Technical Note

Femoral Physeal-Sparing Anterior Cruciate Ligament Reconstruction Using the Iliotibial Band: Over-The-Top Technique

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Abstract: Anterior cruciate ligament injuries are increasingly frequent in skeletally immature patients. However, treatment within this subpopulation remains controversial. Conventional transphyseal reconstruction techniques have been questioned because of potential physeal injuries. Conservative treatment, on the other hand, may lead to degenerative meniscal and chondral lesions. This Technical Note describes the femoral physeal-sparing over-the-top technique using an iliotibial band. It is a safe and effective method for anterior cruciate ligament reconstruction in skeletally immature patients.

With the increase in sports participation in the general population, an increasing number of anterior cruciate ligament (ACL) injuries have been documented. Consequently, an increasing number of young patients undergo surgical treatment to restore normal knee kinematics. Studies have shown that 6.7% of all ACL injuries and 31% of youth knee injuries occur in the pediatric population.[1,2] However, treatment within this subpopulation remains controversial. Whereas surgical treatment places the physis at risk because of potential growth arrest and angular deformities due to physeal damage from tunnel drilling, nonoperative management may lead to functional instability, which increases the rate of meniscal injury and chondral damage.[3-7] The aim of this Technical Note is to present a safe and effective method for ACL reconstruction using a femoral physeal-sparing over-the-top technique with an iliotibial band (ITB) in skeletally immature patients.

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Surgical Technique

The surgical technique is presented in Video 1. Pearls and pitfalls are reported in Table 1.

Patient Setup

The patient is placed supine on the operating table in the standard arthroscopy position with a lateral post just proximal to the knee, at the level of the padded tourniquet, and a foot roll to prevent the hip from externally rotating and to maintain 70° of knee flexion. In this configuration, the knee can be moved freely through its full range of motion.

ITB Harvesting

The skin incision begins 2 cm proximal to the Gerdy tubercle (GT) and is approximately 10 cm long. As the knee is flexed, the incision is curved slightly at its distal portion, so it becomes straight when the knee is extended (Fig 1).

Harvesting of the ITB begins at the GT. Exposure is achieved with a Farabeuf retractor (Landanger, Chaumont, France). The posterior ridge from the GT is incised with a No. 23 scalpel blade and extended proximally 5 to 6 cm; a second incision is made 1 cm

Tables 1. Pearls and Pitfalls

	Pearls	Pitfalls
ITB harvesting	The surgeon should use a large retractor for good exposure while dissecting the ITB. A total graft length of approximately 16-18 cm should be obtained.	The surgeon should be careful not to remove too short of a graft.
	The surgeon should be careful not to cut the vessels posterior to the lateral condyle.	Postoperative hemorrhage can occur due to excessive bleeding from severed vessels.
Graft passage	A minimal dissection may be performed over the top, removing soft tissue, to make it easier to pass the surgical clamp.	Vigorous over-the-top dissection can result in physeal injury because the perichondrial ring is nearby.
Graft fixation	The knee should be maintained at between 30° of flexion and full extension during graft fixation to the tibia.	An inappropriate knee position during graft fixation may lead to a nonisometric reconstruction.

ITB, iliotibial band.

anterior and parallel to the first incision, so the graft is 1 cm wide at this distal end.

The proximal portion of the ITB is then exposed, on its center portion; a large retractor (B. Braun Aesculap, Tuttlingen, Germany) is used to ensure sufficient exposure. Proximal extension of the posterior incision is performed with a No. 11 blade with a long scalpel handle to obtain a total graft length of approximately 16 cm. The anterior incision is enlarged to obtain a 3-cm-wide graft proximally (Fig 2). The fat pad is cleared from the graft, and the graft is shaped into a tube with No. 2-0 Vicryl sutures (Ethicon, Somerville, NJ) placed at the proximal free end over approximately 3 cm to obtain a strong traction suture construct.

Over-the-Top Suture Relay Passage

Deep dissection of the lateral condyle is performed just posterior to the lateral epicondyle to look for the fat pad beneath the ITB that covers the Lemaire vessels. Once identified, the fat pad is carefully detached and retracted to expose the vessels (Fig 3A). Next, a right-angle curved clamp is introduced through the anteromedial portal; pushed through the notch; and turned "over the top" behind the lateral condyle, toward the deep incision performed just posterior to the Lemaire vessels (Fig 3 B and C). The traction suture on the ITB graft is grasped with the right-angle curved clamp and pulled into the joint and through the anteromedial portal (Fig 3 D-F).

