

# THE EXTRA-ARTICULAR LATERAL TENODESIS FOR AN ACL-DEFICIENT KNEE

## SOMETIMES A WINNER IS A DREAMER WHO JUST WON'T QUIT

– Written by Marc Martens, Qatar

### AIM

The purpose of extra-articular lateral tenodesis for an anterior cruciate ligament (ACL) deficient knee is to restore pivot control.

### HISTORY

The optimal ACL reconstruction is still a highly demanding clinical issue in orthopaedic research. In vitro and in vivo studies highlight that pure single bundle ACL surgery is not completely able to functionally restore knee rotational stability patterns. In the past few decades, several surgical reconstructions, combining intra- and extra-articular procedures, have been proposed with the aim of improving the control of both knee translational and rotational laxities.

In the 1960s and 1970s before arthroscopic techniques were introduced

for ACL reconstruction, open surgery with patellar tendon graft (type Kenneth Jones) used to be the standard procedure. However it often resulted in a significant loss of range of motion due to an anterior position of the femoral insertion. It is difficult to reach the posterolateral border of the intercondylar notch through an open medial arthrotomy, therefore modifications such as an 'over the top' position were tried. The complication rate and unsatisfactory results with open intra-articular (IA) procedures, as well as many athletes not being able to resume their previous level of sports performance, pushed surgeons to look for alternatives.

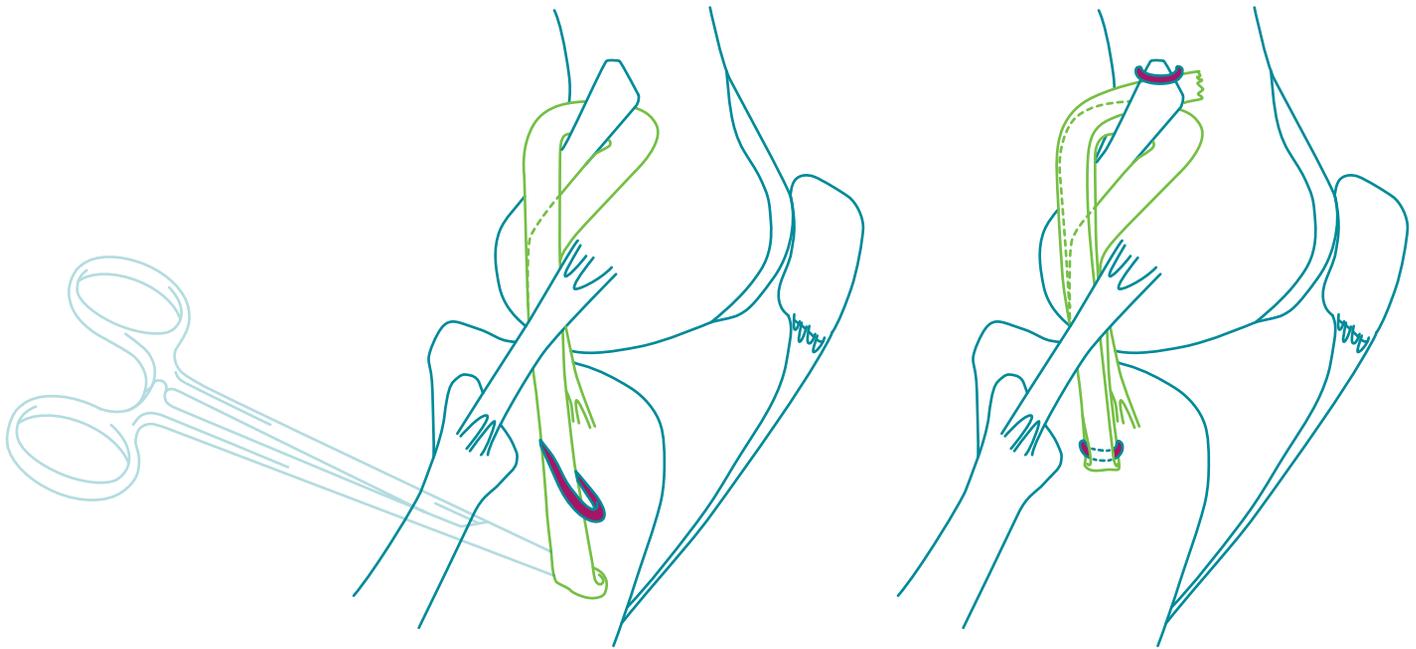
Dr Marcel Lemaire in Europe and McIntosh in the USA introduced extra-articular techniques aiming to restore pivot control at the knee. The author also performed a so-called modified McIntosh, in the early 1970s, applying a triple sling of a

fascia lata fixed with two staples to achieve a bony anchoring at the femoral and tibial attachment (Figure 1 and 2).

