*Acta Orthop. Belg.*, 2020, **86**, 447-452

*ORIGINAL STUDY*

# A revisited technique for combined anterior cruciate ligament and anterolateral ligament reconstructions

K. Smeets, J. Bellemans, J. Truijen

*From the Doctoral School for Medicine and Life Sciences, Hasselt University, Diepenbeek, Belgium*

**A new technique for combined anterior cruciate ligament and anterolateral ligament reconstructions is described. An iliotibial band strip is used as an ALL graft , leaving the distal insertion intact and fix it with a knotless anchor on the femoral origin, after tunneling it under the lateral collateral ligament.**

**Keywords** : anterolateral ligament ; reconstruction ; surgical technique.

## INTRODUCTION

Anterior cruciate ligament (ACL) tears are one of the most common knee injuries with an annual incidence of 68.6 per 100.000 person-years *(17)* and frequently require surgical reconstruction. However, re-rupture of the ACL graft is reported in approximately 1.7% to 18% of patients *(15,31)* and a remaining post-operative pivot shift is seen in 11% to 60% of patients *(10,11,29)*. Therefore, several authors advocate the use of a lateral extra-articular tenodesis (LET) in combination with an ACL reconstruction and report good to excellent clinical results *(3,23)*.

Since a detailed anatomical description of the anterolateral ligament (ALL) was given *(2)*, ALL reconstructions as a LET procedure are becoming more popular and several techniques are described *(1,5,22)*. To date, two outcome study were identified showing a significant reduced ACL failure rate *(26)* and good clinical results at 2-year follow-up *(27)*. Biomechanical studies have shown that the ALL functions as a secondary stabilizer to the ACL in resisting anterior tibial translation and internal tibial rotation. *(13,14,25,28,30)*. In the literature however, there is no consensus on graft choice, fixation method and ALL landmarks. The aim of this article was to describe our technique for combined ACL and ALL reconstructions.

## SURGICAL TECHNIQUE

The patient is placed in supine position on a standard operating table with the injured leg in an automatic leg holder (Maquet, Rastatt, Germany). The knee is able to move freely through the full range of motion and a tourniquet is inflated high on

■ K. Smeets[1,2],
■ J. Bellemans[2,3],
■ J. Truijen[2,3]

[1]*Doctoral School for Medicine and Life Sciences, Hasselt University, Diepenbeek, Belgium*

[2]*Department of Orthopedic Surgery, Ziekenhuis Oost-Limburg, Genk, Belgium.*

[3]*Faculty of Medicine and Life Sciences, Hasselt University, Diepenbeek, Belgium.*

Correspondence : Kristof Smeets, GRIT Belgian Sports Clinic, Engels Plein 35/103, 3000 Leuven, Belgium. Phone : 0032474879934.

E-mail : kristofsmeets@yahoo.com



*No benefits or funds were received in support of this study. The authors report no conflict of interests.*


***Figure 1.*** — Patient positioning and surgical set-up. P= Patella ; LE= Lateral Epicondyl ; JL= Joint Line ; G= Gerdy's Tubercle ; FH= Fibular Head.

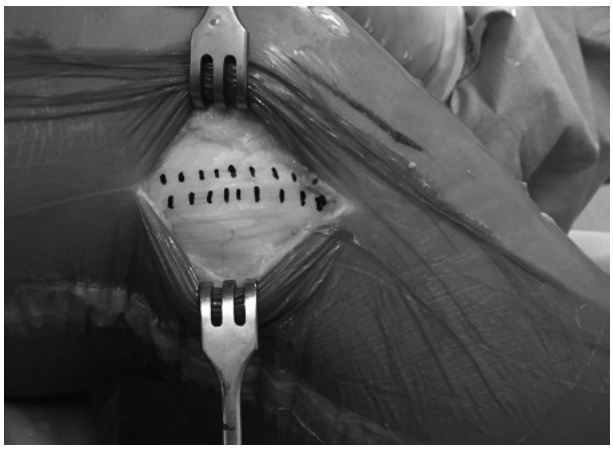

***Figure 2.*** — A straight lateral incision is established from the lateral epicondyle (LE) to a point just inferior of Gerdy's tubercle, and dissection of the subcutaneous tissue is performed until the fibers of the ITB are seen.

