Proximal Tibiofibular Joint Stabilization With Concurrent Posteriorlateral Corner Reconstruction in Multiligamentous Knee Injury

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Abstract: Proximal tibiofibular joint (PTFJ) instability is a rare knee injury, accounting for less than 1% of knee injuries. It causes significant lateral sided knee pain and functional deficits and can be associated with up to 9% of multiligament knee injuries. Concurrent surgical treatment of posterolateral corner (PLC) and PTFJ instability poses technical challenges due to the limited working space of the fibula head and inherent risk of collision between grafts, bone tunnels, and implants. In this Technical Note, we detail our senior author’s technique for PTFJ reconstruction without the use of additional bone tunnels or implants in the fibula head, to reduce the risk of overcrowding and tunnel collision.

Introduction

There are many methods described in posterolateral corner (PLC) reconstruction in the knee. These techniques usually involve graft fixation at the fibular head and are associated with favorable outcomes. Disruption of the proximal tibiofibular joint (PTFJ) can occur with posterolateral corner injury and becomes unstable for a fibula-based posterolateral corner reconstruction (PLCR). PTFJ injuries account for less than 1% of all knee injuries and is associated with up to 9% of multiligament knee injuries (MLKIs). There are a number of techniques described for restoration of an isolated PTFJ instability. These include screw fixation, graft fixation, and suspensory device fixation. When PLC and PTFJ instability need to be addressed concurrently, a number of the described techniques for PTFJ stabilization are challenged. This is partly because of the limited working space, such as fibula bone availability and the risk of collision between grafts, bony tunnel, and implants during reconstruction in a MLKI.

In this Technical Note, we describe our senior author’s technique for PTFJ reconstruction that requires no additional bone tunnels or implants in the fibular head and reduces the risk of overcrowding and tunnel collision in the tibia.

Surgical Technique (With Video Illustration)

This PTFJ reconstruction technique is described in conjunction with a posterolateral corner reconstruction using a fibular head-based technique. The pearls and pitfalls, as well as the limitations of this technique are presented in Tables 1 and 2, respectively.

Positioning and Preparation

The patient is positioned supine and placed under general anesthesia. Examination under anesthesia is performed, assessing for PTFJ instability. This is done via moving the fibular head back and forth in an anterolateral to posteromedial direction to examine for laxity. A tourniquet of appropriate size is then applied onto the proximal thigh, and the patient is cleaned and draped.
A lateral incision with the knee in extension is made. This straight incision extends from 5 cm proximal to the lateral epicondyle, in between the Gerdy’s tubercle and fibular head, and 3 cm distal to these bony landmarks (Fig 1). The knee is flexed to 90°, and a full-thickness posterior flap is raised (Fig 2). The peroneal nerve is identified and neurolyzed. The nerve entry into the lateral leg compartment is decompressed. The fibular head is palpated and the stability of the PTFJ is reassessed (Fig 3). An incision adjacent to the anterior fibular head is made. This extends from the tip of the fibular head anterior to the lateral collateral ligament (LCL) to the fibular neck. The soft tissue attachment is cleared with a periosteal elevator. This is repeated for the soft tissue attachment on the posterior fibula head. The fibular tunnel is reamed and directed 30° in a posteromedial and proximal directions (Fig 4). The diameter of the fibular tunnel is predetermined from the PLC reconstruction graft diameter. The tibia adjacent to the fibular head is exposed for anchor fixation.

A proximal incision over the lateral epicondyle (LE) is made on the distal iliotibial band (ITB) along the direction of its fibers. The LCL and the popliteal tendon (PT) femoral attachment are identified. The two parallel femoral tunnels are reamed and directed 30° in an anterior and proximal direction.

**Ultrabraid Sutures and PLCR Graft Passage, Tensioning, and Fixation**

The Ultrabraid sutures (Smith & Nephew, London, UK) are first threaded through the fibular tunnel (Fig 5). The PLCR graft is then passed through the fibular tunnel. The two graft limbs are tunneled between the ITB and the joint capsule, and is pulled into their respective femoral tunnels. The LCL limb crosses superficial to the PT limb.

The anterior limb of the first Ultrabraid suture is tunneled in an anterior-to-posterior direction under the soft tissue on the lateral fibula head. Similarly, the posterior limb of the second Ultrabraid suture is tunneled in a posterior to anterior direction under the same soft tissue bridge (Fig 6).

The authors prefer to start with the posterior suture anchor for PTFJ stabilization. The site for the posterior suture anchor is on the tibia posterior and adjacent to the fibula head. It is located by palpation below the biceps femoris attachment to the fibula head. A 2.5-mm guide wire is used to determine the direction and level of suture anchor placement. The guide wire is directed 30° in an anteromedial direction at the same level as the tip of the fibula head and adjacent to the fibula head. The wire is initially directed 30° proximally to make a notch on the concave posterior tibia cortex. Its direction is then changed to parallel the tibiofemoral joint line. The guide wire subsequently directs the 5.5-mm cortex breaker and reaming is limited to a depth of 30 mm. The 2 free ends of the first Ultrabraid suture are then threaded through the 5.5-mm Footprint Ultra PK anchor (Smith & Nephew). The PTFJ is held in reduction with the Ultrabraid suture under tension and the posterior suture anchor is deployed (Fig 7).

