Technical Note

# Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction Using Suspensory Button Fixation

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**Abstract:** Despite advancements in surgical techniques for anterior cruciate ligament reconstruction, some patients still experience rotational instability after surgery. Anterior cruciate ligament and anterolateral ligament reconstruction have been described using hamstring tendon autograft while preserving the insertion of the semitendinosus tendon. This article describes a combined anterior cruciate ligament and anterolateral ligament reconstruction using a hamstring tendon autograft with a suspensory button fixation.

Anterior cruciate ligament (ACL) reconstruction is one of the more common orthopedic procedures.[1] Several studies have shown that isolated ACL reconstruction may be insufficient to restore anterior tibial translation and rotational stability and that lateral extra-articular tenodesis procedures help restore normal knee kinematics.[2-4] We describe a combined ACL and anterolateral ligament (ALL) reconstruction using a hamstring tendon autograft with a suspensory button fixation (Video 1, Table 1).

## Surgical Technique

### Patient Setup

The patient is positioned in the supine position with a foot and thigh holder to hold the leg at 90° of flexion and to prevent external rotation of the hip (Fig 1).

### ALL Surface Anatomy

The fibula head, the Gerdy tubercle, and the lateral epicondyle are marked (Fig 2).

### Confirmation of ALL Non-Isometry and ALL Tibial Drilling

Two incisions are made 1 cm distal to the joint line, between the Gerdy tubercle and the fibular head, 2 cm apart (Fig 2). The tibial insertion of the ALL and confirmation of ALL nonisometry is reproduced according to a previous described technique. Two convergent bone tunnels are created with a 4.5-mm drillbit. Its entrances are widened and connected with a right-angled clamp. A looped suture (No. 2 Vycril; Ethicon, Somerville, NJ) is retrogradely passed to allow graft passage (Fig 3).

### Graft Harvest

The semitendinosus and gracilis grafts are harvested through an oblique incision over the pes anserinus tendons. Semitendinosus attachment is preserved (Fig 4).

### Knee Arthroscopy

Standard diagnostic arthroscopy is performed, and meniscus and cartilage injuries are treated accordingly. The tibial and femoral footprints of the ACL are identified (Figs 5 and 6).

### Femoral Tunnel Preparation

One incision is made slightly posterior and proximal to the lateral epicondyle on the femur. A suture (No. 2 Vycril; Ethicon) is passed from this incision to the anterior tibial incision to create a loop (Fig 7).

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**Table 1.** Pearls and Pitfalls

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|---|
| Anterolateral ligament (ALL) tibial drilling must be performed carefully to avoid iatrogenic fractures or tunnel collisions |
| Normal ALL non-isometry should be verified. |
| Hamstring harvest must be done carefully to avoid detachment and should be protected while drilling the tibial anterior cruciate ligament tunnel. |
| Use of a 4.8-mm retrograde drill allows easy passage of the gracillis tendon and button. |
| Femoral and tibial tunnel positioning and correct assessment of the total length of the femoral tunnel, femoral socket, total intra-articular length, and total length of the tibial tunnel are crucial. |
| Precise construction of a 4-stranded graft with 3 strands of semitendinosus tendon and 1 strand of gracilis, the continuation of which is the ALL, graft is dependent on the preceding measurements. |
| During visualization of the button and graft passage over the anteromedial portal, it is important to keep tension on the graft and the sutures of the button for ease of passage. |
| The ALL graft is secured in extension and neutral rotation. |

The femoral ACL tunnel is created through an outside-in approach. The drill guide (Acufex Director Drill Guide; Smith & Nephew, Andover, MA) is positioned intra-articularly, through the lateral portal, at the ACL footprint. A 2.4-mm guidewire is inserted from the lateral femoral cortex at the appropriate point marked for optimal ALL function in the ACL femoral footprint (Fig 8). The total length of the femoral tunnel is assessed, and the tunnel is created using a 4.8-mm retrograde drill (Trunav; Smith & Nephew). The tibial and femoral socket are drilled at 8 mm for a female patient and at 9 mm for a male patient.

## Tibial Tunnel Preparation

The drill guide (Acufex Director ACL Elbow Aimer; Smith & Nephew) is set at 55°, and the guidewire is drilled through the center of the native ACL footprint. The total length of the tibial tunnel is assessed (TTT), and the tunnel is drilled.

## Assessment of Tunnel Length

The free ends of a No. 2 Vycril (Ethicon) suture are threaded through the eyelet of the flexible guidewire and pulled proximally through the femoral tunnel. Next, the loop suture is pulled through the tibial tunnel, and another No. 2 Vycril suture is passed. When the loop suture is at the entrance of the femoral tunnel and tension is applied to the suture, the total intra-articular length (TIA) of the graft is obtained. Correct assessment of the total length of the femoral tunnel, femoral socket, TIA, and TTT is of paramount importance.

## Graft Preparation

The graft is 4-stranded with 3 strands of semitendinosus tendon and 1 strand of gracilis, which is a continuation of the ALL graft. After the overall tunnel length is assessed, we aim for 20 mm in the femoral socket and 15 mm in the tibial tunnel.

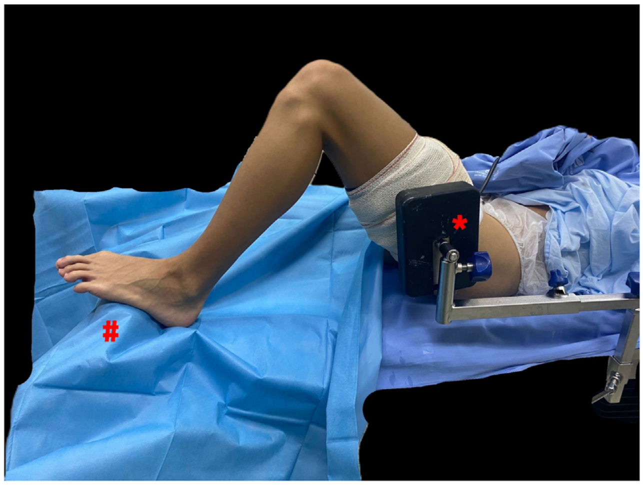


**Fig 1.** The patient is positioned in the supine position with a foot (#) and thigh (*) holder to hold the left knee at 90° of flexion and to prevent external rotation of the hip.


**Fig 2.** Left knee (lateral view): the fibula head (F), the Gerdy tubercle (G), and the lateral epicondyle (E L) are marked, and 2 incisions (*) are made 1 cm distal to the joint line, between the Gerdy tubercle and the fibular head, 2 cm apart.

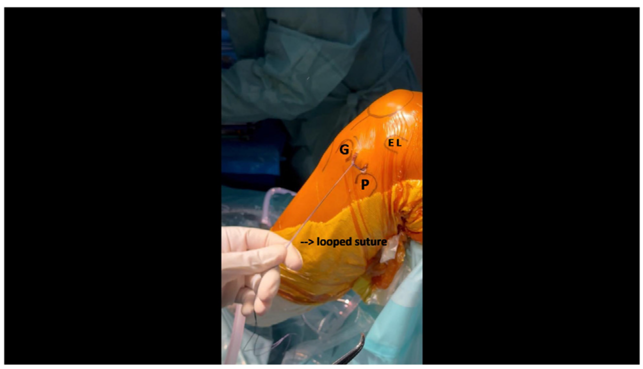


**Fig 3.** Left knee (lateral view): 2 convergent bone tunnels are created with a 4.5-mm drillbit, and a looped suture is passed retrogradely to allow graft passage.

Both free ends of the gracilis are stitched over a length of 20 mm using a No. 2 Orthocord suture. The semitendinosus is measured from its insertion to the entrance of the tunnel and marked. After this mark is made, 2

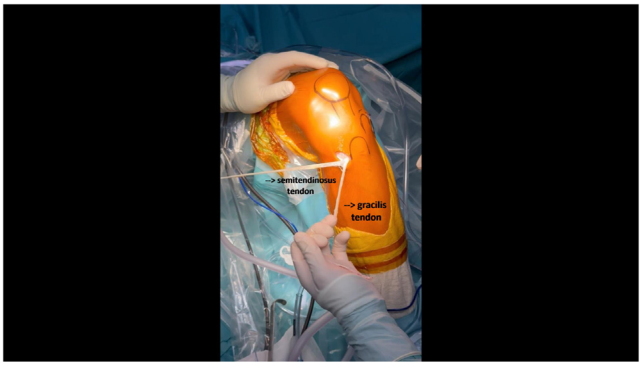


**Fig 4.** Left knee (medial view): using an oblique incision over the pes anserinus, semitendinosus and gracilis grafts are harvested, and semitendinosus attachment is preserved.

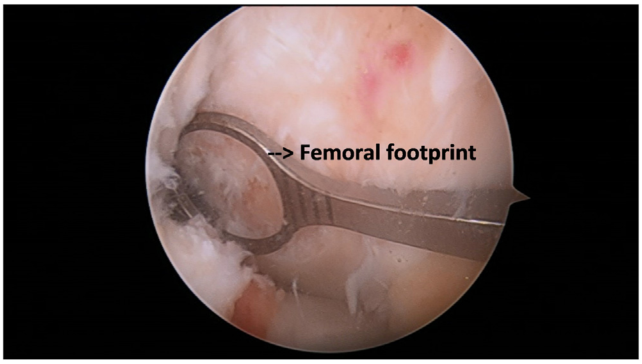


**Fig 5.** Left knee: the femoral footprint of the anterior cruciate ligament (ACL) is identified, and the drill guide (Acufex Director Drill Guide; Smith & Nephew) is positioned intra-articularly through the lateral portal at the ACL footprint.

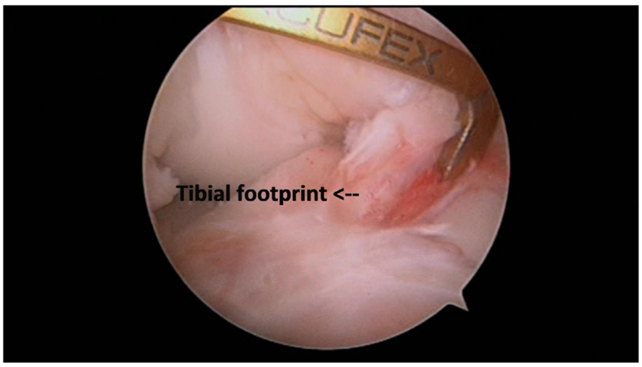


**Fig 6.** Left knee: the tibial footprint of the anterior cruciate ligament (ACL) is identified through the lateral portal, and the drill guide (Acufex Director ACL Elbow Aimer; Smith & Nephew) is set at 55° and positioned intra-articularly, through the medial portal, at the ACL footprint.

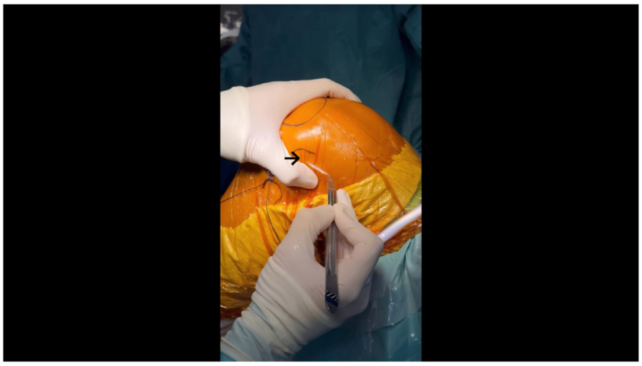

**Fig 7.** Left knee (lateral view): one incision is made slightly posterior and proximal to the lateral epicondyle on the femur (arrow). A suture is passed from this incision to the anterior tibial incision to create a loop.

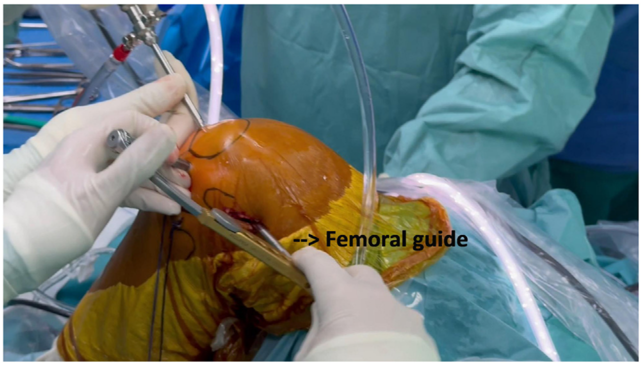


**Fig 8.** Left knee (lateral view): the femoral anterior cruciate ligament tunnel is created through an outside-in approach.

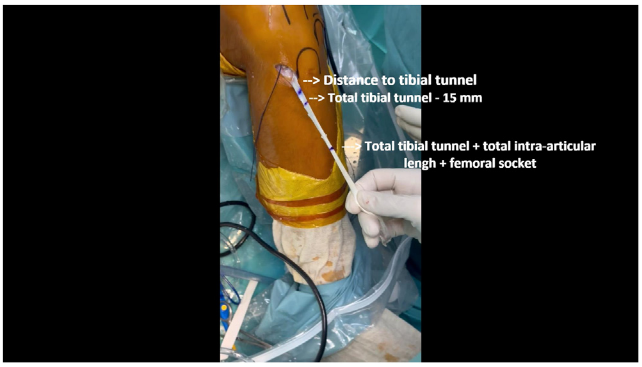


**Fig 9.** Left knee (medial view): the semitendinosus is measured from its insertion to the entrance of the tunnel and marked. Following this mark, another 2 marks are made at the points: "TTT − 15 mm" and "TTT + TIA + Femoral socket." TIA, total intra-articular length; TTT, total length of the tibial tunnel

additional marks are made at the following points: "TTT − 15 mm" and "TTT + TIA + femoral socket" (Fig 9).

Two adjustable-loop suspension devices (UltraButton, Smith & Nephew) are used. The tendon graft is folded over the femoral cortical button loop and stitched with No. 2 Orthocord suture (Fig 10). The free end is passed through the tibial cortical button loop and is symmetrically folded again, and the tendon excess is excised (Fig 11). The free end of the semitendinosus is stitched

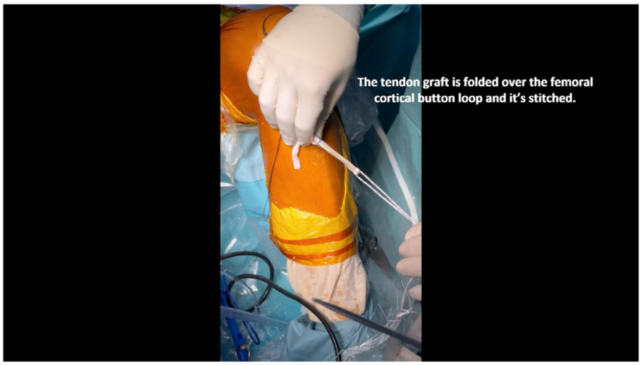


**Fig 10.** Left knee (medial view): 2 adjustable-loop suspension devices are used. The tendon graft is folded over the femoral cortical button loop and is stitched.

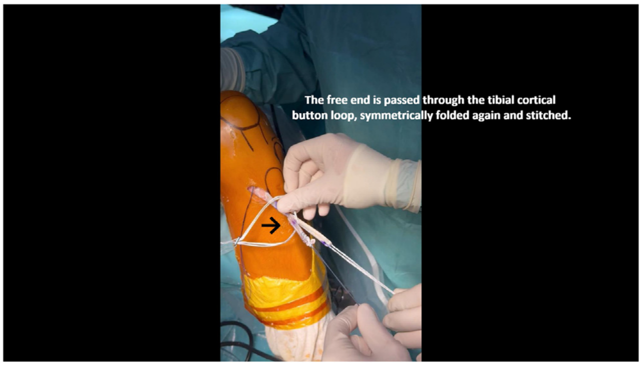


**Fig 11.** Left knee (medial view): the free end is passed through the tibial cortical button loop (arrow) and is symmetrically folded again and tendon excess is excised. The free end of the semitendinosus is stitched over a length of 20 mm.

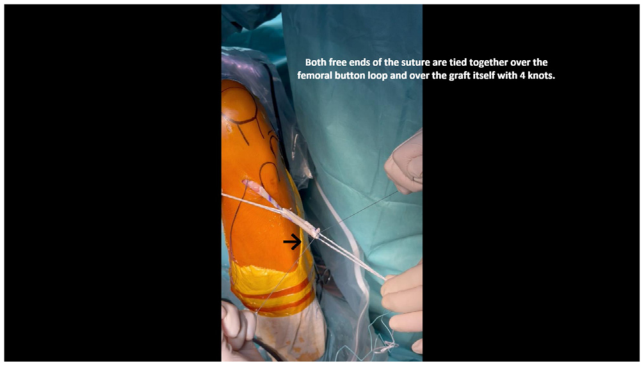


**Fig 12.** Left knee (medial view): both free ends of the suture are tied together over the femoral button loop and over the graft itself with 4 knots.

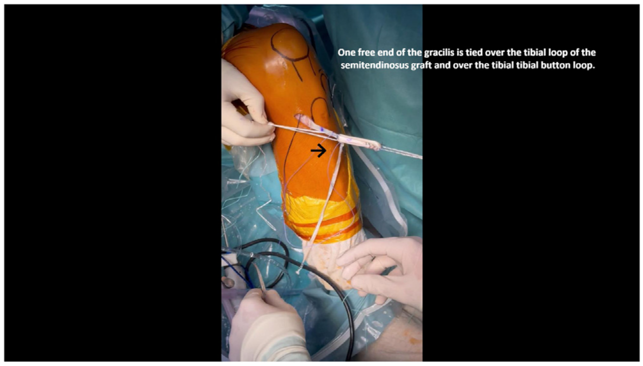


**Fig 13.** Left knee (medial view): both free ends of the suture of 1 free end of the gracilis are tied together over the tibial loop of the semitendinosus graft and over the tibial button loop itself with 4 knots (arrow).

over a length of 20 mm using a No. 2 Orthocord suture. Both free ends of the suture are tied together over the femoral button loop and over the graft itself with 4 knots (Fig 12). The free ends of the suture at one free end of the gracilis are tied together over the tibial loop of the semitendinosus graft and over the tibial button loop itself with 4 knots (Fig 13). To reinforce the 4-stranded graft on the tibial and femoral sides, we used two No. 2 Orthocord cerclage-type sutures on each side. To achieve this, a buried-knot technique is used (Fig 14). The result is a 4-stranded graft with 3 strands of semitendinosus tendon and 1 strand of gracilis, whose continuation is the ALL graft (Fig 15). Graft measurement is confirmed, and femoral and tibial tunnels are increased if necessary.

### Graft Passage and Tensioning

A No. 2 Vycril suture is used to shuttle the graft (Fig 16). The femoral adjustable graft loop is pulled through the tibial tunnel along with the ALL graft and the ACL graft, into the femoral tunnel, under direct arthroscopic visualization, until the button has exited the femoral cortex proximally and is ready to flip. Once the button flips, the graft is pulled back to ensure solid femoral fixation. Next, the femoral pull suture is tensioned to pull the graft up into the femoral tunnel (Fig 17).

The tibial button is incorporated in an XTendoButton (Smith & Nephew), and with the knee in full extension, the tibial tensioning sutures are pulled until the graft and the button are seated in the tibial tunnel and cortical tibial bone, respectively (Fig 18).

The remaining gracilis is used for ALL reconstruction. Using an arthroscopic grasper, the suture attached to the gracilis is passed deep into the iliotibial band, exiting at the posterior proximal tibial incision (Fig 19). Subsequently, it is threaded through the tibial bone tunnel using the previously passed suture (Fig 20). The arthroscopic grasper is then directed beneath the iliotibial band to the anterior proximal tibial incision and is used to retrieve the gracilis graft back proximally to the femoral incision (Fig 21).

At the proximal end, the sutures securing the ACL graft and the femoral button are encircled around the ALL graft and tied in full extension and neutral rotation (Fig 22).

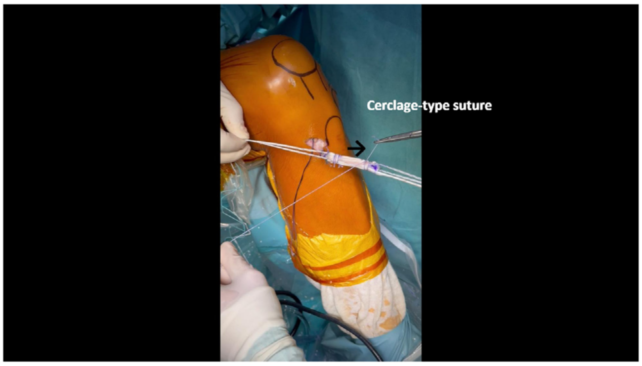


**Fig 14.** Left knee (medial view): to reinforce the 4-stranded graft on the tibial and femoral side, we used 2 cerclage-type sutures on each side (arrow). To achieve this, a buried-knot technique is used.


**Fig 15.** Left knee (medial view): the result is a 4-stranded graft with 3 strands of semitendinosus tendon and 1 strand of gracilis, the continuation of which is the anterolateral ligament graft.

## Rehabilitation

A standard ACL rehabilitation protocol is implemented, which involves immediate full weightbearing postprocedure without the use of a brace, along with a progression of range-of-motion exercises.


**Fig 16.** Left knee (medial view): a suture is used to shuttle the graft.

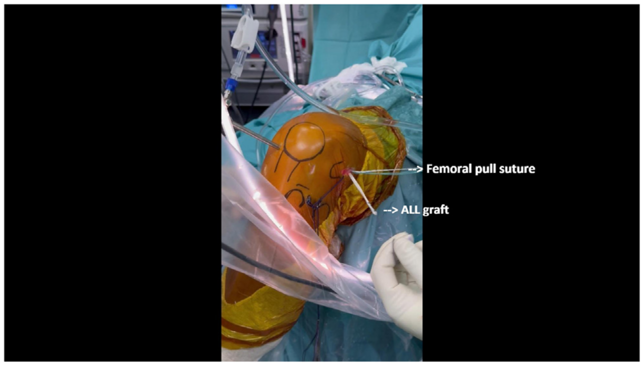


**Fig 17.** Left knee (lateral view): the femoral pull suture is tensioned to pull the graft up into the femoral tunnel.

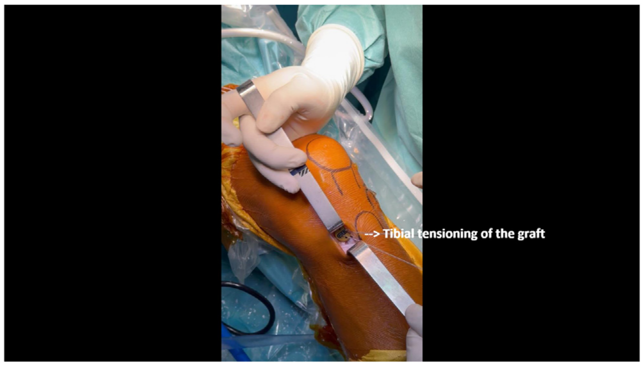


**Fig 18.** Left knee (medial view): with the knee in full extension, the tibial tensioning sutures are pulled until the graft and the button are seated in the tibial tunnel and cortical tibial bone, respectively.

## Discussion

The most important aspect of this technique is that it allows the surgeon to perform combined ACL and ALL reconstruction using cortical suspensory fixation while preserving the semitendinous tibial footprint. Previously described techniques for combined ACL and

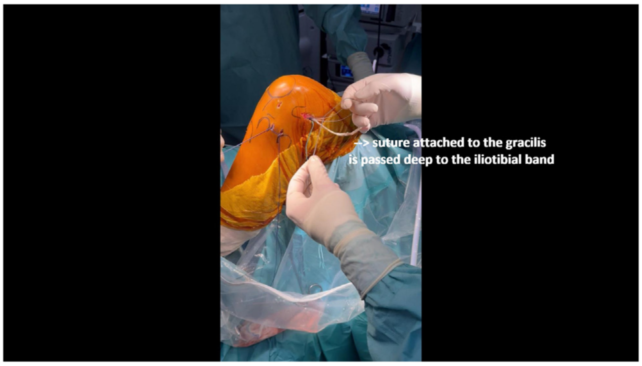


**Fig 19.** Left knee (lateral view): using an arthroscopic grasper, the suture attached to the gracilis is passed deep to the iliotibial band, exiting at the posterior proximal tibial incision.

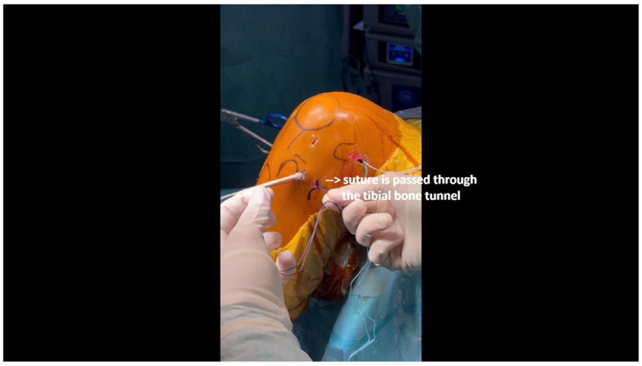


**Fig 20.** Left knee (lateral view): it is then threaded through the tibial bone tunnel using the previously passed suture.

