Technical Note

Fibular Collateral Ligament Reconstruction in Adolescent Patients

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Abstract: Fibular collateral ligament (FCL) injuries can present as lateral-sided knee pain with feelings of side-to-side instability during activity. Patients with FCL injuries can have accompanying symptoms related to irritation of the common peroneal nerve. Preoperative diagnosis is imperative and should include a thorough physical examination complemented with varus stress radiographs before surgical reconstruction is indicated. In the adolescent cohort, surgical planning can be complicated by the presence of open physes, and caution must be taken to avoid drilling through or placing screw fixation across the physes. Potential complications include growth arrest and limb length discrepancy. Therefore, the purpose of this Technical Note is to describe an anatomic FCL reconstruction technique in the skeletally immature adolescent patient.

Nonoperative, repair, and reconstruction techniques have all been developed to treat posterolateral corner (PLC) injuries.[1] Although primary repair is a viable treatment option, increasing reports have illustrated that compared with surgical reconstruction of the PLC, repair does not restore native knee stability and also results in a higher failure rate.[2,3] Within the PLC, the fibular collateral ligament (FCL) functions as the primary stabilizer to varus forces in the knee.[4] Left untreated, FCL injuries can lead to instability and increase the risk of concurrent cruciate ligament reconstruction graft failure.[5] Consequently, reconstruction is the preferred treatment for grade III (complete) FLC injuries.[6,7] Despite our current knowledge regarding the anatomy and biomechanics of the FCL, subjective capabilities such as clinical expertise and experience hinder available treatment options when it comes to injury; this is especially true with adolescent patients. Adolescent patients who undergo surgical intervention with open physes carry the additional risk of growth disruption due to iatrogenic physeal damage. Surgical techniques that avoid damage to the physes are currently lacking. The purpose of this Technical Note is to describe an anatomic FCL reconstruction technique in the skeletally immature adolescent patient.

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Operative Indications

Diagnosis of FCL injuries requires a thorough physical examination including history, varus stress testing at 0° and 30°, and dial testing at 30°. Concurrent with these examination findings, varus stress radiographs should be performed to further confirm diagnosis of an FCL tear.[8] The varus stress radiographic technique has been reported to be highly reliable and valid with a reported intraclass correlation coefficient of 0.99.[9] Indications for FCL reconstruction in an adolescent patient cohort include subjective complaints of lateral knee instability and objective varus stress radiographs with a side-to-side difference of a minimum 2.0 mm (Fig 1).[10] Additionally, the common peroneal nerve (CPN) should be palpated to evaluate its integrity followed by an assessment of sensory and motor function along the CPN distribution. Another important factor in preoperative planning of skeletally immature patients is

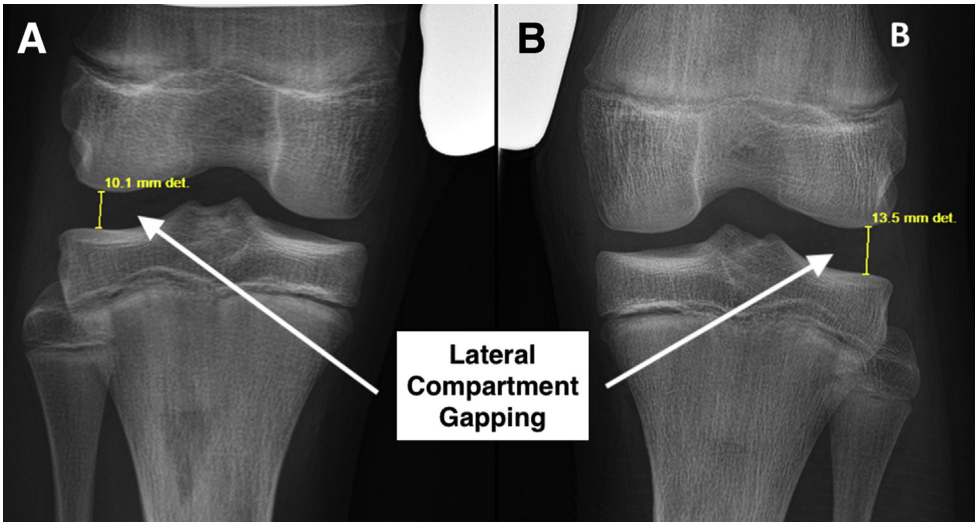

Fig 1. (A, B) Preoperative radiographic imaging showing coronal views of both knees. The left knee (B) illustrates increased separation between the lateral femoral epicondyle and lateral tibial condyle compared with the contralateral side. This can be used as an indication of a fibular collateral ligament tear.

