Chapter

Injuries of the Posterolateral Corner of the Knee-Diagnosis and Treatment Options for Beginning and Advanced Arthroscopic Surgeons

Adrian Góralczyk, Piotr Jancewicz and Krzysztof Hermanowicz

Abstract

Injuries to the posterolateral corner (PLC) of the knee may have a devastating impact on whole joint. Posterolateral rotatory instability, despite getting more and more popular among orthopedic surgeons, still remains challenging to diagnose and even more challenging to treat. Available surgical techniques are demanding and require advanced surgical skills. In this chapter we are going to review the diagnostic tools which help to recognize posterolateral rotatory instability of the knee, to outline its importance and consequences of misdiagnosis as well as present arthroscopic popliteus tenodesis and arthroscopic-assisted posterolateral corner reconstruction which are our minimally invasive techniques used to treat this condition depending on PLC injury pattern and grading. Presented techniques are reproducible, safe and do not require advanced surgical skills being a useful alternative for available open PLC reconstructions.

Keywords: posterolateral corner of the knee, popliteus tendon, lateral collateral ligament, multiligament knee injury, popliteus tenodesis, arthroscopic posterolateral corner reconstruction

1. Introduction

When it comes to the traumatic soft tissue injury of the knee, the patient is always afraid of having a meniscus or cruciate ligament lesion. Despite the widespread disrepute of meniscal, cruciate ligaments or isolated collateral ligaments tears, the management and treatment options are well-established with scientifically proved good results. More challenging remain acute and chronic rotatory instabilities of the knee which require a high grade of suspicion to be recognized, a broad knowledge of anatomy and biomechanics to determine injured structures and properly addressed them and, finally, have a debilitating influence on the whole knee joint when left unrecognized [1–3].

One of the most common rotatory instability pattern is a posterolateral rotatory instability (PLRI), which is a consequence of injuries to the structures of so-called posterolateral corner (PLC) of the knee. This anatomical and functional region of the knee consists of many static and dynamic stabilizers from which the most important are three: fibular collateral ligament (FCL), popliteus tendon (PLT) and popliteofibular ligament (PFL). The others involve iliotibial band (ITB), biceps femoris tendon (BT), posterolateral knee capsule, fabello-fibular ligament [4, 5]. From three main stabilizers mentioned above, the FCL works as a primary restraint to varus stresses, especially close to knee extension, whereas PLT and PFL plays a crucial role in limitation of tibial external rotation. Furthermore, the PLT provides antero-posterior stability in 30° of knee flexion and, working as a dynamic stabilizer, actively rotates the knee internally [4, 6, 7].

Typical mechanisms of injury to the PLC involve knee hyperextension with varus deformation like for example direct hit to the anteromedial region of tibia, forced external rotation with the foot fixed on the ground, mostly during sport activities, but also motorbike or vehicle accidents as a part of complex knee injuries [4, 5, 8]. The PLC injuries account for 16% of all knee ligamentous injuries, but only 28% of them are isolated [5, 6]. Usually they are associated with anterior cruciate ligament (ACL) or posterior cruciate ligament (PCL) tears [5]. Non-recognition of PLRI concomitant with ACL or PCL tears may lead not only to unsatisfactory clinical results of surgical treatment, but also to reconstruction failures and further revision surgeries [9]. Thus, an adequate diagnosis and management of PLC injuries are essential for the knee joint well-being.

2. Diagnosis of posterolateral corner injury

Patient with PLRI of the knee may present with a history of knee sprain with hyperextension or direct hit to the anteromedial region of tibia, forced external rotation with the foot fixed on the ground during sport activities or motorbike accident. The patient usually complains on pain in posterolateral or lateral region of the knee, side-to-side instability close to full extension, difficulties in going up- and downstairs, inability to perform sports activities [4, 5].

In acute setting it is essential to rule out neuro-vascular injuries concomitant to PLC injury. Popliteal neuro-vascular bundle and common peroneal nerve are at risk during knee injuries leading to PLC tears. Moreover, it is very important to assess other intra- and extra-articular structures like ACL, PCL, menisci and exclude their lesions, because isolated PLC tears are rare [6].

The patient suspected for PLC tear should be assessed during gait, standing and lying on the examination table [4, 6, 8, 10]. Chronic PLRI may lead to so-called "triple-varus", which is an evolution from anatomical knee varus through weight-bearing varus to "varus thrust gait", when the knee developed excessive varus and hyperextension during the stance phase of gait [8]. Many clinical tests have been developed and are widely used to assess the structures of the PLC:

- Varus stress test in 0° and 30° of flexion
  This test is positive when applying a varus force to the knee leads to excessive opening of lateral joint space without firm endpoint. If positive in 30°, it suggests the FCL tear. If positive in both 0° and 30°, it suggests more complex lesion of PLC.

- Posterolateral drawer test and posterolateral external rotation test
  The test is performed in 30° and 90° of knee flexion. When applying posterolaterally directed force, excessive tibial translation and external rotation may be observed (**Figure 1**).

