MPFL Reconstruction Using Quadriceps Tendon Graft - Our Five Years Expirience

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Abstract: The primary traumatic luxation of the knee cup affects the general population with an incidence of 5.8 per 100,000 (3), while in the younger age group (10-17 years) it goes up to 29 per 100,000. Most patients will not have instability after non-operative treatment, while repeated luxation will occur in 15 to 44% of cases. The use of the quadriceps tendon for medial patelofemoral ligament (MPFL) reconstruction is a method described independently by Steensen *et al*. and Noyes and Albright. Today have more and more supporters because of their simplicity, minimal trauma and good postoperative results. Reconstruction of MPFL with quadriceps tendon (QT) for recurrent patellofemoral instability started in our Clinic in 2014. Indications for surgery were patients who have had clear clinical and radiological signs of instability, tibial tubercle-trochlear groove distance (TT-TG) < 20 mm, dysplastic trochlea grade A according to the Dejour classification. For clinical testing we used apprehension and Veselko's test. In our clinic 22 patients were operated in past fifth years. This study shows result of 17 patients. We noticed a significant improvement in patients in daily activities (instability, swelling, pain, kneeling, squatting, climbing stairs). All patients had full range of motion after approximately 3 months. The initial Lyscholm score value was 69.2 ± 6.4 while after two years 88.3 ± 3,2. Our observation shows that MPFL reconstruction with quadriceps graft in short time follow-up in selected cases may have very satisfactory results. The method itself is simple, inexpensive, with small complication rate and with great patients satisfaction.

Keywords: Traumatic luxation, Patella, Reconstruction, Quadriceps tendon, Medial patelofemoral ligament.

INTRODUCTION

As the largest sesamoid bone in the body, patella has always been an intriguing structure. In the evolutionary scale the human knee dates back 320 million years. The first living organism with knee is Eryops, the common ancestor of reptiles, birds, and mammals. That knee was bicondylar, with a femorofibular articulation, cruciate ligaments, and asymmetric collateral ligaments. The osseous patella developed about 70 million years ago, separately in birds, some reptiles, and in mammals [1]. The basic biomechanical function of the patella is to improve the efficiency of the quadriceps. Increasing the extensor mechanism lever by taking away the patellar tendon from the femorotibial joint. On that way moment arm and quadriceps force enlarges for 30%, as confirmed by Kaufer's cadaveric studies [2].

The primary traumatic luxation of the knee cup affects the general population with an incidence of 5.8 per 100,000 [3], while in the younger age group (10-17 years) it goes up to 29 per 100,000 according to the data [3]. The main consequence of traumatic patella luxation is the injury of the medial soft tissue elements in the first place of the medial patellofemoral ligament (MPFL), a soft-tissue structure first described but not named by Kaplan in 1957 [4]. MPFL is a passive patella stabilizer and its function is to prevent excessive lateral displacement of the patella.

It attaches to the proximal two-thirds of the medial edge of the patella and extends to the Nomura's recess located on the medial side of the femur between the medial epicondyle and the adductor tubercle. The average length of the ligament is 55mm (47-65mm), while the width on the patella is 24 and on the femur is 12mm [5-7]. The MPFL is extremely tense at the extended knee, slightly relaxing between 15 and 30 degrees of flexion. In further flexion from 45 to 135 degrees is slightly tense [5-7]. Biomechanical studies show that the MPFL firing force is 208 N and that elongation is possible up to 26 mm [8-10]. The conclusion is that MPFL is the major medial patella stabilizer because all other soft tissue stabilizers (medial retinaculum, medial patelotibial ligament and medial patelomeniscal ligament contribute to stability between 20 and 40%, MPFL is responsible for 60 to 80% stability. This role is most significant during the first 30 degrees flexion and then the role of the stabilizer is taken over by the geometry of the trochlea, especially the inclination of the lateral trochlear groove [8-10].

Most patients will not have instability after non-operative treatment, while repeated luxation will occur in 15 to 44% of cases [3, 12, 13]. The ligament heals in

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a loosened, lengthened position. This causes instability which makes the patella unstable and repeated dislocations are a common occurrence which leads to damage to the cartilage of the knee. Once damaged cartilage eventually leads to patellofemoral arthrosis, a condition that is much more difficult to treat. For this reason, it is always useful to advice patient's treatment that might prevent further dislocation of the patella.

