

## Combined Medial Patellofemoral Ligament and Medial Patellotibial Ligament Reconstruction in Children



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Anatomical and biomechanical studies have shown that the Medial Patellofemoral Ligament (MPFL) is the main restrictor to the lateral translation of the patella. Numerous surgical techniques have been described in the literature for the reconstruction of the MPFL with favorable clinical outcomes. In addition to the MPFL, ligaments that contribute to the medial restriction of the patella are the Medial Patellotibial Ligament and the Medial Patellomeniscal one. The latter contribute to the restriction of the patella at angles above 30° of knee flexion. Philipot et al showed that the MPTL contribution increases in extension from 26% to 46% at 90° flexion. Besides contributing to patellar stability, the MPFL influences the tilt and the rotation of the patella. Hence, the reconstruction of the MPFL combined with the MPTL is important to maintain the normal kinematics of the patellofemoral joint throughout the range-of-motion. As found by the group of knee surgery of the University of São Paulo (IOT HC USP), the combined reconstruction with a secondary stabilizer (MPTL or MPML) could reduce stress on the rebuilt MPFL and thus increase the functional results and may be an attractive technique when the osteotomy of the Anterior Tibial Tuberosity (ATT) is not possible.

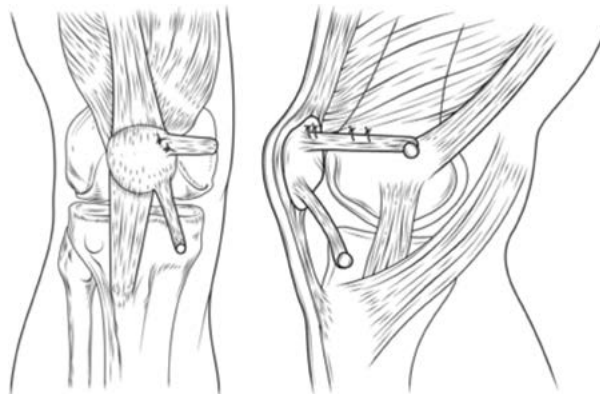
Various grafts have been demonstrated to be effective for the combined MPFL and MPTL reconstruction. Different ways of fixing these grafts have been described with favorable clinical outcomes, despite maintaining a rate of complications around 26.1% with both objective and subjective instability rates of 12%, according to the systematic review published by Shah et al in 2012.

In 1922, Galeazzi described a MPTL reconstruction technique in patients with open physis, in order to control the height of the patella in relation to the femoral condyle and transmit the contraction force from the quadriceps to the tibia. Giordano et al, in 2012, demonstrated the MPFL/MPTL combined reconstruction using the semitendinosus and gracilis tendons with a longitudinal bone tunnel on the patella and fixation on the femur with a metal anchor. The technique was indicated for skeletally immature patients with a high patella, trochlear dysplasia, increased TT-TG and ligamentous laxity.

Hinckel et al published the MPFL/MPTL combined reconstruction technique using the quadriceps tendon for MPFL and the patellar tendon for the reconstruction of MPTL, both from their medial portion and transferred to the anatomical points of both tibial and femoral insertions, with the aid of fluoroscopy (Fig. 1).

The authors developed the variation of the technique previously published by Giordano et al, using the semitendinosus tendon. The graft is fixed to the tibia, patella and femur with the use of metal anchors previously positioned in their respective anatomical landmarks, with the aid of fluoroscopy.

The combined reconstruction is indicated in the presence of patellar instability in skeletally immature patients with patella alta, increased TT-TG, trochlear dysplasia and ligamentous laxity, when techniques such as ATT osteotomy and trochleoplasty cannot be used. However, this procedure may not be needed after skeletal maturity when additional procedures such as ATT osteotomy, osteotomy for the correction of angular deviations of the lower limbs or trochleoplasty are indicated.



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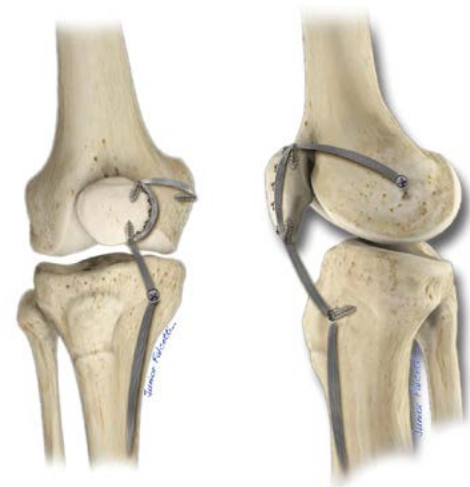
### Surgical Technique

Firstly, the arthroscopic procedure is carried out and the articular cartilage, the menisci and ligaments are inspected. The surgical procedure is performed with three small incisions. The first incision is made at the proximal medial tibia in order to identify the insertion of pes anserinus tendons. The semitendinosus tendon is divided from the muscle-tendon junction, preserving the distal insertion site. The tendon must be at least 12-13 cm in length. The semitendinosus tendon was chosen for greater length and sufficient strength for the reconstruction. A second incision is performed at the medial border of the patella, including the landmark for the fixation of the graft. The last incision is made in the area between the adductor tubercle and the medial epicondyle with the aid of fluoroscopy for the identification of anatomical points of graft insertion.