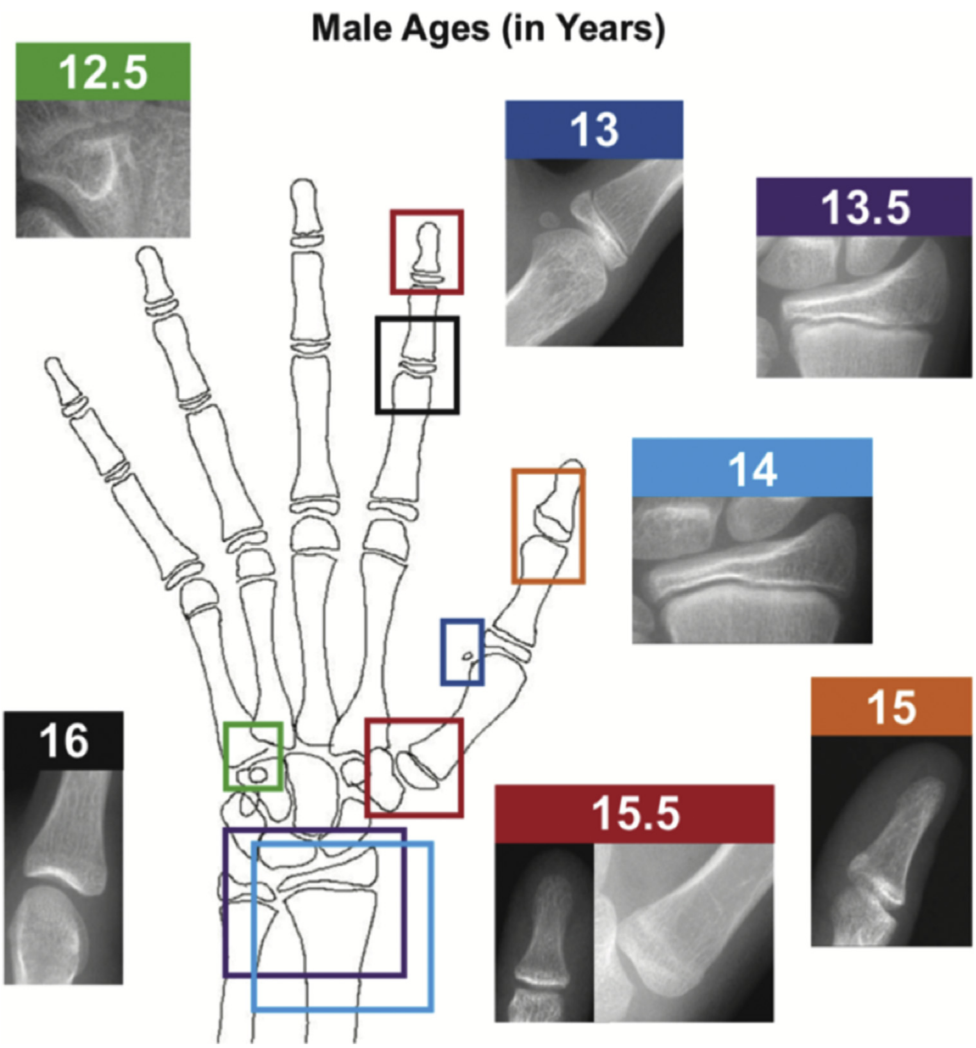

Fig 2. Skeletal (bone) age is commonly used as a biological measurement to assess maturation—this is done using hand—wrist radiographs. Degree of skeletal maturity is dependent on factors such as deposition of calcium and growth of area during ossification. Radiographs above show degree of skeletal maturity (in years).