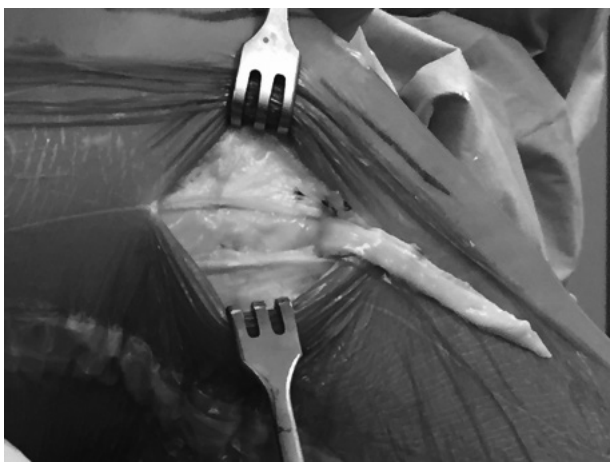

***Figure 3.*** — A 6-8 cm long and 1cm width strip is cut in the posterior part of the iliotibial band (ITB).

the thigh. Before the application of the povidine-iodine – coated cutaneous drape, bony landmarks, the joint level and the incisions are marked. (Figure 1). The surgical technique for a combined ACL and ALL reconstruction is performed in 5 consecutive steps :

1. ACL Graft Preparation

An 3cm long incision is made over the pes anserine parallel with the hamstring tendons. With respect to the infrapatellar branches of the n. saphenous, the semitendinosus is harvested with a closed stripper and prepared as a quadruple ACL graft of at least 8mm using a suspensory fixation system (Tightrope, Arthrex, Naples, USA). If less diameter, the gracilis tendon is taken and a six-strand ACL graft is made.

2. ACL Tunnel Positioning

A high parapatellar anterolateral portal was made as a viewing portal for the arthroscopic part of the procedure. A low anteromedial portal was established as the working portal for the femoral ACL drilling. An arthroscopic debridement of the anterior cruciate ligament and notch was performed to have a clear view on the medial wall of the LFC. A femoral offset guide of 5 mm (6mm if ACL graft $\geq$ 9mm) was placed behind the LFC while the knee was fully flexed. Next an ACL tightrobe drill pin of 4mm was placed at a 2 or 10 o'clock position (for the left and the right knee, respectively) and subsequently overreamed to the size of the ACL graft with a total tunnel length of 25mm.

Next the tibial tunnel is made by placing a drill pin within the native ACL tibial footprint and by overreaming it to the size of the ACL graft. Before passing the ACL graft, ALL tunnel preparation is performed to avoid tunnel collision.

3. ALL Graft Preparation

A straight lateral incision is established from the lateral epicondyle (LE) to a point just inferior of Gerdy's tubercle, and dissection of the subcutaneous tissue is performed until the fibers of the ITB are seen. (Figure 1, Figure 2) A 6-8cm long and 1cm width strip is cut in the posterior part of the iliotibial

***Figure 4.*** — Tunneling of the graft under the lateral collateral ligament (LCL), just beneath his femoral insertion.

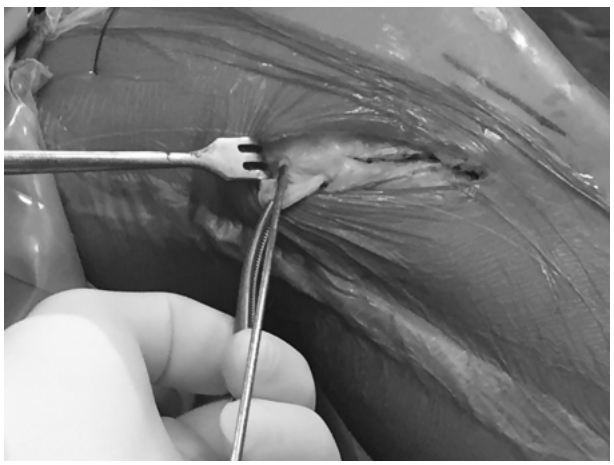

***Figure 5.*** — A 2.4 mm guidewire is drilled in the origin of the ALL, just posterior and proximal of the lateral epicondyle.