After preparing the graft with sutures at its free end, a metal anchor is placed in the tibia with a small incision in the region of the medial patellofemoral ligament insertion, proximal to the physis, between the medial border of the patellar tendon and the superficial medial collateral ligament, forming an angle of approximately 20° with the patellar tendon, proximal to the physal line. The graft is fixed at this point and then transferred percutaneously to the distal incision from the medial border of the patella, which is fixed with a metal anchor at 90° of knee flexion with tension similar to the one perceived in the patellar tendon, according to Hinckel et al. A third anchor is positioned on the patella, at the point between the middle and proximal thirds of the patella in its medial border. Then the graft is passed to the femur through the second layer of the medial retinaculum of the patella, and the fourth anchor is placed in the distal region to the physis, by means of fluoroscopy, according to the study by Schöttle et al, in the region between the medial epicondyle and the adductor tubercle, between 5mm and 6.4mm distal to the physis. Prior to the insertion of the anchor, the positioning must be checked in both planes, AP and true lateral. The graft is then secured with the knee between 45° and 60° flexion without excessive tension, reconstructing the medial patellofemoral ligament. The patella is tested during flexion-extension by observing its medium-lateral course, which should allow mobility between 25% and 50% of the patella without lateral displacement.

After confirming the stabilization of the patella and full range of motion with complete flexion-extension, the graft is enhanced with the suture at the periosteum of the patella between the suture anchors to increase the area of patellar insertion, according to its anatomical characteristics (Fig. 2 and 3).

After surgery, the patient remains with a removable immobilizer for three weeks. Physical therapy is started on the second day after surgery with isometric exercises for the quadriceps. The exercises for range-of-motion and quadriceps strengthening are encouraged progressively and as tolerated after the 30th day after surgery. The load without crutches is allowed when the patient is able to walk without a limp. One month after surgery, knee flexion of more than 90° should be achieved. Sports activities are restricted for 4–6 months.



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- 01 Insertion and reconstruction of medial patellofemoral ligament with quadriceps tendon and of medial patellotibial ligament with patellar tendon.
- 02 Reconstruction of the Medial Patellofemoral Ligament (MPFL) and the Medial Patellotibial Ligament (MPTL) with the semitendinosus tendon.

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#### Discussion

The main advantage of the technique presented is the possibility of carrying out the ligament reconstruction in skeletally immature patients and with the presence of predisposing factors. With the combined reconstruction, it is possible to stabilize the patella without performing other procedures such as ATT osteotomy and trochleoplasty.

In skeletally immature patients, procedures for preserving the physis are recommended.

For the fixation of the graft in the patella, tibia and femur, metal anchors were used due to their capacity to maintain the stability of the graft and eliminate the need for bone tunnels in the patella avoiding complications such as patella fracture and cartilage damage. The advantage of using anchors in the femur and tibia is the avoidance of drilling and bone tunnels near the physeal line, preventing injury. Kang et al demonstrated the effectiveness of using metal anchors for the reconstruction of the two bands of MPFL, with no evidence of failures or recurrence in the reconstruction. This technique allows for small and cosmetic incisions. After achieving skeletal maturity, patients should return for physical examination, as well as x-rays.

The fixation of the graft relative to the femoral distal physis remains controversial because of the publication of Shea et al in 2010, which demonstrated that the fixation point on the femur should be proximal to the physis. However, we fix the graft distal to the physis, inclined distally, slightly obliquely, to prevent the risk of perforation of the physis. We believe that the distal fixation to the physis is more reproducible with the use of fluoroscopy, as described by Kepler (2011), Ladd et al (2010) and Parikh et al (2013). When the fixation is positioned significantly distal to the physis, there is the possibility to overtension the patellofemoral joint in extension, which can be corrected by moving the point to an anterior position in the same proportion that it is placed distally.

In the tibia, the fixation of the graft at the proximal epiphysis instead of the tibial proximal metaphysis, avoids the risk of distal migration of the graft insertion with growth, which could cause a change in tension and function.

The reconstruction of MPFL combined with medial MPTL using flexor tendons as graft has shown satisfactory results. Summarizing the main Tips and Pitfalls in the combined reconstruction of MPFL and MPTL:

- It should be recommended to skeletally immature patients with anatomical risk factors such as generalized ligamentous laxity, knee hyperextension, instability in flexion and subluxation of the patella in extension with the contraction of the quadriceps.
- The single semitendinosus tendon may be used as a graft with preservation of its tibial insertion.
- The use of anchors avoids bone tunnels in the patella and near the physis of the femur and tibia.
- The identification of anatomic points with the aid of fluoroscopy.
- Appropriate tensioning of MPTL at 90° of flexion with similar tension to the patellar tendon identified by touch.
- And, lastly, avoiding the overtensioning of MPFL, which could cause the medial subluxation of the patella, patella baja and medial overpressure of the patellofemoral joint.