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Large incision to identify the common peroneal nerve proximally, posteromedial to the biceps femoris tendon.	Small incisions may make it difficult to identify structures and may lead to iatrogenic injuries.
Neurolysis of the common peroneal nerve.	Injury to the common peroneal nerve.
Use fluoroscopy for pin placement.	Injury to the epiphyses and growth arrest.
Place the screw distal to the graft in the tunnel.	

determining skeletal age with hand and wrist radiographs. A shorthand bone age assessment can be conducted quickly and efficiently to determine a patient's radiographic skeletal age prior to surgical reconstruction[11] (Fig 2).

Surgical Procedure

A detailed video of the technique is shown in Video 1. Pearls and pitfalls of this technique and a step-by-step approach are described in Tables 1 and 2, respectively.

Patient Positioning and Patient Examination

The patient is brought to the operating room and induced under general anesthesia. A high, well-padded, right thigh tourniquet is placed. A bilateral knee examination is performed to assess any concurrent ligamentous instability and to assess knee range of motion. Specifically, varus stress testing should be conducted to confirm that the injury is isolated to the FCL with no associated injuries to the popliteus tendon, popliteofibular ligament, or proximal tibiofibular joint. The patient is then administered prophylactic antibiotics against infection, and the operative limb is prepped and draped in the usual sterile manner.

Surgical Approach

The surgical approach begins with a lateral hockey stick incision centered over the superficial layer of the iliotibial (IT) band. Dissection is then performed down to the superficial layer of the IT band and further over the long and short heads of the biceps femoris. A CPN neurolysis should be performed to release any scar tissue encasing the nerve itself, in addition to incising the proximal portion of the peroneus longus fascia to reduce postoperative risk of footdrop owing to swelling (Fig 3).

Fig 3. Standard lateral hockey stick incision made to approach the posterolateral corner. Dissection is made down to the superficial layer of the iliotibial band and over to the short and long heads of the biceps femoris. Identification of the common peroneal nerve and other structures is essential prior to fluid extravasation.

The FCL attachments on the femur and fibula can be identified by passing a tag stitch in the remnant FCL structure and tensioning the stitch (Fig 4). On the lateral aspect of the fibula, the fibular attachment is identified and the fibular head reconstruction guide is positioned. In adolescent patients with open physes, intraoperative fluoroscopy should be used for confirmation of reconstruction tunnel placement below the open physis. Usual tunnel placement is performed proximal on the lateral aspect of the fibular head, but in adolescent patients the tunnel should be distalized enough to avoid the open physis (approximately 5 to 6 mm distal to the physis). Once the positioning of the guide pin is confirmed with intraoperative fluoroscopy, the pin can then be drilled into the fibular head with the knee in flexion (Fig 5). Using a chandler retractor to protect the posterior tissues from the fibular head, a tunnel 6 mm in diameter is then reamed from anterior to posterior, followed by the placement of a passing stitch through this fibular head tunnel.

In identifying the FCL femoral attachment, if minimal remnant exists for tensioning, measuring 18 mm anterior from the popliteus tendon femoral attachment will assist

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Anatomic reconstruction.	Thorough knowledge of the anatomy of the knee is mandatory.
Use of autograft enhances healing.	Iatrogenic injuries.
Use of fluoroscopy minimizes risk of injury to the epiphyses.	