In the end, the idea of this modification of the lateral tenodesis is to provide enough tissue for the extra-articular graft to withstand loading during cutting movements of the leg on the field and a bony anchoring to avoid slackening of the graft over time.

Through a lateral approach one prepares a 10 to 13 mm wide strip at the posterior section of the Iliotibial (IT) Band. With a fascia cutter one is able to extend the fascia strip subcutaneously up to around 40 cm length. This long fascia lata strand remains inserted at the tibia.

The sling is pulled underneath the proximal part of the lateral collateral (LC) ligament and with an osteotome, a bone flake is taken at the lateral margin of the



**Figure 1 and 2:** The modified McIntosh technique which applies a triple sling of a fascia lata fixed with two staples to achieve a bony anchoring at the femoral and tibial attachment.

femoral shaft, just above the capsular insertion of the knee joint. The graft is pulled from posterior to anterior through this slot and pulled downwards passing again underneath the lateral ligament. At the tibia, a bony slot is created at Gerdy's tubercle with a 10 mm wide osteotome.

With the foot in external rotation and the knee bent at 30°, the graft is brought under tension and it is fixed in this slot with a tendon staple. The remaining part of the graft is pulled once again underneath the LC ligament representing the third strand of the 'triple loop' and through the bony slot at the femur where it is secured underneath the bony flake with a second tendon staple.

Postoperative care in the early days was a cast which was replaced by a brace allowing a range of motion between 15° extension and 90° flexion. This was in the 1980s when casts or braces were applied for 3 weeks.

#### RATIONALE OF AN EXTRA-ARTICULAR RECONSTRUCTION

An athlete with an ACL deficient knee mainly complains of instability during cutting movements on the field and landing at a jump.

There is a difference in anteroposterior (AP) slope of lateral versus medial tibial plateau, the medial being concave and containing whereas the lateral tibial plateau is convex (Figure 3).

Anatomical features such as this difference in AP shape of medial versus lateral tibial plateau and soft tissue considerations lead to an anterolateral displacement of the tibia with respect to the femur and the risk of an anterior subluxation of the lateral tibia plateau on pivoting (Figures 4 and 5).

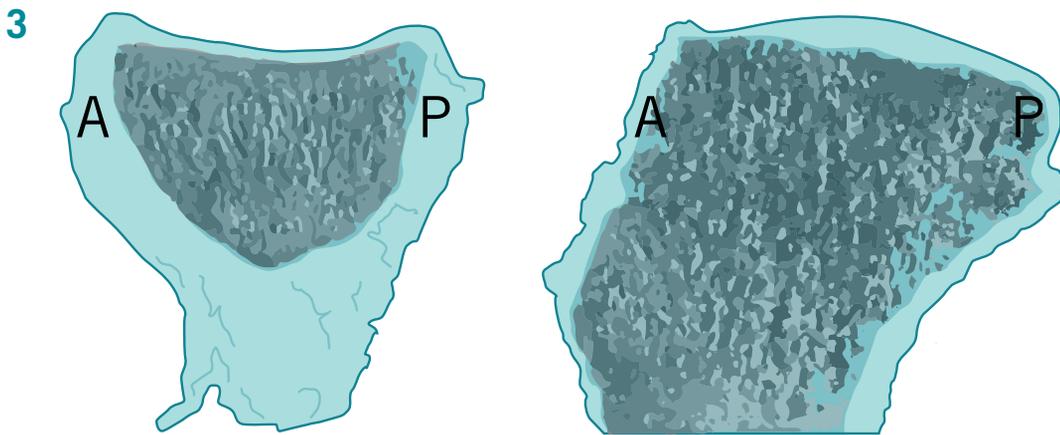
A tenodesis at the lateral side instead of the restoration of a central pivot (as seen in the single bundle intra-articular ACL reconstruction) is, on biomechanical consideration, very effective to abolish this anterolateral displacement on the condition that the posteromedial corner is holding well. We have carried out rotational tests on cadaver knees specimens in our biomechanical laboratory. We compared the resistance to torsional loading of several specimens with intact ACL, torn ACL and after extra articular fascia lata reconstruction. As shown in the graph (Figure 6) the resistance to the