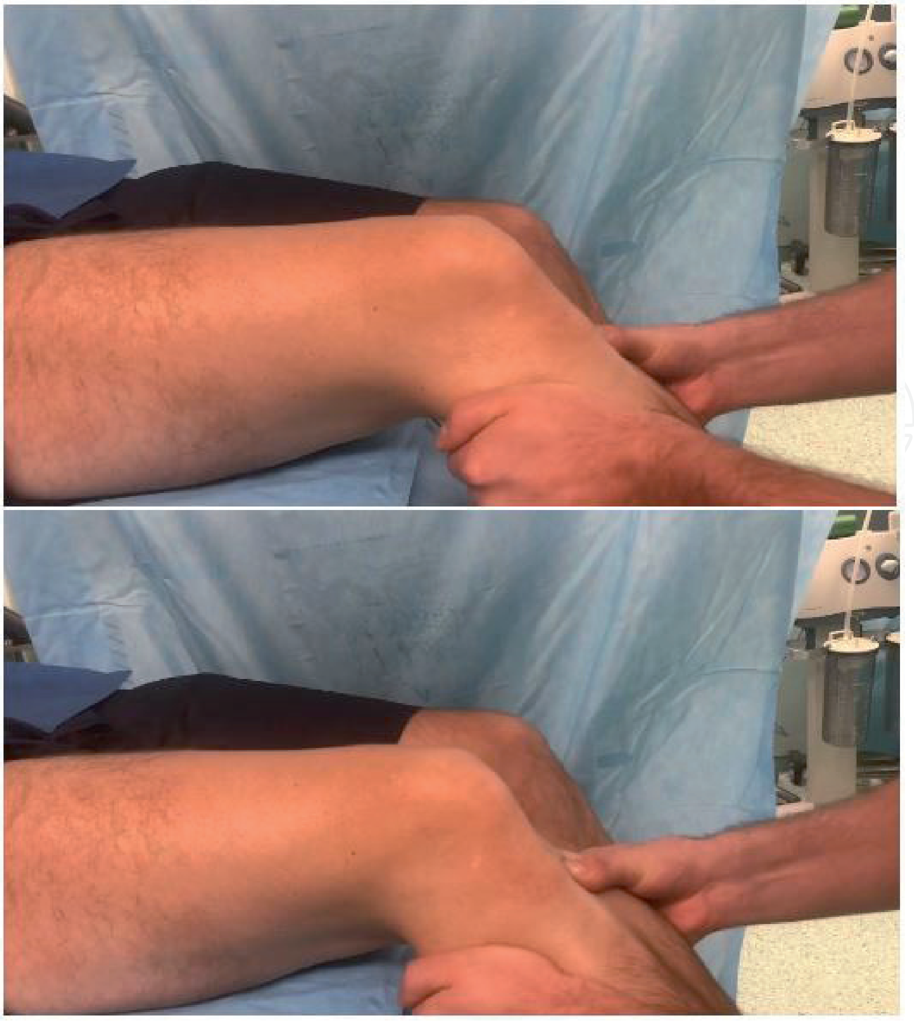

Figure 1.
Posterolateral drawer test performed in the right knee on the operating table. Upper image presents starting point and in the lower picture excessive posterolateral tibial translation with external rotation can be observed under loading.

- Dial test in 30° and 90° of flexion
  Having the patient lying prone, with stabilized thighs, passive tibial external rotation of both lower extremities is being compared considering feet positions. Asymmetric increased in external rotation in 30° suggests injury to the PLC, but asymmetric increased in external rotation in both 30° and 90° implies injury to the PLC and PCL.

- Reverse pivot-shift test
  Starting from from 90° of flexion, the knee is gradually extended with valgus and tibial external rotation applied. In case of PLC tear, posteriorly subluxed tibia is reduced in 30–40° of knee flexion by ITB, which changes its function from flexor to knee extensor.

- External rotation recurvatum test
  Having the patient lying supine, with stabilized thighs, both great toes are grasped and feet lifted by the physician. The knee with PLC injury presents hyperextension and varus deformity.

Other tests like Lachman test, anterior drawer test, posterior drawer test, valgus stress test, different meniscal tests are used to rule out concomitant lesions depending on examiners preferences and experience [4, 6, 8, 10].

Imaging studies are important in diagnosis of PLC injury. Classic anteroposterior and lateral X-rays are used to exclude fractures in acute setting and to assess any degenerative changes existence. Long-leg X-ray is necessary in chronic cases to rule out excessive varus deformity which may require correction before soft-tissue surgeries. Both knees stress X-rays performed in 20° of flexion may reveal asymmetric lateral joint space opening. Side-to-side difference in lateral gapping about 2.7 mm may indicate isolated FCL tear, whereas the difference above 4 mm represents complex PLC injury [11]. Magnetic resonance imaging (MRI) may be a useful technique to diagnose PLC injury in acute setting, but after 12 weeks from initial trauma only 26% of PLC tears are diagnosed this way [4]. Signs of PLC tears which may be observed on MRI scans are arcuate sign, which is an avulsion fracture of fibular head, avulsion or interstitial-type tear of ITB typically close to tibial attachment, BT tear close to fibula, FCL tear usually close to fibular or tibial attachment, rarely mid-substance, PLT injury usually localized on myotendinous junction [12]. It is worth noting that an abundant signal abnormality in the region of the posterior capsule is usually present in case of PLC tear [12]. **Figure 2** presents injury to the PLC of the knee on sagittal MRI scan. Furthermore, MRI allows to rule out other intra- and extra-articular pathologies like cruciate ligament and menisci tears or chondral lesions.

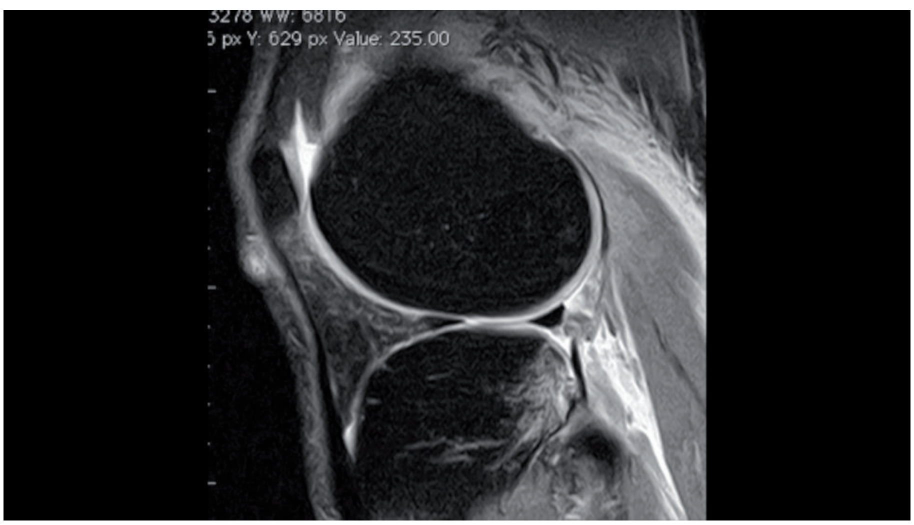

Figure 2.
Sagittal MRI scan of the right knee with PLC injury. Abnormal signal is observed in the region of posterior knee joint capsule.