band (ITB). The distal insertion of the ITB remained intact and the graft is tunneled under the lateral collateral ligament (LCL), just beneath his femoral insertion. (Figure 3, Figure 4)

The ALL insertion point is identified, as described by the ALL Expert Group, just proximal and posterior of the LE (24). From this position, a 2.4mm guidewire is drilled anteriorly in the axial plane and perpendicular to the anatomical axis of the femur in the coronal plane. (Figure 5)

It is verified under arthroscopic view if the guidewire doesn't interfere with the femoral ACL tunnel. (Figure 6) If so, the guidewire is repositioned to a more anterior and/or proximal direction, with

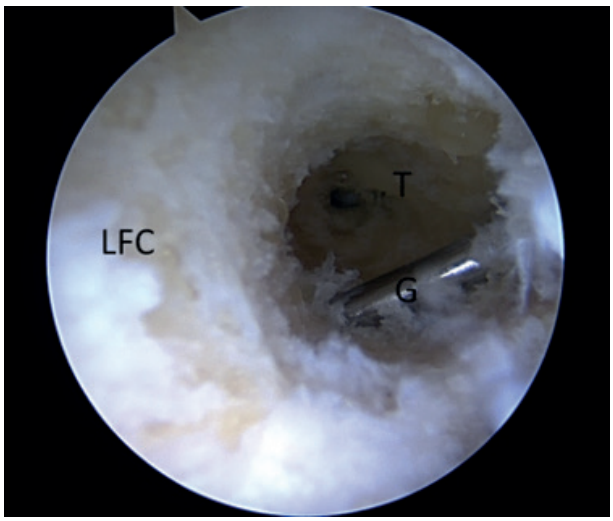


***Figure 6.*** — Example of a tunnel conflict under arthroscopic view between the femoral ACL tunnel and the ALL guidewire. LFC= medial wall of the lateral femoral condyle ; G= guidewire for the ALL tunnel ; T= Femoral ACL Tunnel.

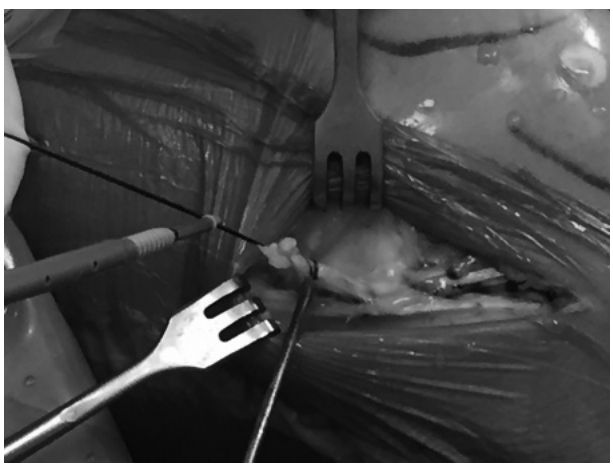

***Figure 7.***. — The free end of the ITB strip is whipstitched and the wires are passed through the eyelet of a 4.75mm knotless anchor. Fixation of the ALL graft is performed with the knee in 45° of flexion and neutral rotation.

attention to not violating the trochlear groove. The guidewire is then overdrilled to increase the diameter to 4.5mm with a total tunnel length of 25mm.

4. ACL Graft Fixation

After preparation of both ACL and ALL tunnels, the ACL graft is passed from the tibia to the femur. The femoral fixation is performed with the tightrope suspensory system. On the tibial side, a

double fixation with first a post screw and then an interference screw is used.

5. ALL Graft Fixation

The free end of the ITB strip is whipstitched with No. 2 absorbable suture for a length of 1cm and the suture wires are passed through the eyelet of a 4.75mm knotless anchor (SwiveLock, Arthrex, Naples, USA). (Figure 7) Fixation of the ALL graft is performed with the knee in 45° of flexion and neutral rotation.