applied Torque after extra articular ACL reconstruction mimics the pattern of an intact ACL.

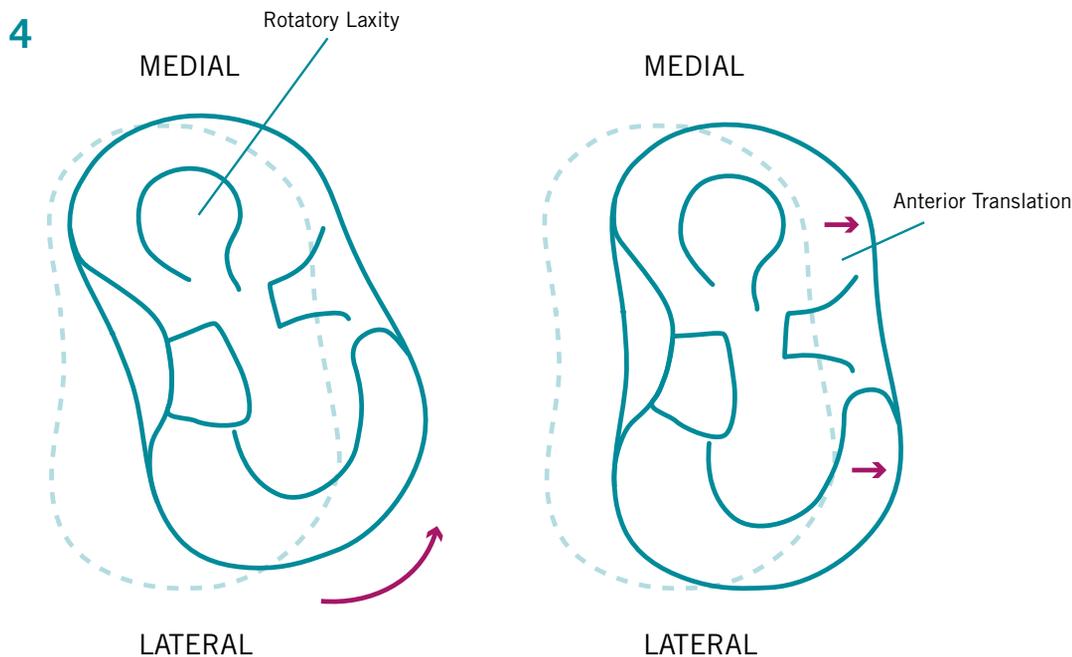
Recent studies confirm that a combined lateral tenodesis plays an important role in better constraining this displacement of the lateral tibial compartment.

The application of a lateral tendon, as extra-articular plasty, has the advantage of mechanically acting on the lateral periphery of the joint, thus preventing the subluxation of the tibial plateau and protecting overloads on the novel intra-articular ACL graft.

**An athlete complains of instability during cutting and landing a jump**



**Figure 3:** The medial tibial plateau displays a concave anteroposterior articular surface and is therefore more containing than the convex lateral tibial plateau.



**Figure 4:** Frequently there is not a straight anterior translation of the tibia but a rotational anterior movement of the tibia – the so called “anterolateral rotatory laxity”.

The clinical need for better reproducing the anatomical structure and functional behaviour of the native ACL led to the idea of combining a lateral tenodesis in the end. This combined procedure in ACL reconstruction surgery is dedicated to a better rotational and dynamic laxity control of the knee.