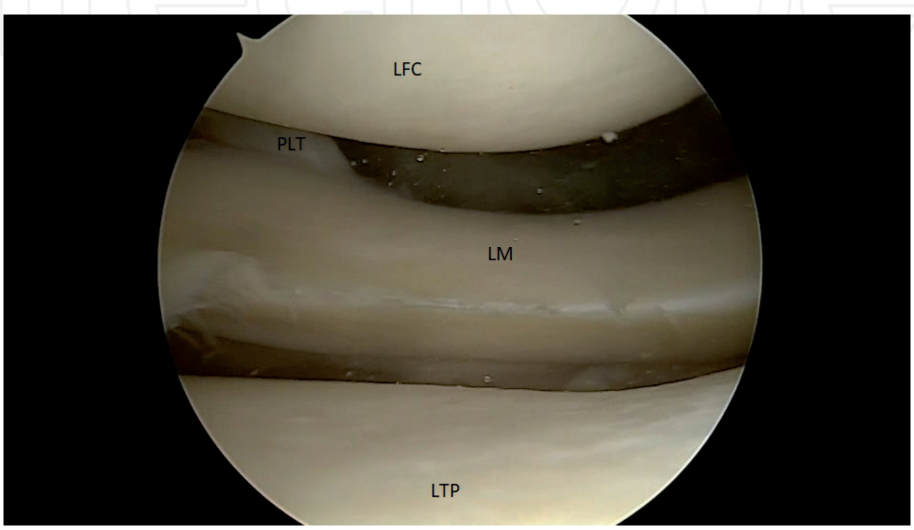

Figure 3.
Arthroscopic view from anterolateral portal in the right knee in figure-of-four position. "Drive-through sign" is visible. LM- lateral meniscus, LFC- lateral femoral condyle, LTP- lateral tibial plateau, PLT- popliteus tendon.

Arthroscopy is no longer only diagnostic procedure. Every surgeon who decided to scope the knee is obligated to treat recognized intra-articular lesions. The direct sign of PLC injury observed during diagnostic part of knee arthroscopy is so-called "drive-through sign" and involves lateral joint space widening with elevation of lateral meniscus (LM) in the figure-of-four position (**Figure 3**). In our practice this sign is very important in decision-making process. **Table 1** summarizes the pearls and pitfalls in diagnosis of PLC injuries.

There is a lack of comprehensive classification system which could cover all aspects of PLC injuries [10]. The most commonly used is classification developed by Fanelli and Larson which is presented in **Table 2** [13].

PLT- popliteus tendon, PFL- popliteofibular ligament, FCL- fibular collateral ligament, ER- external rotation.

Point of evaluation	Pearls	Pitfalls
Clinical exam		
Varus stress test	Perform in 0 and 30°. Positive indicates more complex PLC injury.	Patient may guard during examination. Try to eliminate muscle contraction.
Posterolateral drawer test Posterolateral external rotation test Dial test Reverse pivot-shift test External rotation recurvatum test	Always compare to the uninjured side. Choose 2–3 tests and train them. Dial test is useful to differentiate isolated PLC injury and concomitant PCL injury.	Tibial external rotation may be increased also in anteromedial rotatory instability.
Lachman test, anterior and posterior drawer, meniscal tests.	Rule out other ligamentous and meniscal lesions.	Lachman test may be positive due to PLT injury, anterior drawer may be false positive in complex PLC/ PCL injuries.
Imaging		
X-ray Stress X-ray MRI	Rule out fractures. Segond, reverse Segond fracture and tibial head fracture are avulsion fractures due to pull of ligaments. Useful in assessing intra-articular pathologies.	X-ray does not directly assess soft tissue conditions. Stress X-rays difficult to perform in some countries. Poor sensitivity in diagnosis of PLC injuries especially > 12 weeks.
Arthroscopy	Look for "drive-through sign".	It is difficult to directly assess PLC injury.

Table 1.
Summarizes the pearls and pitfalls in diagnosis of PLC injury.

Grade	Injured structures	Instability pattern
A	PLT + PFL	Increased tibial ER
B	PLT + PFL FCL attenuation	Increased tibial ER Slightly increased lateral joint space opening
C	PLT + PFL FCL tear, capsule tear Commonly cruciate ligaments tear	Increased tibial ER Excessive lateral joint space opening Sagittal plane instability

Table 2.
Posterolateral corner injuries classification according to Fanelli and Larson [13].

3. Current surgical treatment options

Numbers of surgical techniques have been developed for treatment of PLC injuries what outlines that it is a very complex problem and no simple solution does exist [7, 9, 14–20]. Among them one can differentiate 3 types of procedures: tightening of injured structures, PLT bypass and anatomic reconstructions [9, 21]. Anatomic reconstructions, in turn, involve fibular-based and tibio-fibular based techniques [4]. Most anatomic techniques focus on reconstruction of three main stabilizers of the PLC: FCL, PLT and PFL. However, it has been emphasized that concerning surgical techniques, individual PLC structures should be reconstructed only if injured, avoiding reconstruction of that are not damaged [10]. Thus, a proper diagnosis of injured structures is a key to success in surgical treatment and Fanelli and Larson classification mentioned above may be a helpful tool in considering surgical approach. It is worth noting that in case of chronic PLC injury the success rate of surgical management is about 90% [21]. However, detailed description of each available technique for PLC tears treatment is far beyond the scope of this chapter. Interested readers we send to positions from literature [14–20].

When last two decades have provided a comprehensive knowledge about anatomy and anatomical reconstructions of PLC, especially due to studies of dr Laprade and his groups, last years brought a great development in arthroscopic surgery and shift from open to arthroscopic procedures based on previous assumptions [20]. The reasons of these changes were that open PLC reconstructions, despite their effectiveness, are very invasive procedures. They require a broad surgical approach with poor esthetic results, which some patients do not accept, and enforce less aggressive rehabilitation protocol. It causes a longer recovery after surgery. Moreover, common peroneal nerve neurolysis is obligatory [15]. Arthroscopic surgeries have many advantages including better visualization of anatomical landmarks, lower infection rates, lesser amount of scar tissue, less post-operative pain, faster rehabilitation, better protection of common peroneal nerve without obligatory neurolysis [21]. Another advantage of arthroscopic surgery for PLC injury is its proved reproducibility and high accuracy in tunnel placement during reconstructions [7]. However, most arthroscopic techniques require maneuvering in popliteal fossa and trans-septal portal placement, what puts at risk popliteal neuro-vascular bundle. Thus, these techniques are reserved for very experienced arthroscopic surgeons.