The operating techniques used to stabilize the knee cup today are described 50 years ago, they are being improved daily with very encouraging clinical results. The use of the quadriceps tendon for MPFL reconstruction is a method described independently by Steensen *et al*. and Noyes and Albright [14, 15] have more and more supporters because of their simplicity, minimal trauma and good postoperative results.

METHODS

Reconstruction of MPFL with quadriceps tendon (QT) for recurrent patellofemoral instability started in our Clinic in 2014. These were patients who had recurrent patella dislocations from 4 to more than 20.

Indications for surgery inclusion criteria: Patients who have had clear clinical and radiological signs of instability, tibial tubercle-trochlear groove distance (TT-TG) < 20 mm, dysplastic trochlea grade A according to the Dejour classification [16, 17]. For clinical testing we used apprehension [18] and Veselko's test. (Figure **1**) Veselko described a test that could determine an injury MPFL and called it a patella tilt test. The knee is stretched out and the examiner pushes with his thumb the lateral edge of the patella into the groove of the trochlea and at the same time the fingers extend the medial edge of the patella. The patella flexion gain is estimated and compared with the inclination on the other, healthy knee. [19], as well as radiological AP, profile and axial view. Most patients had MRI but not all. MRI is of increasing diagnostic importance and according to Balkarek *et al*. there are 4 types of lesions that are diagnosed by MR.

Classification of MPFL injury patterns according to Balcarek *et al*. [11]

Type I MPFL tear at the patellar insertion

Type II MPFL midsubstance injury

Type III MPFL tear at the femoral origin

Type IV Combined injury

The follow-ups after stichches removalwere scheduled after 4 weeks, 3 months, 6 months, one year and two years. Patients completed the questionnaires preoperatively and at the check-ups (Lysholm score)

Figure 1

Surgical Technique

Surgeries were performed under regional anesthesia in supine position. Pre-operatively the fluoroscope approach and the range of knee movement from 0 to 120 degrees are checked.

Longitudinal incision at the anterior aspect of the knee about 5-7 cm long, starting at the 2 cm above patella base in line with midpoint of the patella and progressing proximally. Blunt dissection with dry gauze removes the adipose tissue and exposes the quadriceps tendon. The graft is taken from the superficial layer of the tendon in the region of the patellar insertion where it is trilaminar. The superficial lamina comprises the rectus femoris. The middle lamina comprises the medialis and vastus lateralis, and the deeper lamina comprises the vastus intermedius. The safest place for identifying a superficial lamina is around 2 to 3 cm proximal to the proximal pole of the patella (Figure **2**). After identification superficial lamina a small T retractor is inserted between laminas and lift superficial. Plane of separation has been identified and now it is very easy to continue dissection proximally and distally. The usual width of the graft taken from the middle third is 10-12 mm, thickness 2-3 mm, length is individual from 9 to 13 cm in our experience (Figure **3**). The proximal end of tendon is separated from the muscle. Special attention is patellar insertion of tendon, which must remain intact. The existing gape on quadriceps tendon is closed with resorbable No 2-0 sutures (Figure **4**). Free proximal end of QT strip is

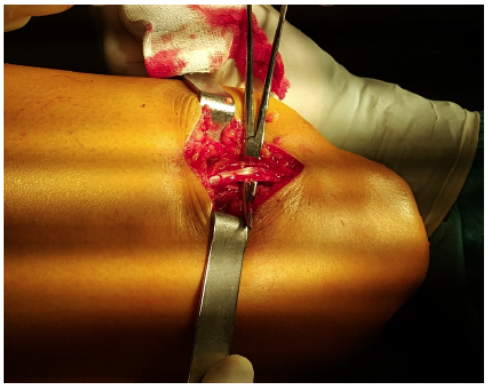

Figure 2

Figure 3

Figure 4

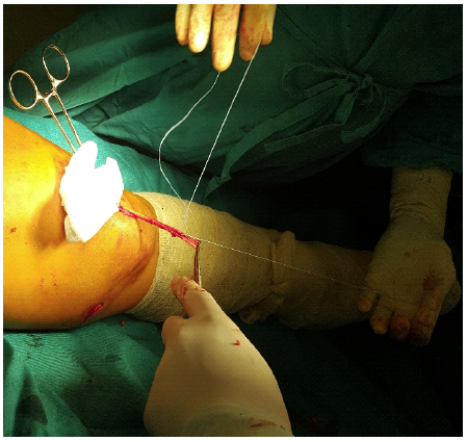

Figure 5

armed with Fiber tape sutures with web-stitch technique (Figure **5**).