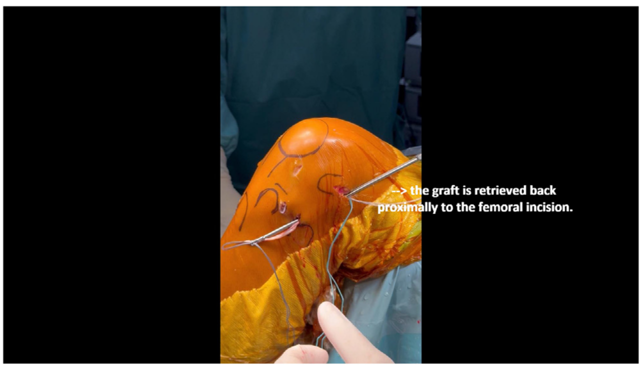


**Fig 21.** Left knee (lateral view): the arthroscopic grasper is then directed beneath the iliotibial band to the anterior proximal tibial incision and is used to retrieve the gracilis graft back proximally to the femoral incision.

extra-articular tenodesis using suspensory fixation used either an independent ALL reconstruction or a modified Lemaire procedure, both of which require additional fixation material.[5-8]

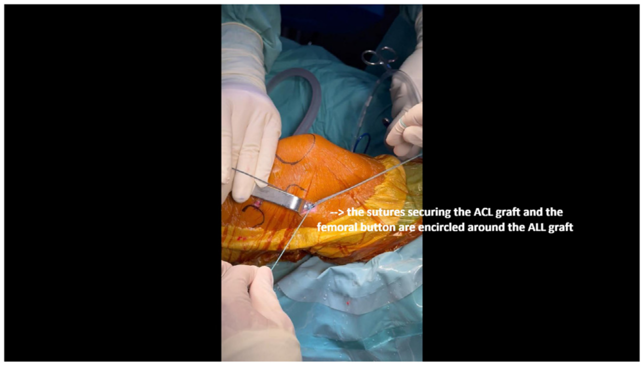


**Fig 22.** Left knee (lateral view): at the proximal end, the sutures securing the anterior cruciate ligament graft and the femoral button are encircled around the anterolateral ligament graft and tied in full extension and neutral rotation.

The surgical technique outlined here presents a key benefit of ensuring control over anterior and anterolateral knee instability, using a minimally invasive technique and a 4-stranded ACL graft while maintaining attachment of the semitendinosus for enhanced graft vascularization. We positioned the ALL femoral tunnel and secured the graft as described by Sonnery-Cottet et al.[9]

There are multiple reasons for ACL reconstruction failure,[10] and the anterolateral complex of the knee has been proposed as an important stabilizer against anterolateral tibial rotation. Despite the controversy,[11] multiples techniques have been described.

ALL reconstruction has been of growing interest in the recent years because it is associated with better outcomes in terms of knee rotational stability and graft failure rates.[12,13] ACL reconstruction implies that the hamstring graft undergoes a process called "ligamentization."[14] Hamstring graft tibial insertion preservation has been proposed because it preserves the vascular supply and therefore is able to avoid the necrosis and revascularization stages of ligamentization[9,14-16] (Table 2).

Among the various graft fixation devices, cortical suspensory buttons have been of growing interest. Several studies have concluded that muscle strength and knee function are similar between interference screws and suspensory fixation.[17-20] One advantage of cortical suspensory adjustable buttons is that they allow retension of the graft after cycling[18] (Table 2). With this technique, we mitigate the theoretical adverse effect on graft vascularity when using the interference screw[16] (Table 2).

Possible risks of this technique are related to cortical suspensory button use and include graft slippage, button migration, and surgical technique dependency; other risks are related to ALL reconstruction, such as anterolateral tibial fracture or tunnel collision. A

**Table 2.** Advantages

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| Anatomic reconstruction of both the anterior cruciate ligament and anterolateral ligament |
| Only uses hamstring grafts |
| Hamstring graft tibial insertion preservation preserves vascular supply and may improve "ligamentization" |
| Allows sparing of the tibial remnant of the anterior cruciate ligament |
| Suspensory button fixation |
| • improves fixation strength, decreasing the possibility of graft failure or slippage |
| • decreases the risk of femoral tunnel blowout |
| • eliminates the risk of a protruding screw irritating the iliotibial band |
| • allows for extracortical fixation |

limitation is that the length of gracilis graft may be insufficient for extra-articular reconstruction.[9]

## Disclosures

The authors (A.C., L.R.F., A.S., C.M.Q.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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