Following sections of these chapter will present arthroscopic popliteus tenodesis and minimally invasive arthroscopic-assisted PLC reconstructions which are techniques for PLC injuries developed and used with success for many years by senior authors (K.H, P.J) [22, 23]. Indications, contraindications, advantages, disadvantages and surgical details will be explained.

4. Arthroscopic posterolateral corner stabilization with popliteus tenodesis

4.1 Indications and contraindications

Indication for this procedure is a posterolateral rotatory instability of the knee grade A according to Fanelli and Larson classification (**Table 2**) [22]. It can also be used in grade B and C PLRI as a part of combined procedure with reconstruction of other structures of the PLC. The main purpose of this technique is to prevent excessive tibial external rotation. Secondly, it allows to reduce posterior tibial subluxation caused by PLC injury.

The contraindications are: damaged femoral attachment of PLT, complete mid-substance PLT tear without scar formation, excessive varus deformity of the knee, advanced osteoarthritis, rheumatoid arthritis.

4.2 Rationale for using arthroscopic PLT tenodesis

The rationale for using arthroscopic PLT tenodesis are facts that most popliteus tears are extra-articular, involving usually the muscle or myotendinous portion and in chronic cases sulcus popliteus is usually covered by popliteus tendon and/or scar tissue [7, 12]. Thus, the PLT is still presented in its anatomical location, despite losing its function. Moreover, it has been proved that anatomic reconstruction of the passive part of PLT significantly restores proper range of tibial external rotation [24].

Presented technique does not require advanced skills in arthroscopic surgery, is safe and reproducible, does not exhaust other surgical options.

4.3 Arthroscopic PLT tenodesis-surgical technique

The patient is positioned supine with a thigh tourniquet applied on operated leg, which is placed in a leg holder. The procedure is performed using standard anterolateral (AL) and anteromedial (AM) portals. After arthroscopic inspection of whole knee joint and excluding other intra-articular pathologies, the arthroscope is inserted to the lateral knee recess and PLT unit is visualized (**Figure 4**). With the knee in full extension an additional mid-lateral portal is placed 1,5 cm above the fibular head, just anterior or posterior to FCL depending on better angle of attack determined with a marking needle (**Figure 5**). It is important to stay anterior to BT to avoid common peroneal nerve injury. Then, under visual control, Pean's forceps with fastened one end of suture tape (FiberTape, Arthrex, GmBH Munich, Germany) are inserted behind the PLT to the posterolateral knee recess, the tape is introduced to lateral knee compartment using an arthroscopic grasper and then it is pulled out the joint through mid-lateral portal with Pean's forceps making a ring around the PLT at the level of planned place for tenodesis (**Figure 6**). The ideal point for PLT fixation is the crossing of the horizontal line at the tip of fibular head with vertical line at the medial edge of fibular head, 1 cm below the joint line [7].

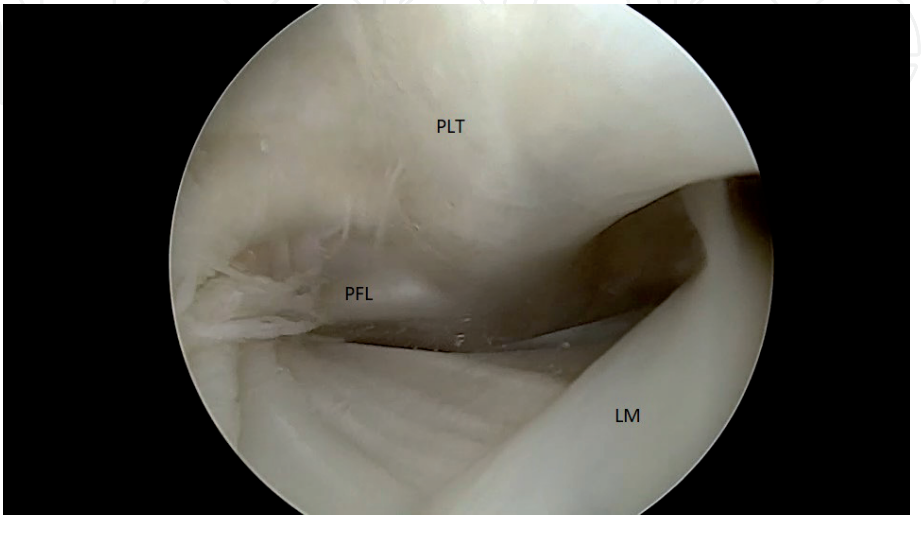

Figure 4.
Arthroscopic view from anterolateral viewing portal in the right knee with the arthroscope in lateral knee recess. Popliteus muscle-tendon unit may be observed. PLT- popliteus tendon, PFL- popliteofibular ligament, LM- lateral meniscus.

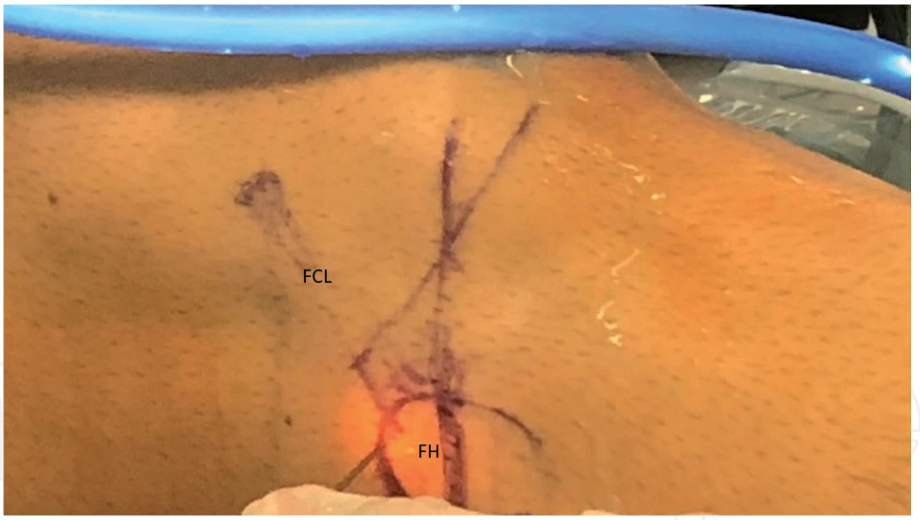

Figure 5.
A marking needle is used to determine the proper place for mid-lateral portal placement in the right knee. FH- fibular head, FCL- fibular collateral ligament.

