Physeal Sparing Medial Patellofemoral Ligament Reconstruction With Suture Anchor for Femoral Fixation of Graft

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Background: Patellar instability is a common problem in the active pediatric population. Physeal sparing medial patellofemoral ligament (MPFL) reconstruction using a soft suture anchor for femoral graft fixation has the proposed advantages of diminishing volumetric bony removal from the epiphysis, increasing the margin of safety with respect to notch, trochlear, and/or physeal damage, as well as reducing the risk of thermal damage to the physis during socket reaming.

Indications: MPFL reconstruction is indicated in patients with recurrent patellar instability with MPFL tear or attenuation on magnetic resonance imaging or failure of conservative treatment. Physeal sparing techniques are necessary in the pediatric population to prevent growth disturbance and deformities that can lead to significant long-term disability.

Technique Description: The patient was placed in supine position. Following examination under anesthesia, diagnostic arthroscopy was performed to assess for patellofemoral chondral defects. The surgical technique required 6 steps: (1) medial patellar dissection, (2) patellar anchor placement with 1.8-mm suture anchors, (3) medial femoral dissection over Schottle's point, (4) femoral anchor placement using 2.8-mm double loaded anchor, (5) allograft femoral fixation, and (6) allograft patellar fixation. After skin closure, examination under anesthesia was repeated.

Results: The patient was weight-bearing as tolerated immediately after surgery, using a brace for the first 6 weeks. Rehabilitation progressed from regaining range of motion, strengthening of the operative extremity, and returning to sport activities. In the senior author's experience using this technique, there have been no recurrent patellar dislocations and no evidence of growth disturbance or angulation. One patient did find that the graft was prominent over the femoral epicondyle and returned to the operating room for debulking at 9 months postoperatively.

Discussion/Conclusion: In conclusion, we propose that physeal sparing MPFL reconstruction using soft anchors for patellar and femoral fixation offers a simple and safe technique with reproducible anatomic graft placement and favorable clinical outcomes. This technique is technically simple and can be easily learned by surgeons familiar with adult MPFL reconstruction techniques.

The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

Keywords: pediatric; patellar instability; medial patellofemoral ligament; reconstruction; physeal sparing

VIDEO TRANSCRIPT

In this video, we present a surgical technique for medial patellofemoral ligament (MPFL) reconstruction in pediatric patients.

There are no conflicts of interest.

Patellar instability is a fairly common problem in the active pediatric population. Surgical treatment may be recommended for recurrent instability after failing non-operative treatment or if a chondral defect or loose body is noted on imaging after initial dislocation. Cadaver studies have demonstrated that the MPFL origin in pediatric patients is a few millimeters distal to the distal femoral physis. There is a risk to the physis with MPFL reconstruction as the typical tunnel trajectory would violate the physis. A magnetic resonance imaging (MRI)-based study

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showed that all epiphyseal techniques still have risk of injury to the physis with a large tenodesis screw. Therefore, physeal sparing MPFL reconstruction with all suture anchors and onlay technique addresses these issues.

Here is a case presentation to demonstrate our technique. We have a 13-year-old female gymnast with bilateral recurrent patellar instability with daily activity for over 1 year. She has completed a course of physical therapy after each dislocation event, and while the right knee has remained stable, the left patella continues to dislocate. On clinical examination, she has full range of motion with an abnormal patellar tracking and a J sign bilaterally. She has increased lateral patellar glide and a positive patellar tilt on the left, as well as patellar apprehension.

Radiographic imaging shows a lateral patellar tilt and a shallow trochlear groove. She has a normal Insall-Salvati ratio and no apparent varus or valgus deformity.

An MRI of the left knee demonstrates a large effusion. Lateral patellar tilt is again seen with subluxation of the patella laterally. The MPFL appears attenuated and she has a normal tibial tuberosity to trochlear groove distance (TT-TG) and no apparent chondral injury.

There are multiple treatment options for patellar instability in the skeletally immature patient. Treatment will typically begin with conservative options if there is no evidence of loose body or chondral injury on imaging. Surgical options may include MPFL repair or reconstruction. If there is evidence of valgus deformity, guided growth may be recommended. Other bony deformities may require various osteotomies, some of which are recommended to delay until skeletal maturity to protect the physis.

Indications for MPFL reconstruction include recurrent patellar instability with MPFL tear or attenuation, failure of conservative treatment, or evidence of chondral injury on imaging. MPFL reconstruction may be contraindicated if the bony deformity appears significant and would be better addressed with other techniques.

We will now show our surgical technique for MPFL reconstruction in pediatric patients. The patient is positioned supine on a radiolucent table with all bony prominences well padded. We begin with an examination under anesthesia to reassess the patellar lateral tilt, the patellar glide, and patellar tracking or J sign, which are demonstrated in this video.

We then proceed to a diagnostic arthroscopy using a standard anterolateral portal to assess for chondral injury. If no intra-articular abnormalities are visualized, no further portals are needed. The arthroscopic picture on the bottom right demonstrates a typical injury to the lateral femoral condyle that occurs often during patellar relocation. The chondral injury in this patient did not require further fixation or treatment.

For the open portion of the procedure, we begin with a 2- to 3-cm incision over the proximal half of the medial patella. Layer 1 of the medial knee is identified, and full thickness flaps are created. Blunt dissection between layers 2 and 3 is used down to the medial epicondyle of the femur. Passing a Kelly clamp between these layers should be fairly easy.