Tunnel Tibial

The tibial ACL guide (Arthrex, Naples, FL) is introduced through the anteromedial portal. The guide's ring target is placed in the middle of the ACL remnant (Fig 4). The guide's angulation is set at 55°. The guide sleeve is seated distal to the tibial physis just medial to the anterior tibial tuberosity to achieve central and vertical positioning of a 2.4-mm guide pin. A 6-mm-diameter tibial tunnel is drilled over the guide pin with a cannulated drill.

Graft Passage and Fixation

The graft's traction suture is grasped with an arthroscopic suture retriever (Arthrex) and pulled through the tibial tunnel. The ITB graft is routed from the femur to the tibia through the joint by pulling on the traction suture on the tibial side. Sufficient graft length is confirmed by checking its emergence from the tibial tunnel. The graft is tensioned, and a bioabsorbable interference screw (Arthrex) is used to fix the graft with the knee in 20° of flexion (Fig 5).

Closure

The proximal part of the ITB is closed using a Knee Scorpion device (Arthrex) (Fig 6).

Postoperative Protocol

Postoperatively, active and passive range of motion is limited to 0° to 90° during the first 6 weeks, with progression to full weight bearing by the fourth postoperative week. Jogging is permitted after 3 months and full activity, after 6 months.

Discussion

The participation of children and adolescents in high-intensity competitive activities has increased in

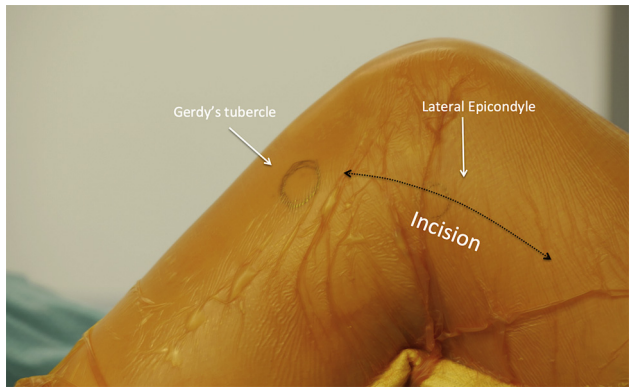

Fig 1. Curvilinear skin incision (arrow) starting 2 cm proximal to Gerdy tubercle and extending proximally to lateral epicondyle in left knee.