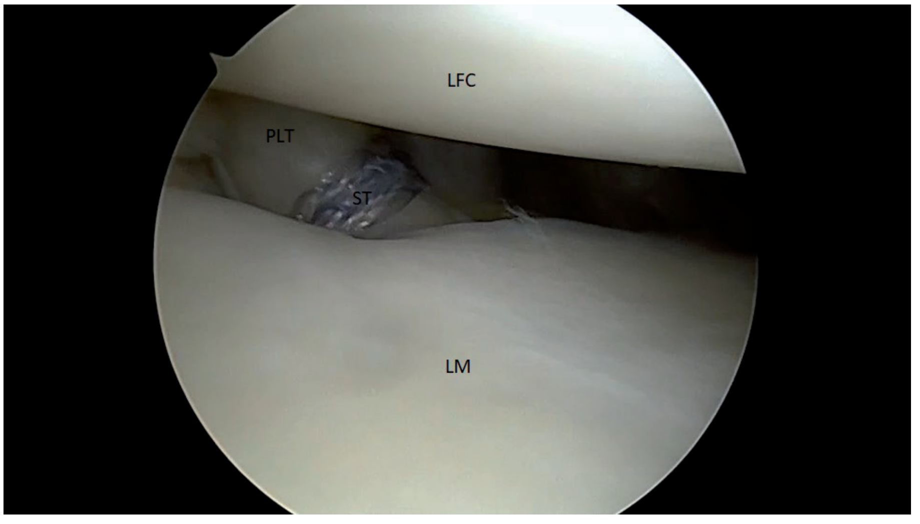

Figure 6.
Arthroscopic view from anterolateral viewing portal in the right knee. Suture tape (ST) rounded the popliteus tendon (PLT) right before making a tenodesis. LFC- lateral femoral condyle, LM- lateral meniscus.

In this place the proximal part of tibial popliteus aiming guide (senior author K. H prototype) is fixed and the distal part is positioned on the anteromedial tibial cortex, just below the pes anserinus where a small skin incision is made. Both parts of the aiming guide are connected and the eyelet pin is drilled through tibia (**Figure 7**). For advanced arthroscopic surgeons it is possible to drill the tibia with an eyelet pin using a free-hand technique after positioning the tip of pin in the proper place for PLT fixation which was previously described. Then, using a 6 mm drill, a 2-cm depth bone sockets are formed in the posterolateral and anteromedial cortex of the tibia. After that, free ends of suture tape rounding PLT are passed through the eye in an eyelet pin and the pin is pulled-out through the anteromedial tibial cortex introducing the PLT into bone socket. Free ends of suture tape are tied on the cortical button placed in the socket on the anteromedial tibial cortex. The tension of tenodesis is regulated by twisting the cortical button with Pean's forceps under arthroscopic control until the drive-through sign and lateral meniscus elevation are eliminated in the figure-of-four position (**Figures 8** and **9**).

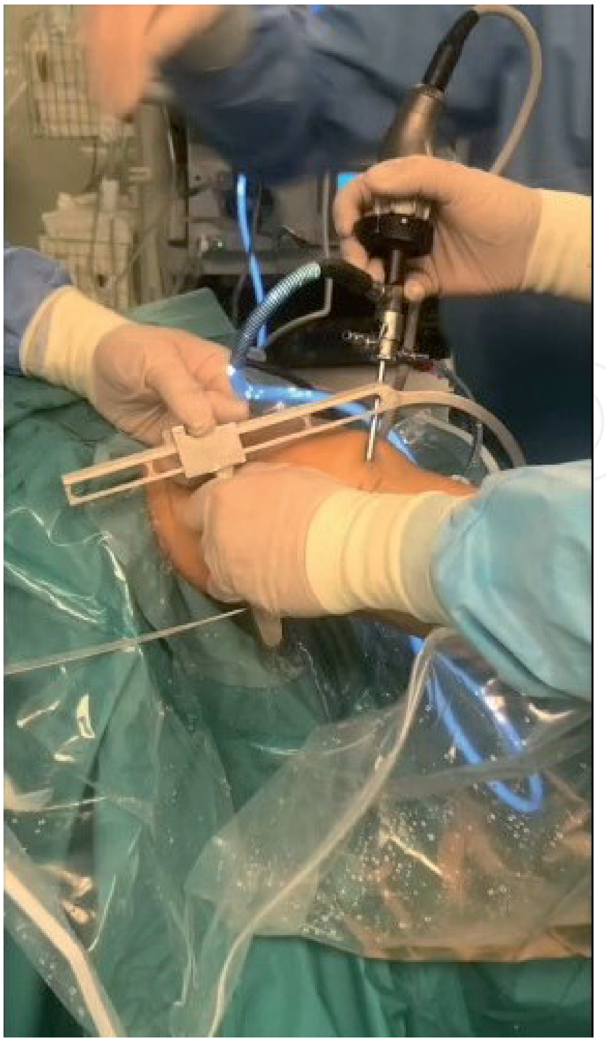

Figure 7.
The right knee. The tibial popliteus aiming guide (K.H prototype) is positioned from posterolateral to anteromedial tibial cortex and the eyelet pin is being used to drill the tunnel.

4.4 Postoperative rehabilitation

After surgery the knee is immobilized in a brace with limited knee extension (30–90°) for 6 weeks. Passive knee motion starts from the second day after surgery. Walking on crutches is recommended for 6 weeks after surgery. Supervised rehabilitation program with experienced physiotherapist is advised. The rehabilitation protocol is similar to this widely-accepted for PCL reconstructions.

4.5 Advantages and disadvantages of PLT tenodesis

The main advantage of arthroscopic PLT tenodesis is that this is a minimal invasive technique utilizing native, vascularized material present in the joint. It does not require harvesting grafts and does not exhaust other treatment options. It allows to restore static PLT function. Presented technique does not demand advanced arthroscopic skills and may be useful for beginning arthroscopic surgeons treating PLRI with dominant external rotation component. Following described technique it is a safe procedure because is performed far from common peroneal nerve and does not require maneuvering in the posterior knee close to the popliteal neuro-vascular bundle. Positioning the tunnel in the tibia from posterolateral to anteromedial facilitates utilizing this surgery without special instruments making it a cost-effective procedure.

