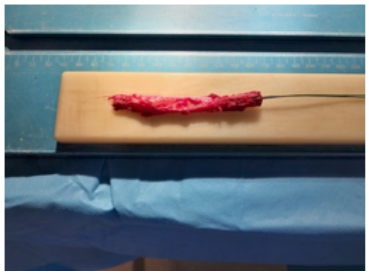

Fig. 8. BTB Graft Preparation

Results and discussions

In the presented case at 3 months post operative the Lysholm test was 82 and at 6 months it was 91 (fig. 9). The patient returned to sport at 7 months post operation. The midterm results were very good also because of the integrity of the knee structures (no meniscus and cartilage lesions). The particularity of the case is represented by the fact that the patient is a professional athlete and he needed a fast recovery and a stronger stability of the knee. Due to the necessity of early return to high demanding activities the patient will undergo a continuing rehabilitation program and several other clinical evaluations during the first postoperative year.

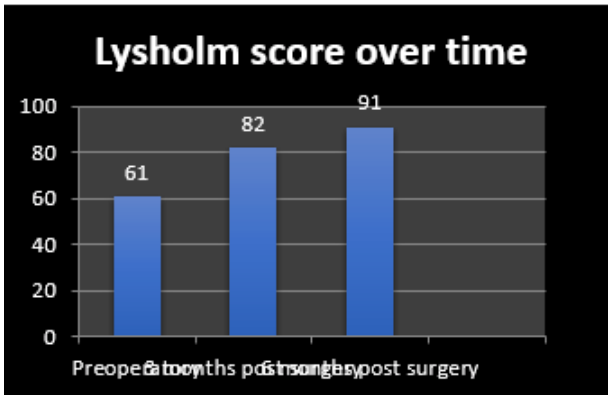

Fig. 9. The Lysholm score over time

The results obtained by associating ACL reconstruction with LEAT tenodesis depend on several factors, of which foremost are the pivot shift test results, with grade 3+ being the clearest indication of a good result. In our experience, another factor that influences the outcome is the overall status of the knee, the presence of osteoarthritis being a strong indication of a poor outcome in time, and is best managed with physical therapy and sometimes arthroscopy [11-13]. Another factor that we found to influence results is a limb axis deficiency, most often resulting from a varus or valgus deformation of the knee, and treated with an osteotomy procedure, or sometimes as a consequence of an ankle deformation, or a plantar arch deficiency, treated with physical therapy, laser therapy, medication, and sometimes open or endoscopic procedures [14-16].

A particular problem that we found in revision surgery, that directly influences the result of the combined procedure, is the altered bone stock in the targeted areas.

This may be grafted, but for a deep understanding of the defect and the manner in which it influences the overall procedure we recommend the use of a 3D reconstruction technique based on the patients MRI or CT scans, which leads to the creation of a 3D printed model of the bone defects [17-22]. The 3D printing technology is mostly used in bone defect reconstruction; although recent developments suggest that it may be used in other areas as well, such as prosthetics, in conjunction with other innovative solutions [23].

Different fixation devices have been described, the most commonly used ones being the PEEK screws and the Biocomposite interference screws. PEEK (Polyetheretherketone) is a very strong thermoplastic polymer. The mechanical properties of the PEEK has advantages for various orthopaedic applications. The tensile yield strength and shear strength are superior matches to cortical bone, especially when compared to titanium materials (table 1).

Table1
ADVANTAGES OF PEEK SCREWS

Mechanical advantages	Non-Mechanical advantages
Little or nocross-linking	Biocompatibility
Little or nohydrolysis	Biostability
Little or nochange in brittleness	

The Biocomposite interference screws used in ACL and PCL reconstruction are made of polylactide (PLA) and polyglycolide (PGA) which are easily degradable within the body. The PLA degrades into lactic acid and the PGA degrades into glycolic acid. Their osteoconductive properties allow for better growth and bone formation when proper growth factors are nearby. In a 2 year animal study (on sheep) biocomposite screws were found to produce new bone, no inflamatory response and little screw degradation [24].

A meta-analysis that included 10 studies published by Pubmed, Medline and the Cochrane database made by North America Arthroscopy Association evaluated the association of a lateral extraarticular tenodesis to the ACL reconstruction. The conclusion was that single extrarticular procedures on an ACL defficient knee did not restore the normal knee function, but when a lateral extraarticular tenodesis was associated with an ACL reconstruction the anterior tibial translation, internal rotation and graft tension were significantly reduced [25].

Another study made byOrtop J Sports Med in 2017 analised the role of LEAT in primary ACL reconstruction in patients with acute lesions (<12 months) and chronic lesions (>12 months). The results did not show a knee function improvement in patients with acute lesion, but showed a decreased lateral translation of the femur in chronic lesions [26].

In the end, we consider that an appropriate reconstruction of the ACL and ALL ligaments is crucial, as a permanent instability of the knee, not considering the patient's comfort, will eventually lead to an ever more advanced osteoarthritis of the knee, which may, in the end, need to be addressed with an uncemented or cemented prosthesis [27].

To increase efficiency in the reconstruction of ACL and ALL ligaments, software, biointerfaces and robotic systems will be used in the future [28-35].

Conclusions

ACL tears are among the most frequent knee lesions. The gold standard treatment is the anatomical reconstruction of the ACL (single bundle or double bundle) using different tendinous grafts. Despite the anatomical reconstruction, anatomical function may not always be restored (increased internal rotation) and a lateral extraarticular technique is associated. We only use antero lateral reconstruction in patients with ACL reconstruction and pivot shift test positive. We prefer osteoinductive implants (PEEK screws) for their superior mechanical and non-mechanical properties: a superior match to cortical bone, shear strength and low friction coefficient.

In our opinion, the ALL reconstruction is mostly needed in high demand patients, with intraoperative pivot shift still positive after ACL reconstruction, which limits the indication to a select group of patients.

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