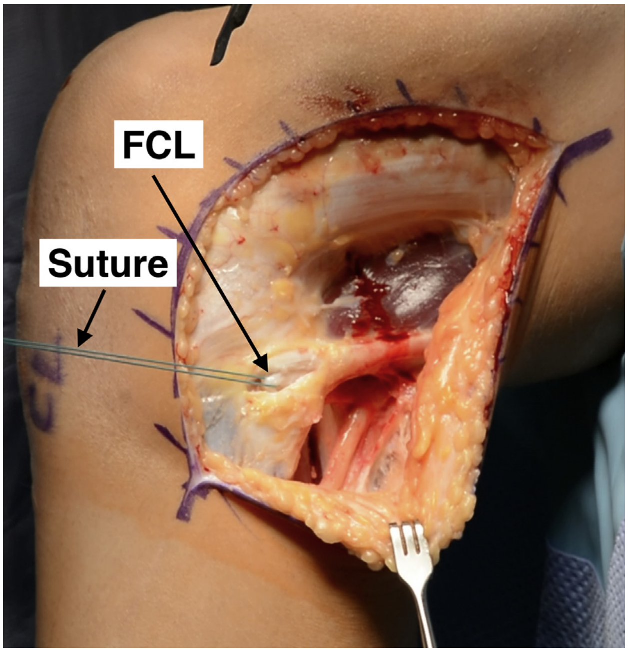

Fig 4. Tag stitch is placed on the remnant of the fibular collateral ligament to help identify it proximally. Identification of lateral aspect of fibular head then follows. Fluoroscopic imaging taken intraoperatively shows the guide pin in the desired location through the fibular head, avoiding the physis.

in identifying the saddle on which the FCL attaches. Following attachment identification, fluoroscopic imaging is once again used to assure guide pin placement across the femur to avoid the open physis (Fig 6). Once guide pin placement is confirmed, the guide pin is overreamed by a 6-mm reamer, followed by a 7-mm tap and passing stitch through the femoral tunnel. A channel beneath the superficial layer of the IT band should be created to facilitate graft passage.

Next, the FCL graft is harvested. An incision is made on the anteromedial tibia over the pes anserine tendon tibial attachments, and the semitendinosus tendon is harvested using a hamstring harvester. The FCL graft is

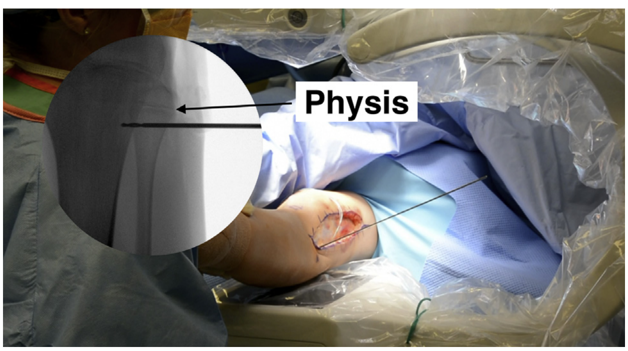

Fig 5. Fluoroscopic imaging that illustrates a Beath pin drilled directly across the fibula (desired location), beneath the physis.

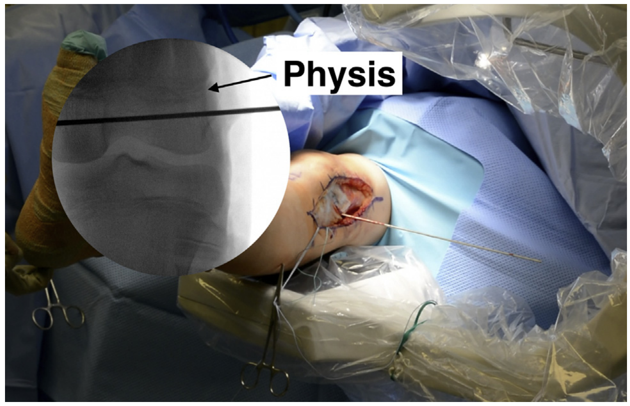

Fig 6. Fluoroscopic imaging that illustrates a Beath pin drilled directly across the femur (desired location), avoiding the physis.

then prepared by whip-stitching each end with a No. 2 FiberWire (Arthrex, Naples, FL). The hamstring graft is first passed into the femur and secured with a 7 × 23-mm bioabsorbable screw (Fig 7). The graft is then delivered through the channel created beneath the IT band and shuttled through the fibular head tunnel from anterior to posterior. The graft is then secured in the fibular head tunnel with a 7 × 23-mm bioabsorbable screw with the knee held in 20° of flexion and a slight valgus reduction force (to resolve varus gapping). On fibular screw fixation, the FCL is tested for restoration of stability, and the surgical incisions are closed in standard fashion using No. 0 Vicryl suture for deep layers, followed by a No. 2-0 Vicryl suture for superficial layers and a Monocryl subcuticular skin stitch.