Figure 8.
Tensioning of the tenodesis by twisting the cortex button with Pean's forceps until the drive-through sign is eliminated.

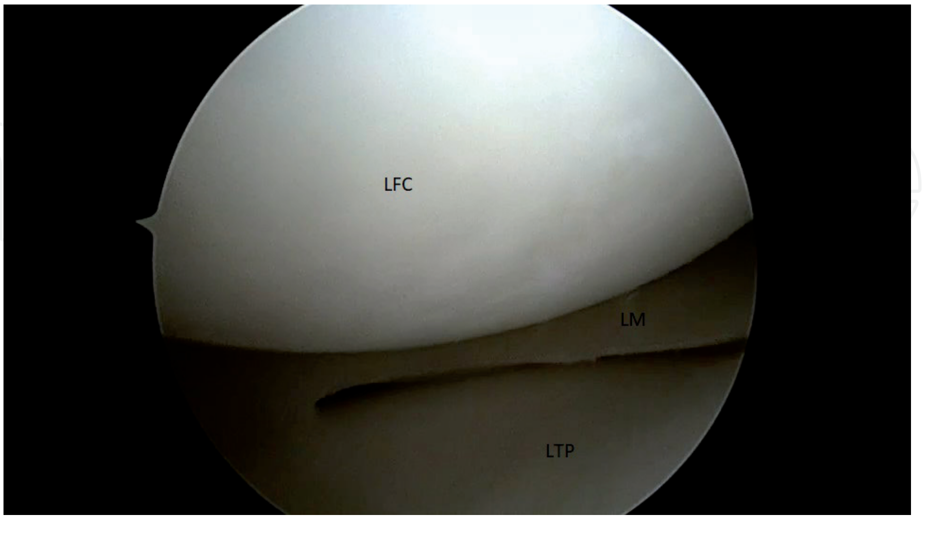

Figure 9.
Eliminated drive-through sign. LFC- lateral femoral condyle, LM- lateral meniscus, LTP- lateral tibial plateau.

Main disadvantage of presented technique is that it is limited to grade A PLRI and higher grades with varus instability require additional FCL reconstruction. Moreover, reconstruction of PFL is not possible. Being focused on static PLT function, its dynamic function may be lost. Furthermore, there is a risk of PLT or LM injury during mid-lateral portal formation. It is also worth noting that knee extension deficit may exclude applying this technique.

5. Arthroscopic-assisted anatomic PLC reconstruction

5.1 Indications and contraindications

The indications for this complex procedure are grade B and C PLC injuries according to Fanelli and Larson classification, especially when varus instability requiring FCL reconstruction is presented and excessive tibial external rotation which cannot be treated with PLT tenodesis is observed [23].

The contraindications are excessive varus deformity, poor bone quality, advanced degenerative joint disease, rheumatoid arthritis, limited range of motion.

5.2 Rationale for using arthroscopic-assisted anatomic PLC reconstruction

The rationale for using presented technique is a scientifically proved efficacy of anatomic PLC reconstructions in treatment of PLRI. Presented technique allows for a stepwise approach and management only this structure which has been damaged-PLT or FCL, or both. Whereas FCL reconstruction is obligatory in case of chronic lateral instability, in many patients the external rotation component of PLRI may be addressed with PLT tenodesis. However, when PLT femoral attachment is damaged or complete mid-substance tear occurs, anatomic PLT reconstruction is necessary.

5.3 Arthroscopic-assisted anatomic PLT reconstruction-surgical technique

The patient is positioned supine with a thigh tourniquet applied on operated leg, which is placed in a leg holder. The procedure is performed using standard antero-lateral (AL) and anteromedial (AM) portals. When the diagnosis of PLC injury is confirmed, semitendinosus tendon (ST-T) is harvested, prepared as a graft and double folded on the suspensory fixation device. Then, additional arthroscopic portals are created: mid-lateral, which was described in the section about PLT tenodesis, and high mid-lateral portal, which is situated at the level of PLT femoral attachment. A retraction suture may be placed on PLT to facilitate maneuvering. With the knee in full extension tibial popliteus aiming guide (K.H prototype) or an ACL tibial aiming guide is used to create tibial tunnel for PLT reconstruction. Senior author prototype allows to drill the tunnel from posterolateral to anteromedial direction without the risk of uncontrolled common peroneal nerve injury, whereas an ACL aiming guide enforces the surgeon to drill in anteromedial-posterolateral direction. The tibial tunnel should be positioned as it was previously described for PLT tenodesis. The drill matched to the size of the graft is used to create the tunnel. Then the knee is flexed to 90°. An eyelet pin introduced through high mid-lateral portal is placed in the PLT femoral attachment and used as an aiming guide to direct the femoral tunnel to the point just above the medial femoral epicondyle. Then the drill matched to the size of the ST-T graft is used to create the tunnel. A passing suture is passed through the eye in the eyelet pin and the pin is pushed medially to introduce the passing suture into the femoral tunnel. The second passing suture is grasped with an arthroscopic grasper inserted through tibial tunnel and pulled out through tibial tunnel outside the joint. It is important to have both passing sutures in mid-lateral portal without tissue bridges between them. At first, the ST-T graft is passed with passing suture through tibial tunnel, then passed below the skin and introduced with the second passing suture to femoral tunnel. The graft is fixed on medial femoral cortex with suspensory cortical device and on the anteromedial tibial cortex with cortical button (**Figure 10**). In this way an anatomic PLT reconstruction was performed.