## DISCUSSION

The aim of this article was to describe our technique for combined ACL and ALL reconstructions. The renewed interest in the anterolateral compartment is largely attributed to the high number of patients with remaining anterolateral rotatory instability after isolated ACL reconstructions (ACLR). It has been demonstrated that the supplementation of a LET procedure is effective in reducing this rotational laxity *(9)*. Moreover, biomechanical studies highlighted the importance of the ALL as an anterior and rotational stabilizer in the knee *(13,16)*. As a consequence, ALL reconstructions (ALLR) are gaining popularity and several surgical techniques for anatomic ALLR are described in literature, but there is still a lack of comparative biomechanical and clinical studies.

Biomechanical studies described the potential overstuffing of the tibiofemoral joint by an ALLR *(6,8,18)*. Therefore, graft choice is important and commonly used graft types are gracilis *(4,7,21,22)*, semitendinosus *(1)*, iliotibial band *(12)* and polyester tape *(32)*. It has been demonstrated that hamstring grafts have a 5-8x higher elastic modulus than the ALL and so could theoretically overconstrain the lateral compartment *(19,20)*. The ITB however, had also a higher elastic modulus than the ALL, but data showed significant lower values in comparison to the hamstring tendons *(19)*. Another biomechanical study on the structural properties of the different ALL grafts demonstrated a significant higher stiffness for the gracilis relative to the ITB *(33)*. Therefore, we prefer the ITB band over the hamstring tendons to reduce the risk of overtightening the lateral compartment.

Cadaveric and radiographic studies from our group showed a high risk of tunnel collision (67%) in combined ACL and ALL reconstructions and this could be avoided by aiming the ALL tunnel anteriorly and perpendicular to the anatomical axis of the femur. (Unpublished data, January 2018) Because tunnel collision can lead to graft rupture, ALL tunnel orientation need to be adjusted. Attention should also be given to the ALL femoral fixation method. The ALL Expert Group reached a consensus about his origin, being proximal and posterior to the lateral epicondyle on the femur *(24)*. Because of this close proximity to the LCL origin, there is a high risk of iatrogenic damage to this ligament when a large diameter femoral ALL tunnel is drilled *(7)*. To reduce that risk, we prefer to create a smaller 4.5mm tunnel instead of larger diameter tunnels *(1,22)*. Also the positioning of the leg in ALL graft fixation has been heterogeneous in the literature, and the ALL Expert Group reached a consensus to fix the graft with the knee in full extension and the foot in neutral rotation. However, Parsons et al. *(16)* showed that the ALL is an important stabilizer of internal rotation at knee flexion angles greater than 35° and therefore we prefer a fixation of the ALL at 45° of flexion.

Our recommendation is to perform combined ACL and ALL reconstructions in patients participating in pivoting sports, adolescents, patients with a high-grade pivot shift, high-level athletics, hyperlax patients and revision cases. However, future studies are required to evaluate the efficacy and long-term results of the different ALL reconstruction techniques.

## REFERENCES

1. **Chahla J, Menge TJ, Mitchell JJ, Dean CS, LaPrade RF.** Anterolateral Ligament Reconstruction Technique : An Anatomic-Based Approach. *Arthrosc Tech*. 2016 ; 5 : e453-7.
2. **Claes S, Vereecke E, Maes M, Victor J, Verdonk P, Bellemans J**. Anatomy of the anterolateral ligament of the knee. *J Anat*. 2013 ; 223 : 321-8.
3. **Dodds AL, Gupte CM, Neyret P, Williams AM, Amis AA**. Extra-articular techniques in anterior cruciate ligament reconstruction : a literature review. *J Bone Joint Surg Br*. 2011 ; 93 : 1440-8.