#### RESULTS OF SO CALLED ‘TRIPLE LOOP’ TECHNIQUE

The extra-articular stabilisation technique proved to be very successful over time. In contrast with the open intra-articular ACL reconstruction, the recovery was smooth with no loss of range of motion, good knee stability for rotation (also in the anteroposterior plane) and a high

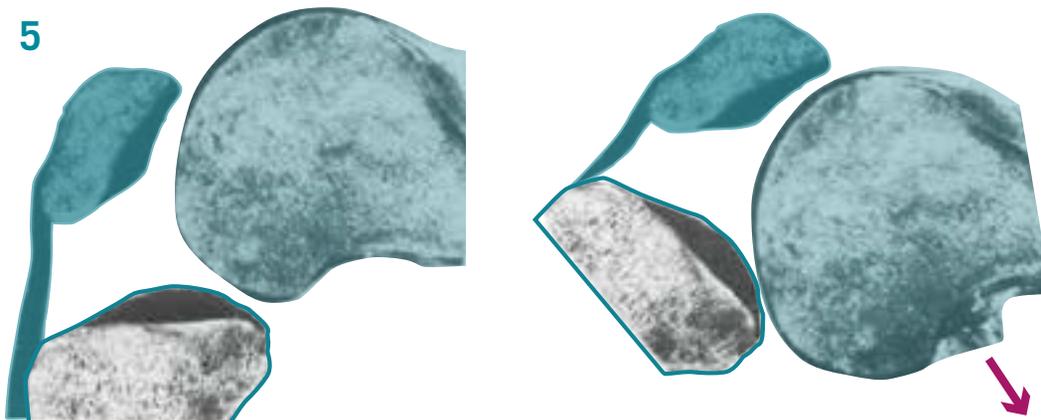
percentage of athletes returned to their previous sports level.

The career-ending lesion of the 1960s seemed to be resolved for many patients. Meanwhile, we learned the situations where this technique was not successful, for example, in case of a medial joint laxity due to a combined medial collateral ligament (MCL) lesion. It proved to be most successful when there was an important pivot shift preoperatively and no marked generalised laxity at the knee. With the introduction of the arthroscopic reconstruction, the patellar tendon graft then became “the golden standard”.

We continued to perform the extra-articular technique in case of a failed IA graft and also in cases of re-rupture or insufficient

pivot restoration. The lack of rotational stability after IA ACL reconstruction was often due to a too vertical position of the IA graft or deterioration of the IA graft with increasing laxity and symptoms of instability over time (We noticed these problems especially after arthroscopic ACL reconstruction with hamstring grafts). We also continued to apply this extra-articular triple loop as a primary procedure for selected cases, for example, to a patient mainly presenting a so-called anterolateral rotatory laxity with a marked positive pivot shift or a patient with a need for quick return to play.

Medium and long-term follow-up data taught us that if stability without pivot shift at the short time postoperative period was



**Figure 5:** The convex anteroposterior shape of the lateral tibial plateau facilitates the anterior subluxation.

observed, there was no deterioration of this stability over time (even up to 20 years).

Secondary late osteoarthritic changes correlated well with combined medial or lateral meniscectomy.