5.4 Minimally invasive anatomic FCL reconstruction-surgical technique

The procedure starts from harvesting gracilis tendon (GT-T). The graft is prepared and double folded on the suspensory cortex device. Then, with the knee in 90° of flexion, a 4–5 cm horizontal skin incision is done above the femoral FCL attachment and 3 cm vertical skin incision is made above the fibular head. Subcutaneous tissues are dissected to bony landmarks. An eyelet pin is placed in the native FCL femoral attachment just proximal and posterior to the lateral femoral epicondyle and used to direct the femoral tunnel toward the point above the medial femoral epicondyle. The drill matched to the size of GT-T graft is used to create femoral tunnel. Then, the eyelet pin is used to introduce the passing suture into the femoral tunnel. In the second step, the eyelet pin is placed in the middle of fibular head and used to position the fibulo-tibial tunnel from this point toward the point just below the MCL tibial insertion (**Figure 11**). The drill matched to the

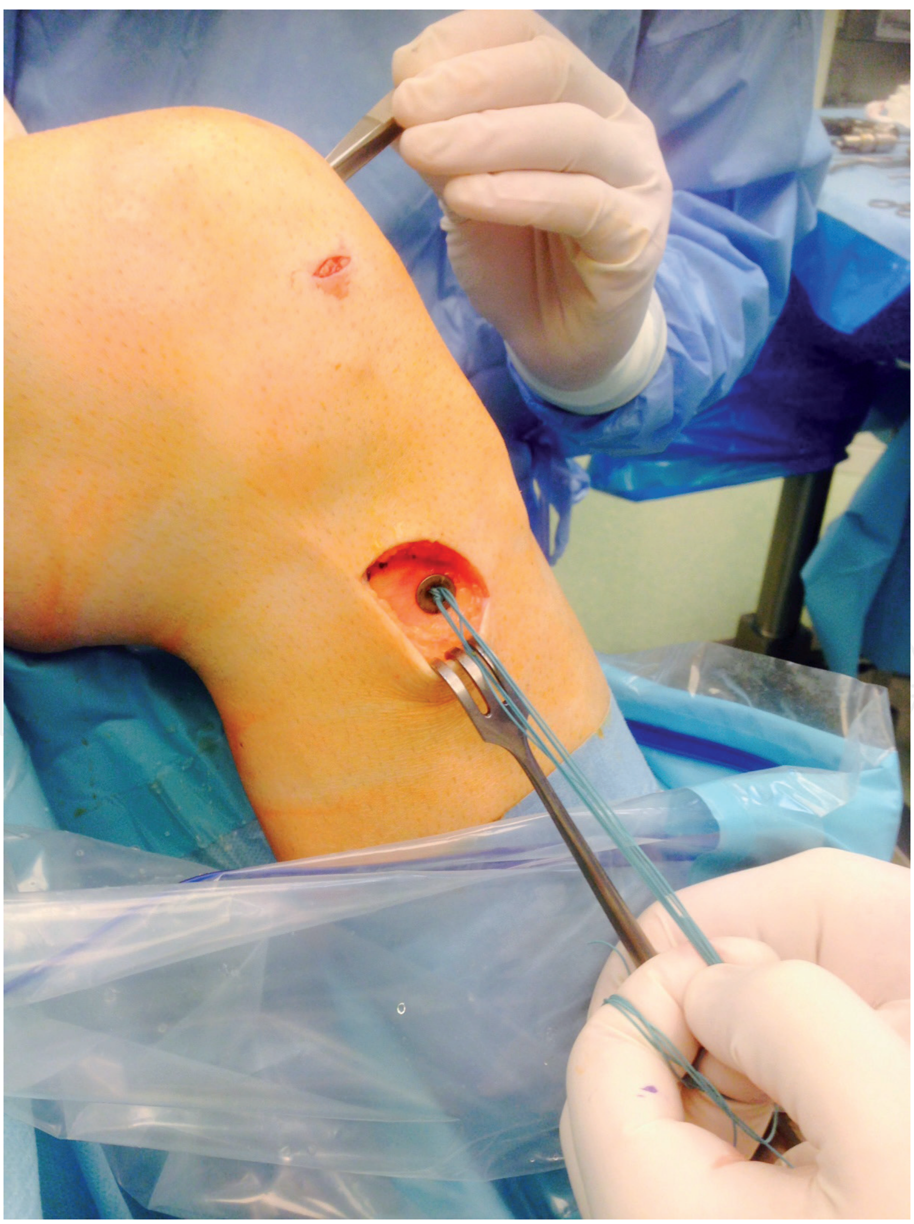

Figure 10.
Politeus tendon graft fixed on the anteromedial tibial cortex with cortical button.