A second 1.5 cm long incision is made in the middle of an imaginary line connecting the medial epicondyle and the adductor tubercle previously identified by palpation. (Figure **6**) Through this incision surgical curved clamp was introduced in a space between vastus medialis and joint capsule. Starting from medial border prepatellar tissue was elevated laterally creating tunnel and reaching medial edge of the graft. (Figure **7**) After grasping suture loop, graft is then pull through the tunnel. (Figure **8**) We didn't secure graft with stiches on medial border of patella as original technique requires and didn't find any significant difference.

Figure 6

Figure 7

Figure 8

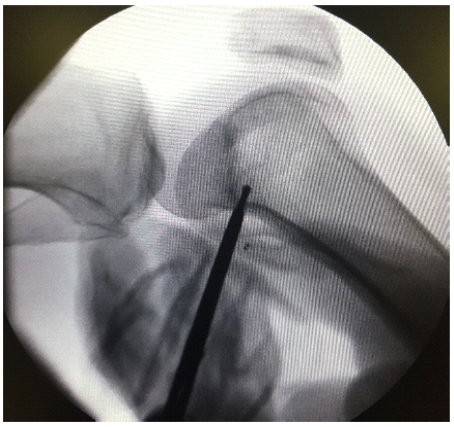

Figure 9

Figure 10

Figure 11

Under fluoroscopic guidance (Figure **8**) we are looking for the spot that crossing Blumenstat line and extension of line that goes on the back side of femur because there is the region of insertion of MPFL. (Figure **9**) The knee was cycled several times with moderate tension of graft previously temporary fixed on chosen spot, looking and checking lateral displacement of patella that cannot be larger than 2 cm. Fixation was performed with Push lock anchor at 20 degree of knee flexion with lateral patellar border flush with lateral border of trochlear groove. (Figure **10**) Closure of wounds by anatomical layers (Figure **11**).

Postoperative Treatment

A knee brace with range of motion (ROM) 0-20 degree or long leg cylinder cast in full extension for three weeks with partial weight bearing. Passive range of motion up to 90 degree was allowed after one month and increasing as tolerated thereafter. Full return to normal activities after 3 months and to pivoting sports after 5 months.

RESULTS

In our clinic 22 patients were operated in past fifth years. This study shows result of 17 patients. More than two years have passed in 19 operated patients but two did not come for follow-up after 24 months and were therefore not included in the statistics. The majority of patients had sports injuries including those with injuries during military training (11 patients 65%). Fall from a height (3 patients 17.6%), during daily activities (3 patients 17.6%). The mean age of the patients was 26.5 ± 3.5 years, 11 men's and 6 women's. During the two-year follow-up of the operated patients, we had no recurrence of patellar instability.

We noticed a significant improvement in patients in daily activities (instability, swelling, pain, kneeling, squatting, climbing stairs). All patients had full range of motion after approximately 3 months. Although 5 patients underwent surgery without fluoroscopy but postoperative X ray showed correct anchor position. The initial Lyscholm score value was 69.2 ± 6.4 while

after two years 88.3 ± 3,2. the results we obtained are consistent with existing data [20, 21].

Complications: We had two patients with persisting apprehension test and one occurrence of scar hypertrophy at the place where the graft was taken, which was confirmed by ultrasound. After two months and adequate rehabilitation, the tumefaction disappeared (Figure **12**).

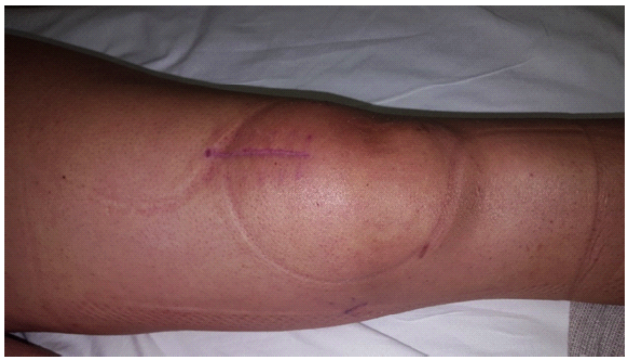

Figure 12

DISCUSSION

Patellofemoral pathology is extremely complex and only few of its aspects can be solved by MPFL reconstruction. MPFL reconstruction are indicated when there is a loss of function of the passive medial patella stabilizers, which must be demonstrated by clinical examination and x-rays. Candidate for MPFL reconstruction has minimal pain between episodes of luxation and comes to the orthopedist due to occasional dislocation of the patella not because of pain [22, 23]. Reconstruction of MPFL is not indicated if the only symptom is isolated patellofemoral pain, if degenerative changes in patellofemoral joint are present and if there is excessive lateral inclination of the patella or excessive lateral displacement without instability. The predisposing factors are overstretched fascia lata, muscle imbalance of vastus medialis and lateralis muscles, hypoplasia of lateral condylar groove as well as increased Q angle

