Surgical Management of Proximal Tibiofibular Joint Instability Using an Adjustable Loop, Cortical Fixation Device

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Abstract: A technique for proximal tibiofibular joint stabilization using an adjustable loop, cortical fixation device is presented. A standard diagnostic arthroscopy is performed to exclude intra-articular pathology. After arthroscopy, a 5-cm posterior-based curvilinear incision is made over the fibular head with dissection of the fascia and decompression of the common peroneal nerve ensuring adequate exposure of the fibular head. A guidewire is placed across 4 cortices using fluoroscopic guidance from the fibular head to the anteromedial tibia. A cannulated drill bit is guided through the 4 cortices. A shuttle wire carrying the adjustable loop, cortical fixation device is fed from lateral to medial and through the skin until the medial cortical button is deployed. The device is tightened until the lateral circular cortical button is secured on the fibula. Fluoroscopy is performed to confirm the button position. The device is secured after tensioning by tying the sutures. To confirm joint stabilization, a shuck test can be performed. If a second fixation device is necessary, this procedure can be repeated distally to the first.

Instability of the proximal tibiofibular joint (PTFJ) is a rare and underdiagnosed disorder that commonly presents as lateral knee pain or a sensation of instability. Once alternative causes are ruled out and instability classification (acute traumatic dislocation, chronic/recurrent dislocation, atraumatic subluxation) is determined, appropriate management can be pursued.

For some patients, nonoperative treatment with physical therapy and exercise bands have shown to be helpful in reducing symptoms; however, for 50% of cases of instability, patients will require surgical stabilization of the PTFJ. Several treatment techniques have been described. Acute PTFJ dislocations can be amenable to closed reduction. If closed reduction is unsuccessful, or a patient presents with chronic recurrent dislocation or symptomatic subluxation, open reduction and internal fixation with Kirschner wires or screws has been described. Despite achieving definitive fixation, these surgical treatments often require removal of hardware at a later date because of the rigidity of the PTFJ fixation construct that inhibits normal external rotation, and anterior-posterior translation of the fibula. In our practice, we perform PTFJ stabilization using an adjustable loop, cortical fixation device (Syndesmosis TightRope, Arthrex, Naples, FL). This technique allows for a more normal physiological movement of the PTFJ and does not require a second surgery for removal of hardware. For stabilization of the ankle syndesmosis, this device has shown good postoperative outcomes and faster rehabilitation, and is the procedure of choice for many foot and ankle surgeons. The use of this device was first documented in a case study by Lenehan et al., who showed successful reduction and stabilization of a PTFJ in a
Patient with chronic recurrent dislocation. This Technical Note aims to provide technical guidance and considerations for performing a successful PTFJ stabilization procedure using an adjustable loop, cortical fixation device when surgical fixation is indicated.

Surgical Procedure Description

Indications

Patients indicated for this procedure are those who have symptomatic PTFJ instability (chronic/recurrent, acute traumatic dislocation, atraumatic subluxation) that has not responded to closed reduction or nonoperative management.

Intraoperative Physical Examination

The patient is taken to the operative theatre and placed in the supine position with a thigh tourniquet. After general anesthesia is induced, a thorough knee examination under anesthesia is performed including range of motion, varus stability, valgus stability, Lachman, posterior drawer, and pivot shift tests. Close attention is paid to testing of the PTFJ with the anteroposterior shuck test. A positive test result occurs when anterior translation of the fibular head relative to the tibia is palpated, often with a clunk. In the present case, a grossly visible and palpable anterior translation was noted, with an obvious clunk from posterior translation and spontaneous reduction of the joint when anterior pressure was removed.

Arthroscopy

Once a diagnosis of PTFJ instability is confirmed, a standard diagnostic arthroscopy is performed through 2 portals. Particular attention is paid to the status of the menisci, patellofemoral tracking, cruciate ligaments, and presence of loose bodies as pathologies in these areas can mimic locking or instability due to PTFJ instability. Once the arthroscopic portion of the case is complete, the portals are closed and attention is turned to the open portion of the case.

Exposure

The operative extremity is exsanguinated and the tourniquet inflated to 300 mm Hg. A 5-cm posterior-based curvilinear incision is made over the fibular head (Figs 1 and 2). Careful subcutaneous dissection is carried down to the level of the fascia, and the common peroneal nerve is identified posterior to the biceps femoris and in the fat stripe passing posterior to anterior just distal to the fibular head (Video 1). The nerve is carefully dissected and decompressed from any potential points of constriction or tethering along its course within the operative field. The nerve is freed proximally and distally to its entrance into the anterior compartment musculatures, as well as above the nerve where adequate exposure of the fibular head is verified. Once adequate exposure is completed, the nerve is protected with a vessel loop for the duration of the case.