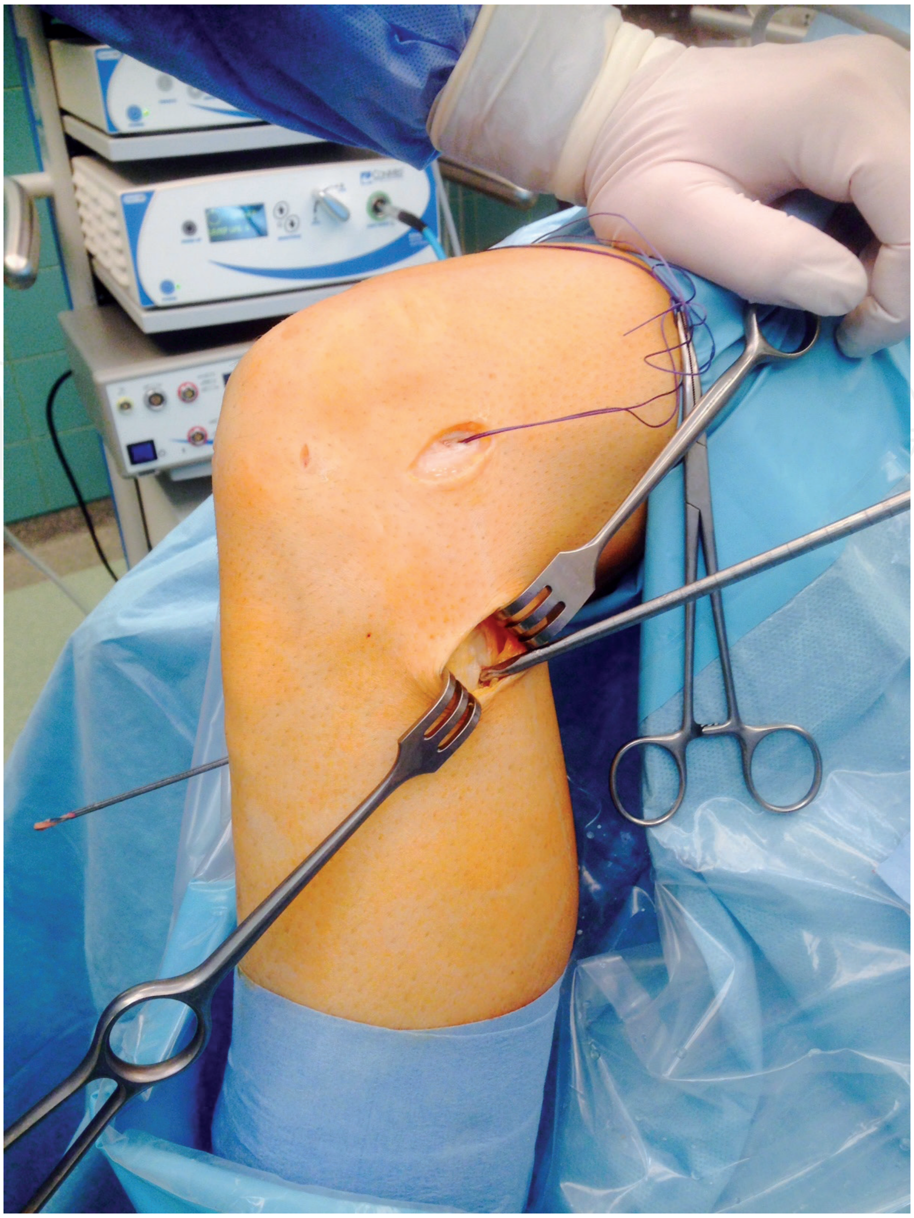

Figure 11.
Minimally invasive approach to fibular collateral ligament reconstruction. An eyelet pin and drill guide matched to the size of the graft are used to create tibial tunnel. Passing suture introduced to femoral tunnel may be observed.

size of the GT-T graft is used to create the tunnel and an eyelet pin is utilized to pass the second passing suture through the fibulo-tibial tunnel. The GT-T graft is passed through fibulo-tibial tunnel from medial to lateral, then passed below the skin and ITB using Pean's forceps and finally introduced into femoral tunnel using the first passing suture (**Figure 12**). The graft is fixed on medial femoral cortex with suspensory device, in the femoral FCL attachment and fibular head using 2 interference screws and additionally on the anteromedial tibial cortex using cortical button (**Figure 13**). In this way the FCL reconstruction is performed.

5.5 Postoperative rehabilitation

Postoperative rehabilitation protocol is similar to this described previously for arthroscopic PLT tenodesis.

5.6 Advantages and disadvantages

The main advantage of presented technique is that this is an anatomic reconstruction of the most important PLC structures with limited invasiveness and faster

Figure 12.
The gracilis tendon graft is passed through tibial tunnel from medial to lateral, then passed below the skin and ITB and introduced to femoral tunnel using passing suture.

recovery in comparison to classic open surgeries. Both procedures can be performed as isolated surgeries. Moreover, fibular part of this technique may be used to stabilize the proximal tibio-fibular joint in case of instability. An another asset of this procedure is that there is no need for maneuvering in posterior knee compartment.

Despite its efficacy and many advantages, presented technique has also some disadvantages. Firstly, there is no possibly to reconstruct PFL in presented way. Secondly, more advanced surgical skills and some experience are required to perform it properly. Moreover, graft harvesting is required what can lead to donor-site morbidity. Improper tunnel positioning may lead to MCL symptoms as well as tunnel convergence during cruciate ligaments reconstructions in the future. Finally, in opposition to arthroscopic PLT tenodesis it is a costly procedure.

6. Discussion

More and more orthopedic surgeons are familiar with treatment of multi-ligament knee injuries [25]. Last two decades brought a great development in

Figure 13.
Fixation of gracilis tendon graft in fibular head using interference screw.

understanding of anatomy, function and biomechanics not only of central knee structures like ACL, PCL and menisci, but also for so-called "knee corners" including PLC and PMC. That has put more interest on rotatory instabilities of the knee and caused introduction of many surgical techniques to address them [1–25]. A lot of surgical techniques were published, however only few presented results, what outlines the fact that objective measurement of rotatory knee stability remains difficult. Currently, reported results include patient subjective outcome scores, clinical examination findings and stress X-ray findings [21]. Each study presented significant increase in Lysholm score and International Knee Documentation Committee score and improvement in clinical exam after surgery [21]. However, it is worth noting that all these factors are subjective and at risk of bias. More objective factor, a stress X-ray, which allows to measure lateral joint line opening or posterior tibial translation, may be useful, but only in more complicated PLC injury patterns, usually with concomitant injuries. The "gray-zone" remain an isolated grade A or B posterolateral rotatory instabilities, where reporting of objective results is difficult. The solution may be a biomechanical cadaveric study. However, as it was previously said, overall success rate in PLC reconstructions may reach about 90% [21]. It depends, among others, on indications and techniques, which were applied. In cases of any doubt, expert consensus statement from 2019 is helpful to make a proper decision about treatment.

Most advantages and disadvantages of open and arthroscopic procedures were explained earlier in this chapter. A shift toward arthroscopic procedures was also outlined. Previously described reasons inspired senior authors (K.H, P.J) to develop arthroscopic PLT tenodesis and arthroscopic-assisted PLC reconstruction, which have been used by our team for many years. Indications, advantages and disadvantages of presented technique were described in detail. These methods meet with high patients satisfaction rate, significant improvement in clinical examination may be observed, thus in our opinions they are effective in treatment of PLRI, however studies on objective results lasts.

7. Conclusions

Posterolateral rotatory instability of the knee (PLRI), which is a consequence of injury to the structures of PLC, is a serious condition causing clinical symptoms and biomechanical changes which may lead to early osteoarthritis development and cruciate ligament reconstructions failures. Many clinical tests and imaging modalities are available for making a proper diagnosis and differentiate injured structures. It is widely accepted that only injured structures should be addressed, whereas reconstructions of structures which are not damaged should be avoided. Surgical treatment remains a gold-standard for high-grade PLC injuries. Arthroscopic popliteus tenodesis and minimally invasive arthroscopic-assisted PLC reconstruction are another surgical procedures which may be useful in hands of arthroscopic surgeons involved in the treatment of instabilities around the knee.

Conflict of interest

The authors declare no conflict of interest.

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