4. **Ferreira Mde C, Zidan FF, Miduati FB, Fortuna CC, Mizutani BM, Abdalla RJ**. Reconstruction of anterior cruciate ligament and anterolateral ligament using inter-linked hamstrings - technical note. *Rev Bras Ortop*. 2016 ; 51 : 466-70.
5. **Ferretti A, Monaco E, Fabbri M, Mazza D, De Carli A**. The Fascia Lata Anterolateral Tenodesis Technique. *Arthrosc Tech*. 2017 ; 6 : e81-e86.
6. **Fu FH, Herbst E.** Editorial Commentary : The Pivot-Shift Phenomenon Is Multifactorial. *Arthroscopy*. 2016 ; 32 : 1063-4.
7. **Helito CP, Bonadio MB, Gobbi RG, da Mota EARF, Pecora JR, Camanho GL, et al.** Combined Intra- and Extra-articular Reconstruction of the Anterior Cruciate Ligament : The Reconstruction of the Knee Anterolateral Ligament. *Arthrosc Tech*. 2015 ; 4 : e239-44.
8. **Herbst E, Arilla FV, Guenther D, Yacuzzi C, Rahnemai-Azar AA, Fu FH, et al.** Lateral Extra-articular Tenodesis Has No Effect in Knees With Isolated Anterior Cruciate Ligament Injury. *Arthroscopy*. 2018 ; 34 :251-260.
9. **Hewison CE, Tran MN, Kaniki N, Remtulla A, Bryant D, Getgood AM**. Lateral Extra-articular Tenodesis Reduces Rotational Laxity When Combined With Anterior Cruciate Ligament Reconstruction : A Systematic Review of the Literature. *Arthroscopy.* 2015 ; 31 : 2022-34.
10. **Jonsson H, Riklund-Ahlstrom K, Lind J.** Positive pivot shift after ACL reconstruction predicts later osteoarthrosis : 63 patients followed 5-9 years after surgery. *Acta Orthop Scand.* 2004 ; 75 : 594-9.
11. **Karikis I, Desai N, Sernert N, Rostgard-Christensen L, Kartus J**. Comparison of Anatomic Double- and Single-Bundle Techniques for Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autografts : A Prospective Randomized Study With 5-Year Clinical and Radiographic Follow-up. *Am J Sports Med*. 2016 ; 44 : 1225-36.
12. **Kernkamp WA, van de Velde SK, Bakker EW, van Arkel ER.** Anterolateral Extra-articular Soft Tissue Reconstruction in Anterolateral Rotatory Instability of the Knee. *Arthrosc Tech.* 2015 ; 4 : e863-7.
13. **Kittl C, El-Daou H, Athwal KK, Gupte CM, Weiler A, Williams A, et al.** The Role of the Anterolateral Structures and the ACL in Controlling Laxity of the Intact and ACL-Deficient Knee. *Am J Sports Med*. 2016 ; 44 : 345-54.
14. **Kraeutler MJ, Welton KL, Chahla J, LaPrade RF, McCarty EC**. Current Concepts of the Anterolateral Ligament of the Knee : Anatomy, Biomechanics, and Reconstruction. *Am J Sports Med*. 2018 ; 46 :1235-1242.
15. **Maletis GB, Inacio MC, Funahashi TT.** Analysis of 16,192 anterior cruciate ligament reconstructions from a community-based registry. *Am J Sports Med*. 2013 ; 41 : 2090-8.
16. **Parsons EM, Gee AO, Spiekerman C, Cavanagh PR.** The biomechanical function of the anterolateral ligament of the knee. *Am J Sports Med*. 2015 ; 43 : 669-74.
17. **Sanders TL, Maradit Kremers H, Bryan AJ, Larson DR, Dahm DL, Levy BA, et al.** Incidence of Anterior Cruciate Ligament Tears and Reconstruction : A 21-Year Population-Based Study. *Am J Sports Med.* 2016 ; 44 : 1502-7.
18. **Schon JM, Moatshe G, Brady AW, Serra Cruz R, Chahla J, Dornan GJ, et al**. Anatomic Anterolateral Ligament Reconstruction of the Knee Leads to Overconstraint at Any Fixation Angle. *Am J Sports Med*. 2016 ; 44 : 2546-2556.
19. **Smeets K, Bellemans J, Scheys L, Eijnde BO, Slane J, Claes S**. Mechanical Analysis of Extra-Articular Knee Ligaments. Part two : Tendon grafts used for knee ligament reconstruction. *Knee*. 2017 ; 24 : 957-964.
20. **Smeets K, Slane J, Scheys L, Claes S, Bellemans J.** Mechanical Analysis of Extra-Articular Knee Ligaments. Part One : Native knee ligaments. *Knee.* 2017 ; 24 : 949-956.
21. **Smith JO, Yasen SK, Lord B, Wilson AJ**. Combined anterolateral ligament and anatomic anterior cruciate ligament reconstruction of the knee. *Knee Surg Sports Traumatol Arthrosc.* 2015 ; 23 : 3151-6.
22. **Sonnery-Cottet B, Barbosa NC, Tuteja S, Daggett M, Kajetanek C, Thaunat M**. Minimally Invasive Anterolateral Ligament Reconstruction in the Setting of Anterior Cruciate Ligament Injury. *Arthrosc Tech*. 2016 ; 5 : e211-5.
23. **Sonnery-Cottet B, Barbosa NC, Vieira TD, Saithna A**. Clinical outcomes of extra-articular tenodesis/anterolateral reconstruction in the ACL injured knee. *Knee Surg Sports Traumatol Arthrosc*. 2018/ ; 26 : 596-604.
24. **Sonnery-Cottet B, Daggett M, Fayard JM, Ferretti A, Helito CP, Lind M, et al.** Anterolateral Ligament Expert Group consensus paper on the management of internal rotation and instability of the anterior cruciate ligament - deficient knee. *J Orthop Traumatol.* 2017 ; 18 : 91-106.
25. **Sonnery-Cottet B, Lutz C, Daggett M, Dalmay F, Freychet B, Niglis L, et al**. The Involvement of the Anterolateral Ligament in Rotational Control of the Knee. *Am J Sports Med.* 2016 ; 44 : 1209-14.
26. **Sonnery-Cottet B, Saithna A, Cavalier M, Kajetanek C, Temponi EF, Daggett M, et al.** Anterolateral Ligament Reconstruction Is Associated With Significantly Reduced ACL Graft Rupture Rates at a Minimum Follow-up of 2 Years : A Prospective Comparative Study of 502 Patients From the SANTI Study Group. *Am J Sports Med*. 2017 ; 45 : 1547-57.
27. **Sonnery-Cottet B, Thaunat M, Freychet B, Pupim BH, Murphy CG, Claes S**. Outcome of a Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction Technique With a Minimum 2-Year Follow-up. *Am J Sports Med.* 2015 ; 43 : 1598-605.
28. **Spencer L, Burkhart TA, Tran MN, Rezansoff AJ, Deo S, Caterine S, et al**. Biomechanical analysis of simulated clinical testing and reconstruction of the anterolateral ligament of the knee. *Am J Sports Med*. 2015 ; 43 : 2189-97.