For anterior fixation, the 2.5-mm guide wire is directed perpendicular to the tibia cortex adjacent to the fibula head at the level of the tip of the fibula head. A 5.5-mm cortex breaker is used and reaming is limited to a depth of 30 mm. The 2 free ends of the second Ultrabraid are threaded through another 5.5-mm

### Table 1. Pearls and Pitfalls for PTFJ Reconstruction Technique

| Pearls | Pitfalls |
|--------|----------|
| Peroneal nerve neurolysis and decompression at its entry point into the peroneal compartment are important to prevent undue tension and also increase the working space. | There is limited working space due to size of fibula, graft in fibula head tunnel, and proximity to structures adjacent to the fibula head, such as peroneal nerve and biceps femoris. |
| Using the same fibula bone tunnel as the posterolateral corner reconstruction (PLCR) graft reduces the risk of collision between graft, bony tunnel, and implant in multiligament knee reconstruction. | Inadvertent injury to the peroneal nerve may occur. |
| Crossing one free end of each Ultrabraid interlocks the sutures. This configuration compresses the proximal tibiofibular joint (PTFJ) and counters anterior-posterior and proximal displacement. | Possible difficulty with positioning of the posterior suture anchor. |
| Placing suture anchors adjacent to fibular head and PTFJ ligaments replicates the native ligaments. | PTFJ reduction might not be accurately assessed. |
| Avoids damage to PTFJ articular surface. | Subsequent PLCR tensioning can potentially disrupt the PTFJR. |
| No additional graft is required. | |

Failure to restore adequate proximal tibiofibular joint (PTFJ) stability affects the subsequent posterolateral corner reconstruction (PLCR) effectiveness.

This is a preliminary study, and further investigation is needed to establish the long-term benefits and efficacy.

PTFJ dislocation is not common and the clinical application is hence limited.

### Table 2. Limitations of PTFJ Reconstruction Technique

Failure to restore adequate proximal tibiofibular joint (PTFJ) stability affects the subsequent posterolateral corner reconstruction (PLCR) effectiveness.

This is a preliminary study, and further investigation is needed to establish the long-term benefits and efficacy.

PTFJ dislocation is not common and the clinical application is hence limited.
Footprint Ultra PK anchor. The Ultrabraid suture is tensioned and the anterior anchor is deployed. (Fig 8) The stability of the reconstruction is checked. Fig 9 demonstrates the suture anchor position on preoperative MRI imaging. Fig 10 demonstrates the overall schematic diagram of the PTFJ stabilization construct.

The fibula screw is subsequently deployed. The knee is in 90° of flexion and neutral rotation under valgus stress. The PT limb is tensioned and the femoral screw is deployed. The knee is then extended to 20° in neutral rotation under valgus stress. The LCL limb is tensioned and the femoral screw deployed. The stability of the reconstruction is
checked. The wound is copiously irrigated and haemostasis checked. The ITB is repaired and the wound closed in layers. A knee brace is applied and locked at full extension. The neurovascular status of the limb is checked.

**Reconstruction for Isolated PTFJ Injuries**
For isolated PTFJ reconstruction, a less extensive exposure and dissection is required in the region of the fibular head and a fibula tunnel of smaller diameter is required.
The surgery requires less than 24-hour inpatient stay. The patient is instructed passive range of motion as tolerated and kept non-weightbearing for six weeks post-surgery. Weight bearing and active range of motion are started after 6 weeks. Good pain control is important for effective mobilization and strengthening. Patients typically are able to return to running by 6 months after surgery.

Discussion

There are a number of techniques described for isolated PTFJ stabilization and good outcomes had been reported. These include as screw fixation\(^3\), graft reconstruction\(^4\), and suspensory device fixation\(^5\). There are challenges in PTFJ stabilization when it is concurrent with MLKI reconstruction. When there is PLCR, the graft in the fibula head tunnel limits the working space. Additional implants in this region pose a potential risk of fracture. When there are anterior cruciate ligament and posterior cruciate ligament reconstructions, the tibia tunnels might collide with the trajectories of the implants used for PTFJ stabilization.

The described technique addresses the limited working space of the fibula by using the same bony tunnel in the fibula head as the PLCR. It reduces the risk of collision of bone tunnels, graft, and implant trajectories in the tibia during a MLKI reconstruction.

Using Ultraplaited sutures minimizes the bony space required in the fibula head. Ultraplaited or a suture of similar strength is preferred. The free ends of the Ultraplaited suture are crossed to effectively reduce the PTFJ. The posterior suture anchor aims to control anterior translation and vice versa for the anterior suture anchor. Each length of Ultraplaited forms a loop. By crossing one end of each Ultraplaited over the other, it interlocks. This configuration provides multiplanar stabilization in anterolateral and posteromedial translation, as well as anteromedial compression to reduce the PTFJ.

No additional graft is required, and the PTFJ articular surface is not violated. The suture anchor enables fixation close to the native ligaments to replicate the static stabilizers. The anchors require comparatively less tibia bone space compared to other described techniques. The direction of the suture anchors is preferably parallel.
to the tibia articular surface to avoid damaging it. The use of a syringe needle helps to locate the joint lines of the PTFJ and lateral tibiofemoral joints and guides positioning of the suture anchors.

This technique is also applicable to isolated PTFJ instability. In this context, it requires comparatively less exposure and smaller fibula bone tunnels. Passive flexion and no weight-bearing are advised for 6 weeks after surgery to reduce the strain on the stabilized PTFJ.

**Conclusion**

PTFJ stabilization is challenging in MLKI reconstruction. This is due to limited working space of the fibula head and inherent risk of collision between grafts, bone tunnels, and implants. This Technical Note presents a surgical technique for PTFJ instability that addresses these concerns and provides multiplanar stabilization for the PTFJ.

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