We use a Bovie (Biomedica Healthcare; Makati City, Philippines) to remove the soft tissue off the medial patella followed by a rongeur to create a bleeding trough for anchor placement. Fluoroscopy is used to confirm placement of 2 anchors, one at the equator of the patella and the second in the proximal third. The Arthrex FiberTak (Naples, FL) anchors used by the author only require a 1.6-mm drill hole, which is ideal in a small pediatric patella. However, if the patella is still too small to accommodate 2 anchors, just 1 anchor can be placed proximally, and the second limb of the graft can be sutured to the quadriceps in a medial quadriceps tendon femoral ligament (MQTFL) fashion.

We next turn our attention to the medial femoral condyle. A 2-cm incision is localized with fluoroscopy over Schottle point on a perfect lateral of the knee. Sharp dissection is carried down to the fascia, which is then incised, and the medial epicondyle is cleared off to access Schottle point.

The drill guide is placed firmly over Schottle point on a perfect lateral radiograph. In pediatric patients, we then confirm the placement of the drill is distal to the physis on the anteroposterior view. The drill is aimed distal and anterior to avoid the notch, trochlea, and the physis. The authors prefer to place a Smith & Nephew (Watford, England, UK) Q-Fix 2.8-mm All-Suture Anchor.

Typically, a semitendinosus allograft is used as shown in the picture on the right. A Kelly clamp is then used to shuttle the limbs of the graft into the patellar incision while maintaining the loop of the graft in the femoral incision. We mark the midportion of the graft with a marker and hold it taut over the femoral anchor. We then use cerclage fixation with each set of sutures from the femoral anchor on either side of the marking to secure the graft to the femoral epicondyle with 2 points of fixation.

Fixation on the patella is performed with the knee in 30° to 45° of flexion, allowing the patella to engage in the trochlea. The 2 graft limbs are held taut but without significant tension, so that the graft acts as a checkrein, while still allowing for 1 to 2 quadrants of translation. We then mark the location of the patellar anchors on the graft. For each anchor, 1 suture is passed from deep to superficial in a locking Krachow stitch starting at the marking and working distal and then back up to the mark.

The second suture from the same anchor is also passed from deep to superficial at the level of the mark and will act as a post, pulling the graft to the anchor. This is repeated for the second anchor securing the other limb of the graft to the patella. The excess graft is then excised. The same sutures from the patellar anchors can then be used to close the layers back over the graft. The incisions are then irrigated and closed with absorbable suture.

Finally, we repeat an examination under anesthesia.

There are several potential complications of this technique. First of all, fixation of the graft is dependent on all suture anchors and suture fixation. Potential injury to the physis is still present though lowered through the onlay technique. There is risk of entering the notch due to the trajectory of the drill, and there is risk of recurrent

patellar instability if bony pathology is not adequately addressed.

There are 4 phases involved in recovery postoperatively. The patient is weight-bearing as tolerated immediately after surgery, but in a brace for the first 6 weeks. The first 2 phases focus on maintaining and regaining range of motion. Phase 3 then progresses strengthening of the operative extremity, and phase 4 involves progressing to sport-specific activities.

To return to sport without restriction, patient should demonstrate strength of the operative leg at 80% to 90% of the contralateral side. For high-level athletes, functional testing can provide additional information for the surgeon and physical therapist before returning to play.

Previous studies have validated suture anchor fixation as equivalent to tenodesis screw fixation in both the humerus and the femur. In addition, animal studies of onlay technique for biceps tenodesis show equivalent healing as with fixation in bony tunnels. Healing occurs at the cortex and periosteum. In the authors' experience using this onlay technique, there have been no recurrent patellar dislocations and no evidence of growth disturbance or angulation. One patient did find that the graft was prominent over the femoral epicondyle and returned to the operating room for debulking at 9 months postoperatively.

These are our references and thank you for listening.

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REFERENCES

1. Calanna F, Pulici L, Carimati G, Quaglia A, Volpi P. Medial patello-femoral ligament (MPFL) reconstruction using suture anchors fixation: preliminary results. *Muscles Ligaments Tendons J*. 2016;6:64-70.
2. Desai VS, Tagliero AJ, Parkes CW, et al. Systematic review of medial patellofemoral ligament reconstruction techniques: comparison of patellar bone socket and cortical surface fixation techniques. *Arthroscopy*. 2019;35:1618-1628.
3. Golish SR, Caldwell PE, Miller MD, et al. Interference screw versus suture anchor fixation for subpectoral tenodesis of proximal biceps tendon: a cadaveric study. *Arthoscopy*. 2008;24(10):1103-1108.
4. Haidamous G, Noyes MP, Denard PJ. Arthroscopic biceps tenodesis outcomes: a comparison of inlay and onlay techniques. *Am J Sports Med*. 2020;48(12):3051-3056.
5. Ladenhauf HN, Berkes MB, Green DW. Medial patellofemoral ligament reconstruction using hamstring autograft in children and adolescents. *Arthrosc Tech*. 2013;2(2):e151-e154.
6. Liu JN, Steinhaus ME, Kalbian IL, et al. Patellar instability management: a survey of the international patellofemoral study group. *Am J Sports Med*. 2018;46:3299-3306.
7. Nguyen CV, Farrow LD, Liu RW, Gilmore A. Safe drilling paths in the distal femoral epiphysis for pediatric medial patellofemoral ligament reconstruction. *Am J Sports Med*. 2017;45(5):1085-1089.
8. Saper MG, Meijer K, Winnier S, Popovich J, Andrews JR, Roth C. Biomechanical evaluation of classic solid and all-soft suture anchors for medial patellofemoral ligament reconstruction. *Am J Sports Med*. 2017;45:1622-1626.
9. Tan H, Wang D, Labaschi AH, et al. Comparison of bone tunnel and cortical surface tendon-to-bone healing in a rabbit model of biceps tenodesis. *J Bone Joint Surg Am*. 2018;100:479-486.