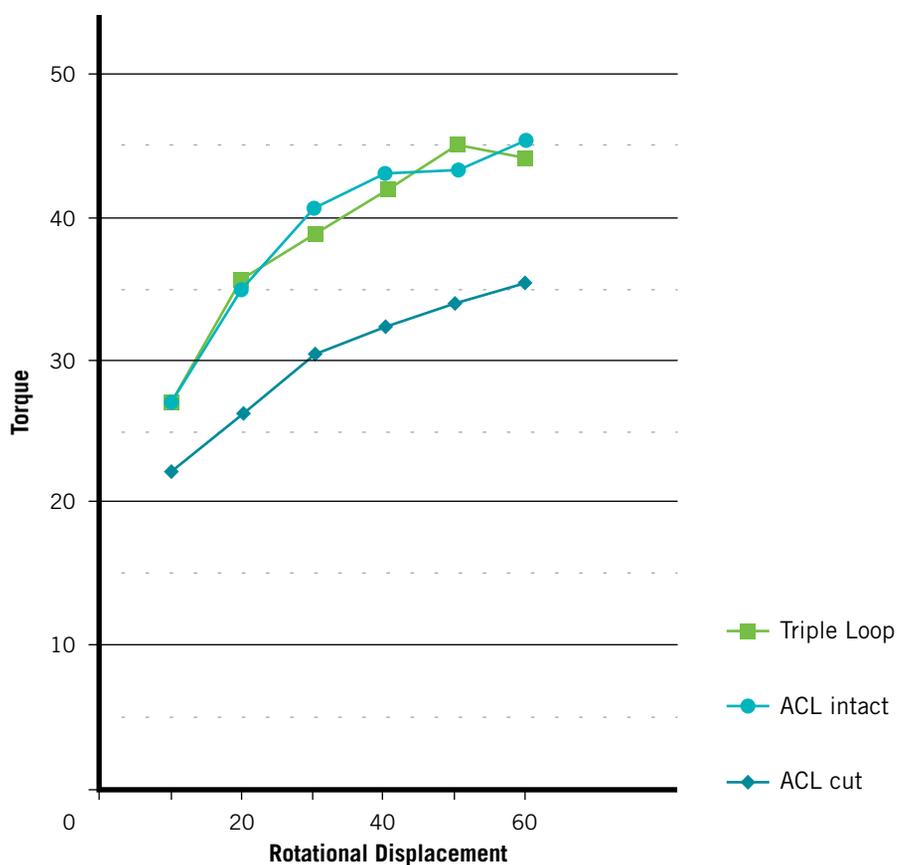
This was then eventually the main cause of later chondropathy. Many patients in the 1970s underwent delayed surgery for chronic symptomatic knee laxity after an ACL rupture and a high percentage suffered from secondary meniscal lesions, sustained as a consequence of recurrent episodes of giving away. The questionable outcome after open ACL reconstruction made many patients reluctant to undergo surgery.

#### INTRA AND EXTRA-ARTICULAR ACL RECONSTRUCTION

In view of the author's extensive and positive experience with the extra-articular so-called 'Triple Loop' technique since the 1990s, we often combine the IA reconstruction using bone tendon bone or hamstring graft with an extra-articular technique applying a single strand of fascia lata (so called 'Monoloop') which was fixed with a tendon staple at a bony slot created at the same femoral location as for a so-called 'triple loop' technique (Figures 7, 8, 9 and 10).

The indications for this combined surgical approach are:

1. 'High demand' athletes such as a professional soccer, basket or handball players.
2. Revision surgery after rupture of ACL graft.
3. Marked anterolateral rotatory laxity with pronounced pivot shift at clinical examination.

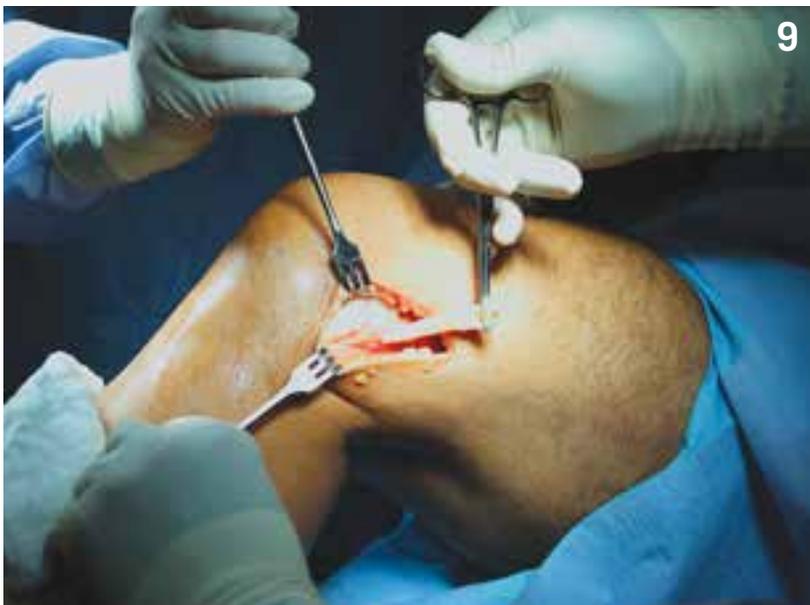


**Figure 6:** Comparison of the resistance to torsional loading. As shown, the resistance to the applied torque after extra articular ACL reconstruction mimics the pattern of an intact ACL.