Postoperative Rehabilitation

Following surgery, the patient is placed into a knee immobilizer and allowed partial weight bearing on the operated limb for 6 weeks. Patients are instructed to bear weight at 40% of their total body weight and use a body weight scale to practice this guideline with a physical therapist to ensure weight-bearing compliance.[12] Patients are permitted to transition from the knee immobilizer into a functional hinged brace once they can perform a straight leg raise without extension deficit, which typically occurs around week 2 postoperatively. There are no restrictions regarding knee flexion range of motion (ROM), and the patient may gradually increase ROM as tolerated. Full weight bearing with no restrictions and stationary cycling are initiated at 6 weeks, and patients may discontinue crutches once they are able to walk without a limp. A running progression typically begins around 4 to 5 months postoperatively; however, patients are restricted from performing side-to-side maneuvers at this time. In our practice, gradual return to play progression is initiated after 6 months following the successful completion of a functional sports test. Return to sports or full activity is allowed when normal strength, stability, and knee ROM comparable to the contralateral

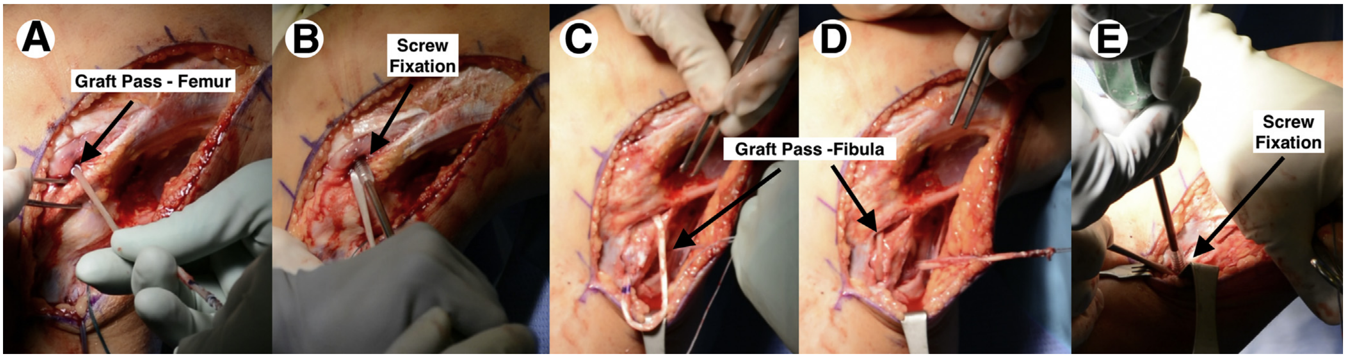

Fig 7. Fibular collateral ligament reconstruction graft is passed in the femur (A) and fixed in place with a 7 × 23-mm bioabsorbable screw (B). Graft is then passed through a previously created tunnel and channeled through the fibular head tunnel (C, D). Graft is finally fixed in the fibular head tunnel using another 7 × 23-mm bioabsorbable screw.

side is achieved; this typically occurs at 7 to 9 months postoperatively.

Discussion

This Technical Note describes our surgical technique for addressing isolated, complete (grade III) FCL injuries in adolescent patients with open physes. Indications for surgical reconstruction of the FCL depend on a thorough preoperative diagnosis including varus stress radiographs with a minimum side-to-side difference of 2.0 mm.[9,10] A shorthand bone age assessment should be conducted to determine a patient's radiographic skeletal age prior to surgical reconstruction.[11] Use of intraoperative fluoroscopy is crucial because care must be taken to avoid drilling through the epiphyses or placing screw fixation across the epiphyses. Potential complications include growth arrest and limb length discrepancy; however, the risks are decreased with direct visualization during tunnel placement.

Isolated, anatomic FCL reconstruction can be achieved in the skeletally immature patient with open physes with the use of intraoperative fluoroscopy. By following the technique detailed above, surgeons may decrease the risk of potential consequences including injury to the epiphyses and growth arrest in adolescent patients with complete grade III FCL injuries.

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