There are many different MPFL reconstructions today that differ in graft choice and fixation mode. To this day it does not exist clinical evidence which confirms that one technique is better than other. The goals of MPFL reconstruction are to establish an anisometric position of the patella that permits mobility.

Anatomical studies describe the MPFL as a very thin fascial band with a width of 3-10 mm at the femoral attachment 10 to 30 mm at the medial edge of the patella [24, 25]. This structure and shape do not resemble hamstring graft whose typical stiffness is 171 N / mm (+/- 11) [26]. Therefore, higher and non-physiological stiffness results from a structural difference. The quadriceps tendon flap on the other side with a width of 10 mm and a depth of 3 mm imitate the original MPFL structure sufficiently [27].

Hamstring grafts are far more common for MPFL reconstruction than quadriceps tendon techniques. These procedures document a high rate of success for the patients with patellofemoral instability [28]. Still, there are failures of these procedures. One of the MPFL complications are patella fracture which use tunnels to fixate the graft. The numbers of patellar fractures post MPFL reconstruction ranged from 0.45% to 2.25% [28]. Another common complication of this method is reduction of knee flexion [29]. In our Clinic we worked according to the method by Steensen *et al*. described by 2005 [14]. Only the surface layer is taken for the graft so that it is 10 and 12 mm wide and about 10 cm long. At the base of the patella, the lateral part of the graft is only subperiosteally separated if it then rotates 90 ° medially and rotates about 180 ° about its axis. In this way, a 45 ° angle is formed at the point where the graft is folded. Unlike the original method, we did not fix the graft with patella seams. The free (proximal) part of the graft is extruded between the medial retinacular layers extracapsular and is drawn through an additional cut of skin that is made about 2-3 cm in length above the adductor tubercle [30]. Diverging the tendon strip underneath the prepatellar tissue improves healing and provides a more anatomic fixation of the QT strip [29]. Dissection of the graft on the anterior surface of the patella is crucial because graft amputation can take place if the subperiosteal plane is missed. At the medial border of the patella is required to gain access to the subvastus space [31]. Advantage of the quadriceps tendon technique is a remaining attachment of the tendon at the proximal patella pole at anatomical position of the MPFL.

The positioning of the femoral tunnel at the medial femoral condyle seems to be a crucial step for physiological reconstruction and prevention of high patellofemoral joint pressure [27]. Using an image intensifier in flexion position of 20-30° we get close MPFL insertion to its anatomical position, which was the best position of MPFL to prevent the movement of patella laterally. On this way we prevent over-correction and medial shifting of the patella. Over-tensioning of the graft must be avoided, and only the optimized graft length should be selected before performing femoral

fixation. Changes in location of MPFL on femoral insertion can cause lax MPFL during knee extension and tense MPFL during knee flexion. Consequence is reduction of flexion and also pain, discomfort and degeneration of patellar cartilage [32]. There are two potential intraoperative complications: QT strip could peel off from bony surface of patella and that QT strip could be too short.

Different rehab protocols are used after MPFL reconstruction. We choose immobilization for three weeks in extension or in brace with limited movement up to 20° and partial weight bearing because we didn't strengthen graft with stiches on prepatellar tissues. The reason for this was to give time to the graft to attach in the soft tissue prepatellar tunnel.

CONCLUSION

Repeated dislocations of the patella may occur in a large percentage of patients with a history of acute dislocation. Despite the large number of operations currently in place, there is no gold standard as shown by meta-analyzes [33]. Our observation shows that MPFL reconstruction with quadriceps graft in short time follow-up in selected cases may have very satisfactory results. The method itself is simple, inexpensive, with small complication rate and with great patients' satisfaction. Equally important is the preservation of the gracilis tendon. Our study, as well as many in the world, show that the reconstruction of the MPFL by quadriceps tendon graft is deserving attention and our desire is to encourage other orthopedic surgeons in other hospitals to begin its application in their work.

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