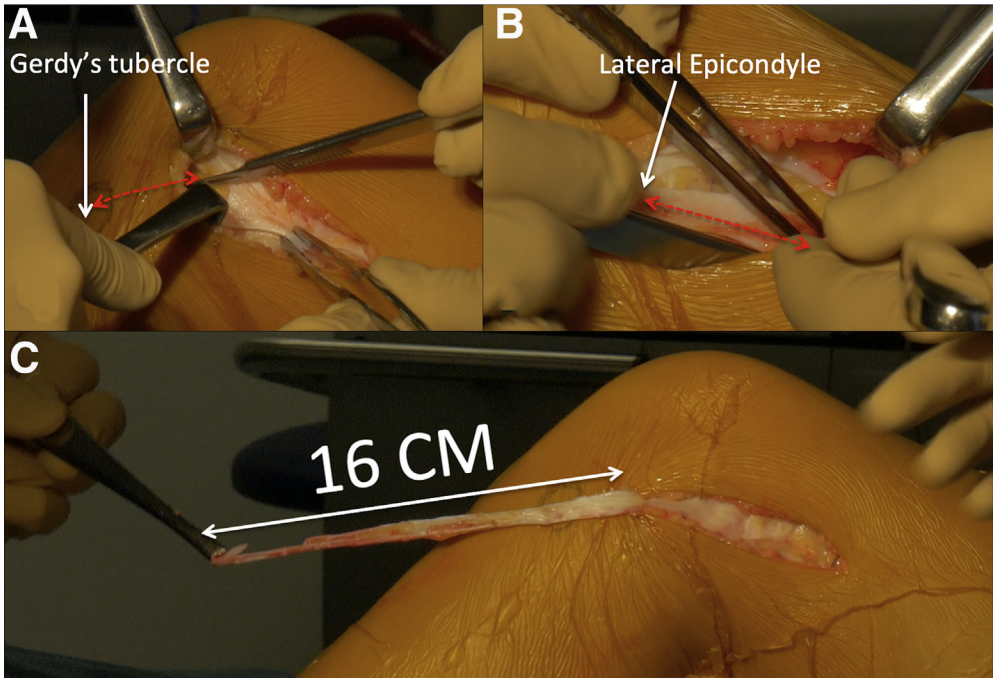

Fig 2. Graft harvesting from left knee. (A) A 1-cm-wide iliotibial band (ITB) strip is harvested from the Gerdy tubercle toward the lateral epicondyle, keeping the ITB insertion intact at the Gerdy tubercle. (B) The ITB harvest is extended proximally and enlarged to 3 cm wide proximally to the lateral epicondyle. (C) A total length of approximately 18 cm (in this case, 16 cm [arrow]) is harvested.

recent years. They often participate in rigorous training regimens for long periods during a given year, comparable to adult schedules. Consequently, we have observed an increasing number of ACL lesions.[8] We understand that young athletes, just like adult athletes, are under pressure to quickly return to their sport and consequently require faster rehabilitation. With that in mind, we prefer early surgical treatment of ACL tears and reserve nonsurgical treatment for only Several surgical techniques have been developed

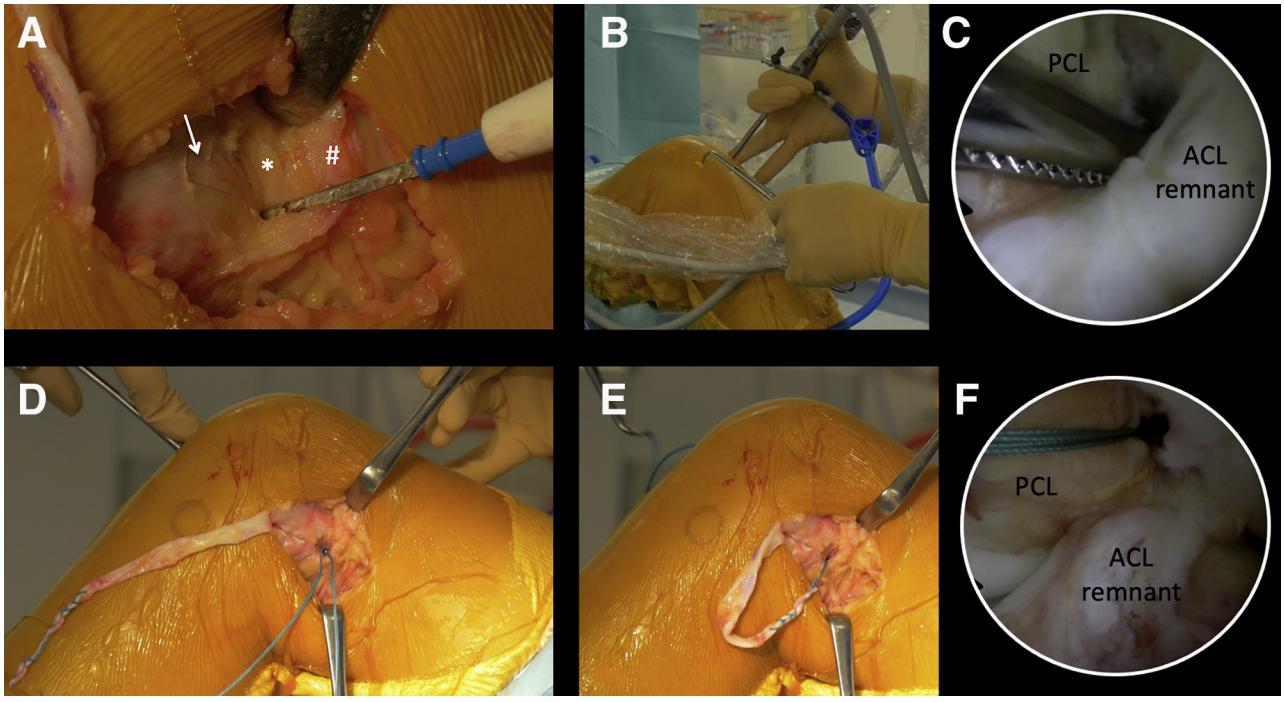

Fig 3. Left knee, 90° of flexion. (A) Exposure of Lemaire vessels (arrow) located just under the fat pad (asterisk) beneath the iliotibial band (pound sign). (B) Introduction of a right-angle curved clamp through the anteromedial portal. (C) The clamp is pushed deep in the notch and rotated behind the lateral condyle toward the deep lateral incision. (D) The graft's traction suture is grasped with the right-angle curved clamp emerging through the deep lateral incision. (E, F) The traction suture is pulled from the anteromedial portal through the joint. (ACL, anterior cruciate ligament; PCL, posterior cruciate ligament.)

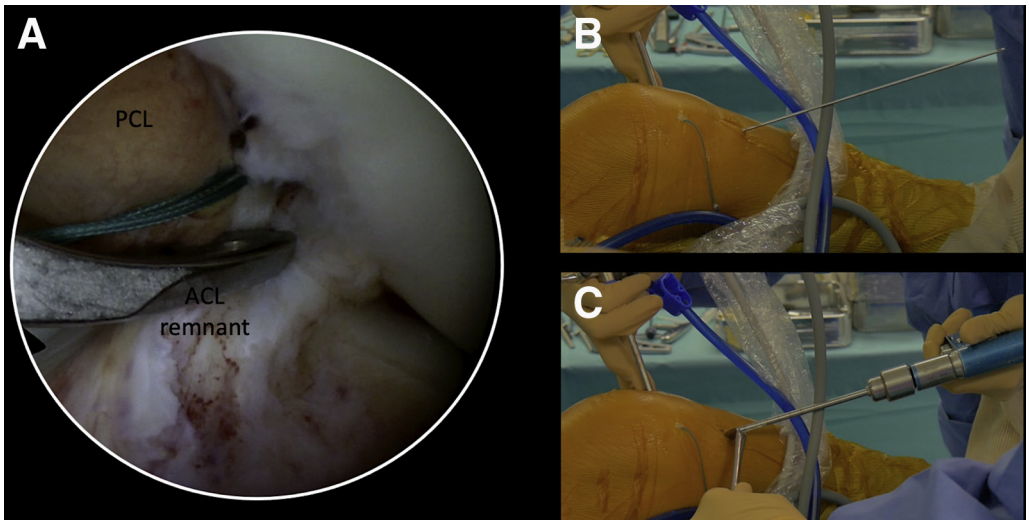

Fig 4. Left knee. (A) An anterior cruciate ligament (ACL) tibial guide is positioned on the ACL remnant. (B) A central and vertical guide pin is placed through the physis. (C) A 6-mm-diameter tunnel is drilled in the tibia. (PCL, posterior cruciate ligament.)