4. Allograft which is particularly used in cases of repeat previous surgery (and patellar tendon plus hamstrings already sacrificed). We prefer an allograft instead of taking a graft from the healthy knee. For an allograft, it is known that revascularisation and remodelling of the IA graft is slower and less complete therefore not yielding the same strength as an autograft. My preference in case of the use

of allograft is a fresh frozen Achilles tendon with a bone block and sufficient length to perform an IA and EA reconstruction with an outside in femoral tunnel on the lateral side of the knee. The fascia lata sling is in this situation replaced by a portion of the Achilles tendon.

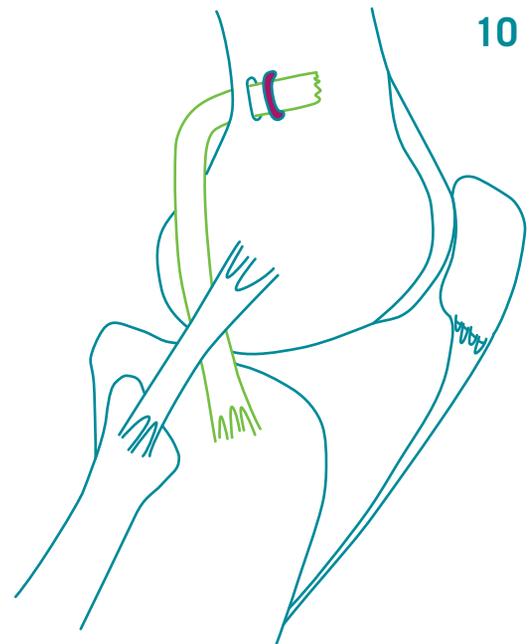
The philosophy behind the idea of combining of IA and EA reconstruction for an ACL deficient knee is to add extra



stabilisation to the knee for these patients and hopefully reducing the risk of further graft rupture, or residual laxity.

Adding the extra-articular reconstruction could also act as a protection for the IA graft on pivoting. This 'belt and suspenders' procedure is nowadays advocated by short- and long-term studies for ACL reconstruction to control both anterior laxity and rotational stability. A recent navigation study also demonstrated that this additional procedure improved internal tibial rotation control. Furthermore, it is now also clearly shown that the added extra-articular procedure does not increase long-term osteoarthritis.

The main finding of recent studies is that the association of a lateral tenodesis with the intra-articular graft increases the knee stability after revision ACL reconstruction. However, this extra-articular graft does not improve the global IKDC (International Knee Documentation Committee) score – and remains therefore questionable – as proven by two recent retrospective studies on revision ACL reconstruction.



**Figures 7 - 10:** The combined IA reconstruction using bone tendon bone or hamstring graft with an extra-articular technique applying a single strand of fascia lata (so called 'Monoloop') which was fixed with a tendon staple at a bony slot created at the same femoral location as for a so-called 'triple loop' technique.



## CONCLUSION

The issue of ACL reconstruction remains controversial. Discussions about surgical technique, graft material, rehabilitation programme and time to sports resumption are still on-going. We know that failures are still present after arthroscopic reconstruction, even in the hands of experienced knee surgeons with possible residual laxity, deterioration of the IA graft and thereby increasing laxity or rupture of the graft. Extra-articular reconstruction has been widely abandoned at the time of introduction of the arthroscopic ACL reconstruction. However, recent studies clearly demonstrate the significant influence of the combined lateral extra-articular tenodesis in ACL reconstruction, showing a tendency towards a lower failure rate and a significantly higher percentage of negative pivot shift.

Based upon the author's extensive and long-standing experience with the so called 'triple loop' technique, he has continued to apply one or another type of extra-articular reconstruction over the years for the indications as mentioned in this paper. Also, in ACL revision cases with a combined lateral extra-articular tenodesis, a lower failure rate of the intra-articular graft is seen together with an increase in knee stability but not in IKDC scores at follow-up. It is therefore my belief that an extra-articular procedure for pivot control still has, even today, a place in the armoury of surgical techniques for an ACL deficient knee.

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