INTRODUCTION

The medial patellofemoral complex, consisting of the medial patellofemoral ligament (MPFL) and the medial patellotibial ligament, is the main passive stabilizer of the patellofemoral joint. Since it has been shown that rupture of the MPFL is the main pathological consequence of patellar dislocation [1] and biomechanical studies have demonstrated that the MPFL is the main restraint against lateral patellar displacement, reconstruction of the MPFL has become a widespread technique for restoration of patellofemoral stability. An additional reason that MPFL reconstruction became as popular is the fact that distal realignment procedures such as transfer of the tibial tuberosity or release at the lateral patellar retinaculum/capsule have provided inadequate restoration of patellofemoral stability in every patient, frequently leading to increased mediolateral instability, increased patellofemoral pressure or arthritic degeneration.

Therefore, numerous techniques for reconstruction of the medial patellofemoral complex have been described with promising clinical results [2]. However, since it is known that a non-anatomical reconstruction of the MPFL can lead to non-physiologic patellofemoral loads and kinematics [3], the goal of a surgical intervention must be an anatomical reconstruction. Since the femoral insertion of the MPFL has been evaluated anatomically [3], biomechanically [4],
and radiologically [5], the complications of increased patellofemoral pressure in flexion associated with non-anatomic femoral graft fixation that is too anterior/proximal [3] can be avoided. Upon careful observation of the anatomical shape of the original MPFL, it is apparent that the patellar insertion is much wider than the femoral one. Additionally, Amis et al. have proven double bundle structure provides a more stable proximal and distal ligamentous structure [3]. Respecting this anatomic condition, a double bundle reconstruction at the patellar side is reasonable to restore native ligamentous morphologic and biomechanical properties; moreover, this method lessens the patellar rotation during flexion–extension movement that may occur during single bundle reconstruction. Under these conditions, the double bundle reconstruction, described earlier [6] shows very satisfying clinical results. As we know from ACL reconstruction, direct anatomical/aperture fixation, [7] provides the highest time-zero fixation by avoiding elongation of the graft or “bungee” effect, resulting in the possibility of early rehabilitation with full range of motion. In a similar manner, these concepts may be applied to MPFL reconstruction.

Although most of the actual surgical techniques utilize a free tendon graft to reconstruct the MPFL as the only method for anatomic double bundle graft fixation, an all aperture fixation has not yet been described.

Recent studies have described an anatomical double bundle reconstruction, using an aperture fixation at the femoral insertion [6, 8], while the patellar fixation remains relatively indirect resulting in the eventual risk of post-operative micromotion and subsequent loosening. Patellar graft fixation has been described with either an anchor system, attaching the graft into a bony rim, [6] or by tying the attached graft sutures to each other at the lateral patellar edge[8]; however, this method may potentially result in graft slippage by degloving [7].

The double bundle technique described here offers an aperture fixation at the patella and the femur, providing a high initial stability on both insertions, resulting in improved bony in growth, and consequently, an earlier return to full range of motion.
SURGICAL TECHNIQUE

HARVESTING AND PREPARING OF THE GRACILIS TENDON

After completion of the arthroscopy, the gracilis tendon is harvested and used as an autograft. The usable part of the tendon should be at least 18 cm long and both ends are whipstitched with an absorbable braided suture over a length of 15 mm.

PREPARING THE SOFT TISSUE LAYER

A 2 cm skin incision is performed from the superomedial corner to the end of the medial margin of the patella, where the patellar MPFL insertion is located [4, 10] (figure 1). As the MPFL is situated central to the Vastus medialis obliquus (VMO) in the second layer of the medial patellofemoral complex [10], the central part of the VMO is identified and a scissor is brought along to the medial femoral epicondyle in between the VMO and the joint capsule, cautiously avoiding any injury to the joint.

PREPARING THE FEMORAL INSERTION SITE

To avoid non-physiological patellofemoral forces, the femoral MPFL insertion has to be very accurate. Therefore, a guide wire with an eyelet is placed slightly posterior to the midpoint of the medial epicondyle and the adductor tubercle and the entering point into the bone is marked with a clamp [10]. Then the guide wire placement is controlled by a picture intensifier on a straight lateral view to obtain the correct anatomical femoral insertion; if the graft is placed too anterior or proximal, abnormal graft tensioning will lead to increased patellofemoral pressures during flexion [3]. Therefore, we use the radiographic landmark of the anatomical MPFL insertion which has been shown to be located slightly anterior to an elongation of the posterior femoral cortex in between the proximal origin of the medial condyle and the most posterior point of Blumensaat’s line [6]. If necessary, the guide wire
entry point is corrected before overdrilling to the contralateral cortex with a drill diameter 1 mm larger than that of the graft loop.