Fig 1. Right lower limb, lateral view. A 5-cm curvilinear incision is being developed over the fibular head.

Fig 2. Right lower limb, cross-sectional view, orientation shown by arrows in the top right-hand corner. The cross-sectional anatomy shows the incision site on the lateral aspect over the heat of the fibular. Note the proximity of the common peroneal nerve (CPN) to the fibular head. Careful subcutaneous dissection is performed to the level of the fascia. The CPN is identified posterior to the fibular head and in the fat stripe passing posterior to anterior, distal to the fibular head. The relevant anatomy is as follows: (1) tibia, (2) fibula, (3) CPN, (4) tibial nerve, (5) patellar tendon, (6) sartorius tendon, (7) gracilis tendon, (8) semitendinosus tendon, (9) medial collateral ligament, (10) tibialis anterior muscle, (11) extensor digitorum longus muscle, (12) tibialis posterior muscle, (13) Soleus muscle, (14) lateral head of gastrocnemius muscle, (15) medial head of gastrocnemius muscle, (16) peroneus longus muscle, (17) popliteal vessels, (18) lesser saphenous vein, (19) long saphenous vein, (20) skin.
With the common peroneal nerve decompressed and protected, deep dissection between the peroneus longus and soleus muscles is performed to allow complete visualization of the fibular head (Fig 2). The decision to place 1 or 2 devices is based on the degree of instability noted on performing an anterior shuck test under direct visualization. In the present case, the patient was noted to have marked anterior translation of the fibular head relative to the tibia even with minimal pressure, and therefore the decision was made to use 2 devices.

Device Deployment

Using fluoroscopic guidance, a 1.6-mm guide pin is driven straight across the 4 cortices of the fibula and tibia starting at the posterolateral fibula, centered within the
fibular head, and aiming anteromedially toward the tibia, just medial to the tibial tubercle (Figs 3-5). Once acceptable position is confirmed fluoroscopically, a 3.7-mm cannulated drill bit is used to drill over the guide pin with care being taken to pass all 4 cortices without piercing the skin on the anteromedial side. The drill and guide pin are then withdrawn. The relevant anatomy is shown: (1) tibia, (2) fibula, (3) common peroneal nerve, (4) tibial nerve, (5) patellar tendon, (6) sartorius tendon, (7) gracilis tendon, (8) semitendinosus tendon, (9) medial collateral ligament, (10) tibialis anterior muscle, (11) extensor digitorum longus muscle, (12) tibialis posterior muscle, (13) soleus muscle, (14) lateral head of gastrocnemius muscle, (15) medial head of gastrocnemius muscle, (16) peroneus longus muscle, (17) popliteal vessels, (18) lesser saphenous vein, (19) long saphenous vein, (20) skin.

Confirmation of Device Position and Joint Stability

Once the acceptable position of the buttons against the cortex of the tibia and fibula is confirmed fluoroscopically (Figs 12 and 13), the sutures are tied to secure the button in place and prevent cyclic displacement (Fig 14). Care is taken not to over-tension the TightRope because this can fracture the lateral fibular cortex.

If extra fixation is needed, the above procedure can be completed with an additional device applied distal to
the first with a diverging orientation. In the present case, we chose to apply 2 devices because of the gross instability detected on examination in the clinic and on examination under anesthesia.

At the conclusion of the procedure, the anteroposterior shuck test is repeated to confirm the improved stability of the PTFJ (Video 1).

**Wound Closure**

The wound is then thoroughly irrigated and closed with 2-0 vicryl in the subcutaneous layer and a running 3-0 Prolene subcuticular stitch for skin. A bulky, dry, and sterile dressing is placed and a hinged knee brace locked in extension is applied.

**Rehabilitation**

Our recommended postoperative rehabilitation protocol is slightly different to that described by Coetze and Ebeling for syndesmosis fixation using an adjustable cortical fixation device. The patient is non-weight-bearing.
for achieving reliable PTFJ stabilization.

vided an in-depth description of our surgical technique regarding operative stabilization of the PTFJ and provided an adjustable loop, cortical fixation device is in situ with both cortical buttons secured firmly at the anteromedial tibia and lateral fibular head, respectively. The relevant anatomy is shown: (1) tibia, (2) fibula, (3) common peroneal nerve, (4) tibial nerve, (5) patellar tendon, (6) sartorius tendon, (7) gracilis tendon, (8) semitendinosus tendon, (9) medial collateral ligament, (10) tibialis anterior muscle, (11) extensor digitorum longus muscle, (12) tibialis posterior muscle, (13) soleus muscle, (14) lateral head of gastrocnemius muscle, (15) medial head of gastrocnemius muscle, (16) peroneus longus muscle, (17) popliteal vessels, (18) lesser saphenous vein, (19) long saphenous vein, (20) skin.

Fig 14. Right lower limb, cross-sectional view, orientation shown by arrows in the top right-hand corner. The adjustable loop, cortical fixation device is in situ with both cortical buttons secured firmly at the anteromedial tibia and lateral fibular head, respectively. The relevant anatomy is shown: (1) tibia, (2) fibula, (3) common peroneal nerve, (4) tibial nerve, (5) patellar tendon, (6) sartorius tendon, (7) gracilis tendon, (8) semitendinosus tendon, (9) medial collateral ligament, (10) tibialis anterior muscle, (11) extensor digitorum longus muscle, (12) tibialis posterior muscle, (13) soleus muscle, (14) lateral head of gastrocnemius muscle, (15) medial head of gastrocnemius muscle, (16) peroneus longus muscle, (17) popliteal vessels, (18) lesser saphenous vein, (19) long saphenous vein, (20) skin.

for 6 weeks with the brace locked in extension; however, as soon as possible, they are encouraged to unlock the brace and, whilst in the seated position, move their leg through passive- and active-assisted motion under the guidance of a physical therapist. Six weeks post-operatively, the patient can begin weight bearing and unlock the brace. The brace can be removed for low-impact activities such as stationary cycling, pool walking, and swimming. Three months after surgery, the patient can commence moderate-impact activities such as walking and jogging, and at 6 months the patient can commence a gradual introduction to cutting activities.

Pearls and Pitfalls

For surgeons attempting this procedure for the first time we have outlined some common pearls and pitfalls that we have developed in our practice for performing this procedure successfully (Table 1).

Discussion

This Technical Note outlined the current literature regarding operative stabilization of the PTFJ and provided an in-depth description of our surgical technique for achieving reliable PTFJ stabilization.

Table 1. Pearls and Pitfalls

| Pearls | Pitfalls |
| --- | --- |
| The use of a leg holder allows the contralateral leg to be held in a safe, comfortable position and brings the knee clear of the contralateral side, reducing the risk of iatrogenic injury when drilling and allowing for an adequate proximal tibiofibular joint shuck test to be performed. Diagnostic arthroscopy is useful for excluding other pathology that commonly presents as lateral knee pain or instability such as posterolateral corner injury. It is helpful to always have the instrumentation required for a meniscectomy or meniscal repair as patients with a history of trauma can often have multiple knee pathologies. Use of a posterior-based curvilinear incision is recommended because it allows for direct exposure of the fibula head and can be extended if a second implant is required for fixation. A vessel loop is helpful for identifying and protecting the common fibular nerve throughout the procedure. A needle driver or an artery clip providing counter-tension helps with securing the lateral cortical button whilst maintaining adequate tension, preventing displacement on the medial cortical button. | A poorly centered drill hole in the proximal fibula can lead to fracture and/or inadequate fixation. When using the cannulated drill bit, ensure that the drill bit passes through 4 cortices but does not breach the medial skin. Similarly, do not allow the medial cortical button to breach the skin. It is recommended to use fluoroscopy to confirm cortical button positioning to ensure that it is not superimposed on any soft tissues before final fixation. Care is taken not to over-tension the device construct because this can fracture the lateral fibular cortex. |

Conventionally, screws have been used for surgical stabilization of the PTFJ; however, these can often restrict motion of this mobile joint and require removal. Device failure can also occur whereby screws may loosen or snap and a second implant removal surgery is required. This can be technically challenging and can have greater potential for tissue trauma accompanied by the risks associated with an additional surgical procedure. An adjustable loop, cortical fixation device is advantageous because it provides fixation whilst allowing for the normal physiological movement at the PTFJ, thus eliminating the need for implant removal surgery because of impairment of normal joint mechanics (Table 2).

Table 2. Advantages and Disadvantages

| Advantages | Disadvantages |
| --- | --- |
| Cortical fixation through an adjustable loop allows for a more physiological stabilization of the proximal tibiofibular joint. There is a lower rate of hardware removal surgery. In the event of hardware removal, there is less bone loss compared with screw fixation. Compared with screw fixation, the cortical buttons have a lower profile and are less likely to irritate the overlying skin. | In a single procedure, the use of an adjustable loop, cortical fixation device can be more expensive than conventional screw fixation. |
In respect to economics, the adjustable loop cortical fixation device is similarly priced to the conventional PTFJ stabilization procedures using screws. When accounting for the higher likelihood of a second implant removal surgery, the costs of using a screw fixation procedure significantly exceed the costs of the technique described in this Technical Note.

In conclusion, an adjustable loop cortical fixation device provides a reliable, economical, and easy to perform surgical technique that achieves better replication of a physiological PTFJ compared with traditional screw fixation and has a reduced risk for a second surgery. We recommend it as first line for patients requiring operative stabilization of the PTFJ.

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