29. **Suomalainen P, Jarvela T, Paakkala A, Kannus P, Jarvinen M.** Double-bundle versus single-bundle anterior cruciate ligament reconstruction : a prospective randomized study with 5-year results. *Am J Sports Med*. 2012 ; 40 : 1511-8.
30. **Thein R, Boorman-Padgett J, Stone K, Wickiewicz TL, Imhauser CW, Pearle AD**. Biomechanical Assessment of the Anterolateral Ligament of the Knee : A Secondary Restraint in Simulated Tests of the Pivot Shift and of Anterior Stability. *J Bone Joint Surg Am*. 2016 ; 98 : 937-43.
31. **Thompson SM, Salmon LJ, Waller A, Linklater J, Roe JP, Pinczewski LA.** Twenty-Year Outcome of a Longitudinal Prospective Evaluation of Isolated Endoscopic Anterior Cruciate Ligament Reconstruction With Patellar Tendon or Hamstring Autograft. *Am J Sports Med.* 2016 ; 44 : 3083-94.
32. **Wagih AM, Elguindy AM**. Percutaneous Reconstruction of the Anterolateral Ligament of the Knee With a Polyester Tape. *Arthrosc Tech.* 2016 ; 5 : e691-e97.
33. **Wytrykowski K, Swider P, Reina N, Murgier J, Laffosse JM, Chiron P, et al.** Cadaveric Study Comparing the Biomechanical Properties of Grafts Used for Knee Anterolateral Ligament Reconstruction. *Arthroscopy*. 2016 ; 32 : 2288-2294.