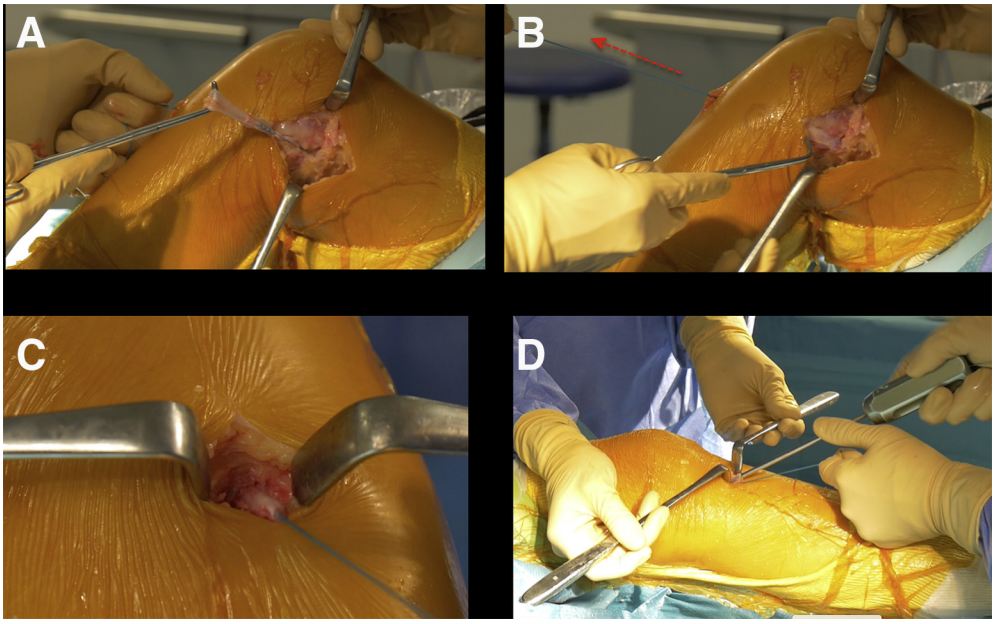

Fig 5. Left knee. (A, B) The iliotibial band graft is routed from the femur to the tibia by pulling on the traction suture. (C) Adequate graft length is confirmed by checking the emergence of the graft at the tibial tunnel. (D) Fixation is performed in 20° of knee flexion with an absorbable interference screw.

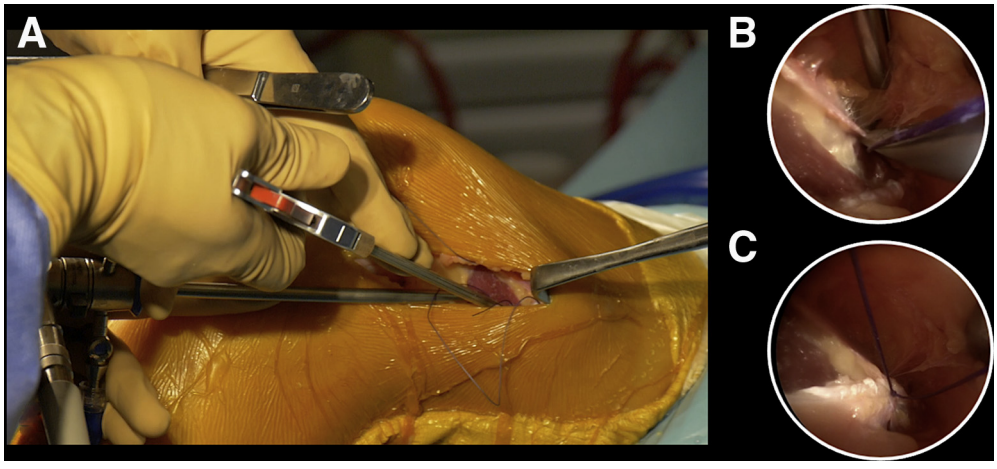

Fig 6. Left knee. (A) The proximal portion of the iliotibial band (ITB) is closed using a Knee Scorpion device. (B) Passage of the suture with the device in the ITB can be performed under arthroscopy. (C) Arthroscopic view of most proximal ITB suture.

Table 2. Advantages and Disadvantages

Advantages
Minimal risk of growth disturbance
Combined intra- and extra-articular ACL reconstruction
Sparing of patellar and hamstring tendons, which may be used for revision
Technique able to be performed in very young patients
No need for fluoroscopy
Disadvantages
Additional incision
Significant learning curve in passing graft from extra- to intra-articular position
ACL in nonanatomic position
Potential risk of hematoma on lateral part of thigh and muscular hernia on proximal part of harvesting

ACL, anterior cruciate ligament.

for ACL reconstruction in young patients. Although many "physeal-respecting" or "partial-sparing" procedures have been described that compromise only a small physeal area, defining which procedure is the gold-standard technique is still controversial.[9,10]

Our technique reduces the risk of physeal injury and restores the stability of the knee, combining intra- and extra-articular ACL reconstruction in 1 procedure. The ITB is a good graft for ACL reconstruction; besides being relatively easy to harvest, it saves other donor areas for future surgery if necessary.

Although this technique has its risks, including hematoma on the lateral part of the thigh and muscular hernia on the proximal part of harvesting, it has several advantages (Table 2). The most important is that it spares the femoral physis, reducing the risk of any angular deformity in the future.

This technique is an alternative to other mixed reconstruction techniques and grafts described for ACL reconstruction in young patients. We have found it to be a safe and effective technique for knee stabilization.

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