PREPARING THE PATELLAR INSERTION SITE

To achieve aperture fixation at the patellar side, the free graft ends have to be fixated directly to the patella. Therefore, the medial patellar margin is prepared and two guide wires are drilled tangentially into the patella at the proximal and distal end of proximal 50% of the medial edge.

GRAFT FIXATION:

The two free sutured graft ends are fixed into the patellar holes one after each other, using a knotless anchor system, achieving a direct anatomical graft fixation. The suture loop is then used to pull the graft in between layer 2 and 3 to the femoral insertion. Next, a Nitinol wire is inserted into the femoral drill hole and the suture loop of the graft is pulled laterally using the guide wire. Finally, while maintaining equal tension on both bundles, the graft is pulled into the femoral socket. Since biomechanical studies have shown that the MPFL has its maximal length and restraint against patella lateralisation in 30° of flexion [3], with the lateral patellar edge positioned in line with the lateral trochlear border using a bioreabsorbable interference screw. An anatomical femoral insertion avoids an overcorrection, since an overtension of the graft can only occur if the femoral tunnel is placed too far anterior or proximal. In this case, the insertion point would move towards posterior in flexion, leading to a lengthening of the distance between patellar and femoral insertion, increasing the load onto the graft, and consequently, onto the patellofemoral joint.

If adequate medial restraint has been restored, lateral patellar dislocation should no longer be possible and routine skin closure is performed after reattaching the aponeurosis of the VMO back to the medial edge of the patella with resorbable sutures.
DISCUSSION

The most important finding and improvement in using the above described technique was the possibility of an immediate full range of motion due to the aperture fixation at both sides. The benefit of anatomic graft positioning in ligament reconstruction has been known for a long time and has been clearly demonstrated in ACL reconstruction. Anatomical reconstruction of the MPFL is particularly important as biomechanical studies have demonstrated that the length change pattern of a MPFL reconstruction depends critically on the site of the femoral attachment; moreover kinematics change significantly when the patellar or the femoral insertion has been off by only 5 mm [4]. Aside from tunnel placement, graft fixation is the other determining factor in ligament reconstruction [7]. Non-aperture fixation at either the femoral or patellar insertion can increase the risk of a delayed or insufficient tendon to bone healing, which may result in early loosening or slackening of the graft. To avoid this, a restricted range of motion is recommended by some surgeons; however, this may lead to arthrofibrosis, potentially necessitating an additional arthroscopic arthrolysis, carrying the additional risk of damage to the graft.

In recent studies, a tendon transfer is described either to the patella or to the femur for reconstructing the MPFL [11, 12]. However, in these techniques, not only the is transferred muscle weakened in its original motion, but neither the patella nor the femoral insertion can be reconstructed at its anatomical insertion, and the graft used is always a single bundle graft despite the fact that the MPFL consists of a proximal and a distal bundle [3]. This also includes a single point fixation at the patellar side, increasing the rotational moment of the patella in flexion extension movement. In terms of the fixation itself, some techniques fix the graft to the surrounding soft tissue [13] and not to the patellar and / or femoral bone even though a ligament is a structure in between bones, and recent studies have proven the high resistance to failure of tendon-bone interfaces.
While tendon-to-bone tunnel healing is created on the femoral side using a biodegradable screw for fixing the graft loop, the free graft ends are now fixed directly and anatomically into the patella using a biotenodesis device. This technique seems to provide a higher load to failure strength than an earlier described technique, where a laminar attachment of the graft was performed at the patellar side using two suture anchors [6], which may result in loosening of the knot during full range of motion testing; or, the patellar bone may be too soft for a secure anchoring. Knotting the free graft ends to each other at the patellar edge [8] are comparable to a non-aperture indirect fixation in ACL surgery. With the suture anchor technique, a secure graft to bone healing can not be provided in every case and loosening of the graft could occur.

Another technique, looping the graft through the patella provides a very high initial fixation strength and preliminary results are promising [9]. However, if micromotion in the patellar tunnels develops, it may lead to a slackening of the graft at later follow up. However, if the graft is very short, the femoral insertion can not be reached and an overly anterior fixation has to be accepted, leading eventually to an increased patellofemoral pressure or loss of flexion.

For those reasons, we prefer the above described technique with an patellar and femoral aperture fixated double bundle MPFL reconstruction for an immediate stable situation and full range of motion.
REFERENCES:


