

Case Report

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5 keys to the reconstruction arthroscopic PCL

Abstract

In general PCL injuries are less frequent than ACL injuries, currently it is very controversial to treat isolated lesions and combined injuries a swell. Some patients present significant symptoms and posterior joint deterioration due to instability, while others are essentially asymptomatic but maintain normal function. Not always PCL injuries are isolated, they can be associated with ACL ones, also with posterolateral complex, in this case, it adds to the posterior instability, a various instability with tibial rotation, anterior and exterior. For these instabilities it could be recommended a surgical reconstruction to restore the anatomy and the normal kinematics of the knee. The treatment is controversial and prognosis may vary greatly. In the last decade, there have been several new reconstruction techniques in the Posterior Cruciate Ligament (PCL), trying to reproduce a normal anatomy based on the original ligament. Furthermore, to reduce comorbidity, postoperative pain, surgical time and to maintain the normal knee's biomechanics we use allograft in the Achilles Tendon, obtaining a neo-ligament with the thickness and length necessary. In this study, from January of 2014 to October 2014 (10 months) in 4 patients, were held Plastia of PCL Arthroscopic with Allograft aiming to show the arthroscopic technique, which is used currently in hospital alcvir in this technique its used a dual-band femoral tunnel and just one tibial tunnel using Tight Rope and retrograde guide, taking a look back and how has evolved surgical management since 2003 in which open technique and autologous graft HTH were used, in this study we teach the five keys to the surgical management of ruptured PCL.

Keywords: Posterior cruciate ligament, PCL, PCL Arthroscopy

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Abbreviations: PCL, Posterior Cruciate Ligament; CPL, Posterolateral Complex; LP, Lateral Portal; MP, Medial Portal

Introduction

Information related to PCL injuries has increased greatly in recent years. Despite these advances, there is still significant controversy regarding many aspects of the assessment and treatment of those kind of injuries, especially with the natural evolution of knee injury PCL. The most common cause of this type of injury is hyperextension (overextending the knee) or a direct hit to the knee as its being flexed just like car or motorbike drivers. The better understanding of the anatomy and biomechanics of PCL, has led to a more rational and sensible base to design rehabilitation programs for the treatment, of both non-surgical and post-surgical context. The main function of PCL, is to avoid the subsequent translation of the tibia regard to the fémur. Biomechanically, the anterolateral bundle, which is the thickest, is stressed during knee flexion, but relaxed on the extension, the posteromedial bundle, relaxes during flexion, straining during extension. When instability is produced by the knee unto posterior, by a PCL injury, it increases the pressure on the inner compartment and the patellofemoral joint that produce premature wear.¹⁻⁵

The PCL injury may be associated with injury to the posterolateral complex (CPL).⁶ Harner et al.² reffering in his casuistry between 50 and 90% of cases. The posterolateral complex (CPL), anatomically is composed of a group of structures, statics and dynamics.⁶ The statics include external colateral lig, popliteal fibular lig, arcuato lig the peroneal tibio lig, and posterolateral capsule. The dynamics structures include the biceps tendon, the iliotibial tract and the popliteal tendon muscle complex. This complex is responsible for the posterolateral knee stability, mainly resist varus rotation, and external rotation of the tibia in all flexion angles. The PCL isolated injury does not increase the external tibial rotation, which is restricted by the already mentioned complex.⁶ In the PCL injury and CPL, both must be repaired, for anatomical and biomechanical restoration of the knee.⁷

The Key to identify these patients requiring surgical treatment is to make a good study: Clinical History, detailed physical examination, complementary exams for full image (Figure 1).



Figure 1 PCL.

The surgical indications at the present time are:

1. Laxity Symptomatic Instability Posterior
2. Ligament Combined Injuries
3. Avulsion Bone
4. Deterioration Chronicle Injury
5. Rehabilitation protocols have changed and will change as surgical techniques evolve.

One of the main objectives of PCL reconstruction is isometric graft placement.

Objectives

- A. To present our surgical technique for PCL arthroscopic reconstruction in Alcívar Hospital.
- B. Identify the demographic characteristics of patients operated on Hospital Alcivar, age, gender, affiliation, causes of knee injury and laterality.
- C. Determine the important steps in the surgical management of the PCL reconstruction.
- D. Functional results with subjective assessment of pain and clinical maneuvers stability.

Theoretical anatomy of PCL

The origin of the PCL it's in the medial femoral condyle, on its lateral surface, and goes to the back and inserted behind the ACL, on the tibia posterior superior side of it. Their average length is 38 mm and 13 mm diameters. Recent studies have shown that the PCL has two functional bands, a larger anterior and a smaller posterior. These components vary their behavior according to the different degrees of knee flexion. In the previous band extension is loose, while posterior is tense. In bending the opposite occurs.⁸

The ligament is composed of two functional bundles:

- A. Anterolateral Beam, Bigger that develops tension when the knee is flexed, stiffer and requires a higher ultimate load to fail.
- B. Posteromedial Beam, Smaller, which develops tension with knee extension.

Half its thickness, in anterolateral beam has approximately twice the size of the posteromedial beam in a cross section. The PCL functions as the primary restriction to posterior translation of the tibia and as secondary restraint external rotation (Figure 2).

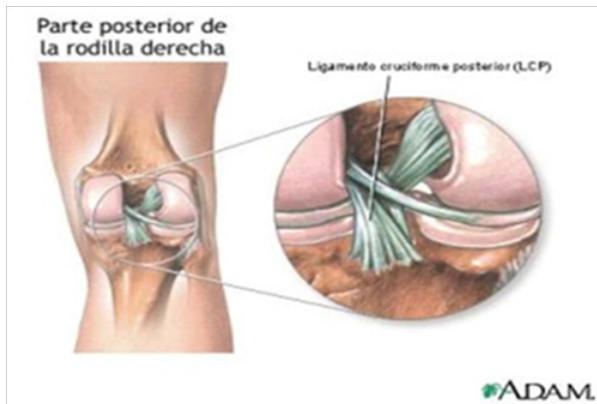


Figure 2 Anatomy (Courtesy of Adam).

Mechanism of injury:

1. Usually the cause of injury is:
2. Direct Hit In The Proximal Tibia
3. Fall Over The Knee With Foot In Position Of Bending Plant
4. Hiperxtension Knee (Figure 3A)
5. Less Common Causes:
6. Hyperextension or combined forces.

7. Typically, the ligament fails in average thickness, but described avulsions femoral or tibial insert.
8. The PCL injury may be isolated or associated with multiple ligament injuries or knee dislocation. Isolated lesions tend to occur in sports, and usually combined injuries are the result of a high-energy trauma. Isolated lesions tend to occur in sports, and combined injuries usually are the result of a high-impact trauma (Figure 3B).



Figure 3A Mechanism of injury.



Figure 3B Mechanism of injury.

Biomechanica of practice

Markolf et al. (1997) showed that ADM passive in the knee leads to generate a minimal force in the PCL intact throughout the range of motion. Reconstruction after a significant change is not seen in the production of forces, except for a small increase flexión angles greater than 60 degrees. During closed-chain posterior shear force across the ADM of the knee, generating greater forces with increasing knee flexion. With the activities in open kinetic chain, seems to be a tremendous force exerted on the PCL during flexion exercises. The magnitude of the force generated in PCL during exercise is much higher than in the ACL, which may be a factor in the tendency to stretch PCL grafts after surgical reconstruction. It had to avoid rebuilding PCL when is possible, but proper rehabilitation can prevent the development of laxity progressive and improve reconstruction results. It has been avoid rebuilding PCL when is possible, but a proper rehabilitation can prevent the development of laxity progressive and improve reconstruction results.

In 1993 O'connor figured that it is possible to dynamically download the cruciate ligaments using contraction of the quadriceps, hamstrings and gastrocnemius. The goal should be to minimize the potentially damaging force generated during rehabilitation. It seems that passive mobility can be safely throughout the range of flexion and extension.

The activities throughout every active closed kinetic chain of any kind, at any ADM, should be used with caution when it's rehabilitated with PCL, either non surgical or after reconstruction treatment. They should be:

1. ADM limiting knee flexion 45 or less to avoid the generation of more high forces on the PCL.
2. Flexion exercises in open kinetic chain generate strong forces and should be avoided.

In the other hand the extension of CCA are safe in lower bending angles 60-0 but are not recommended because there are a significant peak patellofemoral stress, causing symptoms, so its only recommended closed ones. The menisco femoral ligaments surrounding the PCL in all their passage. The anterior called Humphrey ligament according Ranalletta et al.⁸ is present in 100% of knees observed by him, while the posterior called Wrisberg ligament, is unstable and present in only 60%.^{9,10} Clancy W et al.¹¹ mentions that both meniscofemoral ligaments act as secondary stabilizers and this could explain the absence of posterior drawer in isolated ruptures of the PCL.¹² In our surgical technique, when feasible, we respect Humphrey ligament allowing us to guide us in the preparation of the femoral hole and for placement of bone dowel in the medial femoral condyle.

Function of PCL

It is the primary stabilizer of the knee, prevents external rotation of the tibia, as well as hyperextension. The PCL prevents posterior translation of the knee at all flexion angles, the largest displacement occurring between 75 and 90 degrees.⁸

Clinical evaluation

PCL injuries and posterolateral structures of the knee usually go unnoticed at the time of initial evaluation. Therefore the semiological examination should be undertaken carefully; using complementary tests and Nuclear Magnetic Resonance.

It is important that during interrogation, violent traumas background as a result of vehicle or sports accidents are taken into account. The most frequent knees symptom with chronic inadequacies of PCL is pain. Dandy reported the existence of pain in 70% of patients with chronic insufficiency of the PCL that was present in long walks and 50% when descending stairs.³ Cross HD¹ described the presence of retropatellar pain in 36% of a series of 116 cases with PCL injury.³ In contrast to the instability that produces insufficient ACL, PCL injuries caused impairment manifested by symptoms described above.

Semiological maneuvers

The Posterior Drawer is taken in three positions, neutral, internal rotation and external rotation. In neutral rotation, is positive for isolated PCL injuries. When it's positive on internal rotation, we can suspect lesions at the postero medial sector medial meniscus, posterior capsule and muscle attachments of the medial gastrocnemius and semimembranosus expansions. Finally, when positive on external rotation, there is a high possibility to be associated with the knee

angle postero external. The test Godfrey taken with the hips and knees at 90 degrees of flexion, holding both heels and observing if exist posterior translation of the tibia. The Test of Daniel or dynamic test of quadriceps consists on the replenishment that happens at the posterior displacement of the tibia when the knee flexion to extension takes.⁴ Shelbourne K et al.¹¹ was who described the shift of the posterior dynamic test, which is taken with the knee flexed to 90 degrees, which slowly leads to the extension occurring subsequent reduction to reach full extension subluxation.⁷

Strobel MJ et al.¹³ have described similar to the above maneuvers to demonstrate PCL injuries, as so-called sign of gravity next to the extensión and reverse pivot shift.¹⁴ The Test of external rotation recurvatum was described by Hugston, and is performed with the patient dorsal decubitus, holding both members extension from the hallux. Allows diagnosis of combined PCL injuries and posterolateral angle.¹⁵ Radiographic studies taken with the knee flexed to 90% allow highlighting the posterior translation of the tibia and performing, according to the same classification into three degrees of PCL injury. Grade I, there is a posterior shift of less than 5 mm, grade II between 5 and 10 mm and in grade III of over 10 mm (Table 1). Nuclear Magnetic Resonance is a valuable supplementary examination, whenever it's performed by staff trained on search of this type of injury. Shelbourne et al.¹¹ reported the experience of five orthopedic surgeons in diagnosing PCL injuries, describing that in cases of injury grade I diagnosis was made in a 70%, while in grades II and III was performed in 97%.¹⁶⁻¹⁹

Table I Classification of Injury of LCA

Classification

Grade 1	Having 0 to 5 mm posterior translation and maintaining the position of the anterior medial femoral condyle to the medial tibial.
Grade 2	Having from 5 to 10 mm and posterior translation of the medial tibial plateau rests aligned with the medial femoral condyle.
Grade 3	They have more than 10 mm of posterior translation and medial tibial plateau falls posterior to the medial femoral condyle.

Key points to consider

- I. The PCL is the first posterior translation limitation in all positions of knee flexion. Much as 30 degrees to 90 degrees of flexion, the PCL resists 85 to 100% of the subsequently directed forces.
- II. The PCL sprain is best detected with a 70-90 degrees flexion of the knee on a posterior drawer test.
- III. The isolated sprain of the PCL does not cause varus and valgus laxity and increased rotation.
- IV. The isolated tear of the PCL and the isolated corner posterolateral injury will produce approximately the same degree of translation back to 30 degrees of flexion of the knee will produce approximately the same degree of back to 30 degrees of flexion of the knee translation.
- V. If there varus or valgus laxity in full extension, by definition

there are a combined injury PCL and the collateral complex.

VI. The posterolateral corner injury can produce a slight degree of varus laxity, but a more intense degree of varus laxity indicates PCL injury.

VII. A combination of PCL sprain and posterolateral corner sprain produces a subsequent translation and external rotation much worse than any other isolated lesions.

VIII. It's hard to find a serious instability of the posterolateral corner without a PCL injury, the ligament collateral peroneal and the popliteal.

Materials and methods

A retrospective study was conducted, type of case series, Where 4 patients were evaluated with plastic arthroscopic PCL, operated in 2014 with technical of simple single band by femoral tunnel with single tibial tunnel. They were selected by inclusion and exclusion criteria.

Inclusion criteria.

- a. Grade II and III
- b. Patients between 20 and 40 years engaged in some form of physical activity
- c. Allografts: Achilles Tendon
- d. Fixing with Arthrex system and tibial Exoshape
- e. Monitoring

Exclusion criteria.

- f. Sedentary Patients
- g. Injuries Grade I
- h. Chondral lesions G III, IV (Outer bridge)
- i. Clearance

In this study all patients that presented clinical and imaging injury posttraumatic instability of the PCL were included. The total was 4 patients admitted Alcivar Hospital between January 2014 and October 2014. During 2014 only 4 patients with PCL injury were treated at the Department of Traumatology and Orthopedics Hospital Clinica Alcivar, two with combined ACL injury and two with isolated PCL injury with symptomatic laxity.

All patients were male with an average age of 25-36 years who had injured their knee, two cases had motorcycle antecedents and two labor accidents. The average completion time of surgery was 4 months. The parameters evaluated were physical examination, joint laxity and functional knee scores.

Técnica

The patient is placed on supine position with epidural anesthesia, hemaclear tourniquet is placed, to the middle third of the thigh, after placement of sterile drapes and connecting the arthroscope, its proceed to:

Ligament

Ligament: To prepare the neo-ligament it's used Achilles tendon cadaveric allograft with two tendon ends of 9 or 10 mm Krakow suture type, Ethibond threads 2, a long, each suture, 25mm. At tibial

end (11 mm) we add Retro Button (Arthrex), of the necessary measure considering the length of the tibia and along the tibial hole. And 7mm, which is the postero-medial band, is placed Nitinol rod that will serve for the passage of tibial exo shape screwdriver (Figure 4).



Figure 4 Achilles tendon allograft.

Portals

The lateral portal (LP) for the camera is made lateral to the patellar tendon to the height of the lower pole of the same one. For the job portal we perform a oblique incision of approximately 2 cm. medial to the patellar tendon. This medial portal (MP), must be of this nature, and that through him we will make one of the femoral holes and then the passage of the graft, and posteromedial portal.

Technical arthroscopic

We started the arthroscopic part; we make a neat examination of the joint, proceeding with the repair or removal of meniscal lesions when present. At this point it is frequently observed indemnity Humphry ligament, should not be confused with the PCL. This structure is respected as much as possible. The first thing to be done is a shaving of rasa lag Hoffa, synovial plica and other Posterior Cruciate Ligament remnant. To perform this we also put a postero interanal cannula that allows us to visualize better the tibial insertion of PCL (Foot Print). Once we have a good visualization of the intercondylar, it is very important to visualize the posterior wall of the internal condyle, as this will help us achieve the femoral hole. First we started with the realization of the tibial hole, placing the PM Retrograde Tibial Guide (Constant Guide Arthrex) (Figure 5) wick of 11mm on Foot Print of PCL, (this guide allows us to move back the posterior capsule). We 2mm skin incision on the antero-medial aspect of the tibia and spent the guide pin; the wick is engaged, and always advancing the guide in the direction of clockwise, it begins to pry back, and so it begins to make the tibial hole. Once we have carved a hole, we have to take it back to make the wick have contact with the Retrograde Femoral Guide, and in this moment its placed them in reverse perforator so that the wick can be hooked to the the guide again. Right then the Retrograde Femoral Guide is removed, leaving only the Pin Guide. The rod guide is regulated with markings every 5 mm, allowing us to meet the tibial length. Usually this length is approximately 70mm, being recommended to leave 10mm undrilled so the tibial cortex won't be violated. Finishing the previous steps, we get through a Fiber stick by the guide pin, which recovered by the PM, thread that will help us to pass the neo-ligament (Figure 6).

To perform the Femoral hole, we place in the PM the femoral guide on a anterograde way, by the PM we put the Over the Top, special for the performance, through the antero-medial portal and then we pass the bottom hole rod, that will serve as a guide for the cannulated wick of 9 or 10 mm. We do it this way and not with retrograde wick. In this surgical moment, there are two very important keys to make this hole; one is to make them as large as possible (about 40 mm) to prevent the neo-ligament not to enter completely and that it remains lax, meaning that it should enter completely to the tunnel for an excellent ligamentacion, the neoligament has to be in contact with the tunnel

and fixating the end tibia with 70 degrees of flexing on the anterior drawer. To repair the femoral, in which we still have placed the guide pin, we pass through it a nitinol rod, which is recovered by the PM and then we put a Fiber wire (Arthrex), we traction the guide pin, bringing back the nitinol rod we proceed to place the graft. This is accomplished with the next maneuver, taking the fiber wire, that we left out of the antero-medial portal, and tie it to the Loop of Retro Button, when we traction distally the end it should enter to the tibial hole and be fixed to the outer tibial cortex. In one only motion, making this easier and shorten the surgical time (Figure 7).



Figure 5 Guide flip cutter retrograde



Figure 6 Arch Pcl Arthrex

Postoperative

Recovery is a bit slower than the ACL, to avoid stretching the graft; is more care. Because it is a procedure that is not as common as the ACL, requires that Rehabilitation to be done by a person trained in knee preferably. The Law of Gravity is an enemy of this surgery and therefore IS Recommended that the first 2 months can be just with face down exercises; Extension splint to 3 weeks to download; Progressive motility of 4 to 6 weeks; Progressive loading from six

weeks; Hinged knee brace to 10 weeks and Sports at 9 months. The rehabilitation of this surgery takes between 6-12 months. It is more intense at first and then ends during the final recovery and return to sports activities. In function of the associate injuries it's allowed in immediate or late support. Return to sporting activities is on an average a year after surgery.

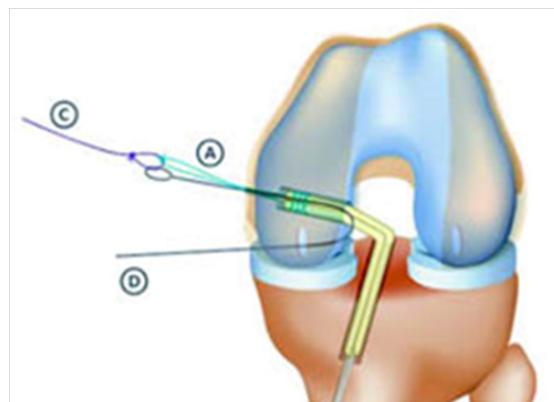


Figure 7 We watch how pass allograft with the fiber wire through the hole tibial

Results

We have shown the surgical technique with flip cutter retrograde of arthrex for PCL reconstruction we do it in all four patients (Figure 8A & 8B). The four male patients between 20 and 36 years, mean age 26 years, left and right knee, both are with combined ACL injury and two with isolated PCL. In combined injuries was performed reconstruction in two stages, in a first stage ACL arthroscopic repair and 4 months PCL arthroscopic reconstruction. The results of this surgery are not as reproducible as in the LCA and may be a slight residual instability that has no clinical impact. For these reason, only patients that have extreme instability can be operated.

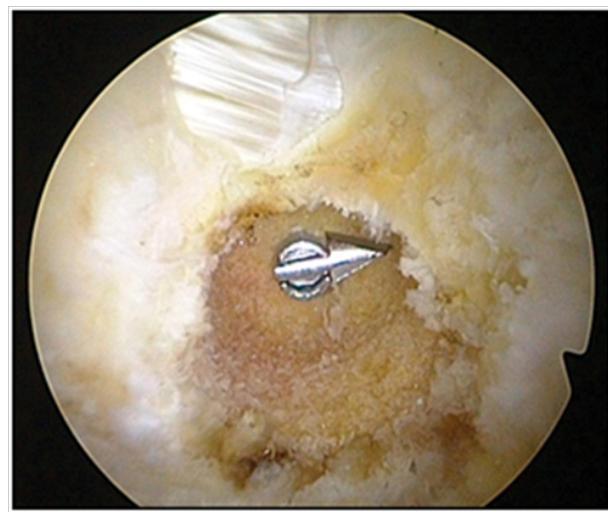


Figure 8A Flip rotating cutter retrograde.

Discussion

Alternative approaches are analyzed on natural evolution of a knee with chronic deficiency of PCL. Some authors maintain that PCL isolated injury allows operation without causing knee degenerative

symptoms for many years. Shelbourne K et al.,¹¹ in a study of 40 patients with PCL isolated injury who were treated in a bloodless and with a mean follow-up of 6 years, found that all knees were symptomatic and present radiographic degenerative changes that occurred in the first term in the medial compartment of the knee and secondarily affect the patellofemoral joint. While it is true that chronic PCL injuries associated with other structures should be surgically repaired, there are still different opinions regarding the proper course of actions in isolated lesions of the same. In order to establish therapeutic protocols for PCL injuries, several authors argue that grade I lesions should be treated bloodlessly, while grade II and III shall be operated. Others argue that should be surgically treated ligament insufficiency those that allow posterior translation of more than 15 mm tibia. In our opinion, should be treated surgically knees that submit a symptomatic failure of the PCL. For the same therapeutic approach its used in our service because of the lack caused by the LCA.¹⁴

The other aspect to discuss is the question of the surgical technique. Almost all authors relate the difficulty in the passage of the graft by the end articular tibial tunnel. Recently, Mariani & Colleagues have described a technical device to facilitate this operative step. Freddie Fu mentioned the contingency described and emphasized the need to remove the graft by the posterointernal approach as a step to achieve the above relocation. Freddie Fu mentioned the contingency described and emphasized the need to remove the graft by the posterointernal approach as relocation. The major advantage of our technique is that when making the passage from proximal to distal, allows us to save the difficulty mentioned. The ability to view the arthroscopic form, the compartment of the knee and observe the reduction that is achieved in the posterior subluxation of the tibia with arthroscopic procedures, is an important technical advance and allows a new perspective for the surgical treatment of patients with chronic injury and symptomatic of PCL.

Conclusion

Procedural success is the result of the sum of factors that interact between the patient, the surgeon and the procedure performed. So important is the method, like the correct patient selection and diagnosis of associated lesions. Given the knowledge that the best result, Will never reach the biomechanics of healthy PCL, just as the discipline and responsibility of the patient, the arthroscopic surgeon should prioritize the doctor-patient relationship. Technical development - instrumental in the last decade offers multiple alternatives that often distract the arthroscopista in formation on basic aspects of ACL reconstruction

1. We have shown our surgical technique arthroscopy with Flip Cutter Guide Retrograde at Clinica Alcivar conducted in 2014, which has evolved considerably since it was made more than 4 years in our Department of Traumatology and Orthopedics, and this cutting edge procedure on Alcivar Clinic as currently the surgical time is less and Achilles Tendon Allograft frozen Banhuesos Alcivar used.
2. Were determined Demographic characteristics as the 4 patients are male sex , average age 26 years, 3 left knee and right, two combined ACL injury and two with isolated PCL injury with symptomatic laxity. Two cases had motorcycling history and two labor accidents
3. Important steps for successful PCL Reconstruction:

The five keys to setup your surgery are

Patient selection grade II and III

- a. **Type of graft:** we use Achilles Allograft frozen as it shortens the operation time and decreases autograft comorbidity should be 9 or 10 mm in diameter.
- b. **Position and realization of tunnels:** a Very Important accessory Portal for viewing and cleaning the foot print for the tibial tunnel should use the FLIP Guide retrograde Cutter.
- c. **Fixing type:** For femoral fixation was used tight Rope (Tight rope) Arthrex and for tibial fixation Exoshape Tibial which is a compression system intratunnel.
- d. **Postoperative e detention:** The tibial implant is fixed at 70 degrees of flexion and anterior drawer once and surgical wounds covered sutured with sterile dressings, two bands of water is placed in the posterior region of the proximal leg and immobilizer is placed in full extension for 3 weeks performing a routine isometric quadriceps exercises.

All 4 patients complained about pain, full function extension and flexion is not painful, 3 patients have residual laxity at 30 degrees no significant when performing flexion posterior drawer.

Recommendations

As in the work, the femoral reconstruction and tibial tunnel band if only show statistically significant advantages over reconstruction patients not performed when comparing subjective parameters. Clinical significance lies mainly in patients with low demand for sports and high demand for their work with lesions of PCL band Simple techniques to restore biomechanical Sufficient are as close to normal so we make reconstructions with a femoral tunnel those with high demands. Missing comparative clinical studies with homogeneous groups with long-term follow to confirm the results.

References

1. Harner CD, Höher J. Evaluation and Treatment of Posterior Cruciate Ligament Injuries. *Am J Sports Med.* 1998;26(3):471–482.
2. Harner CD, Fu FH, Irrgang JJ, et al. Anterior and Posterior Cruciate Ligament Reconstruction in the New Millennium; a Global Perspective. *Knee Surg Sports Traumatol Arthrosc.* 2001;9(6):330–336.
3. Kurosawa H, Yamakoshi K, Yasuda K, et al. Simultaneous Measurement of Changes in Length of the Cruciate Ligaments during Knee Motion. *Clin Orthop.* 1991;265:233–240.
4. MacWilliams BA, Wilson DR, DesJardins JD, et al. Hamstring Cocontraction Reduces Internal Rotation, Anterior Translation, and Anterior Cruciate Ligament Load in Weigh – Bearing – Flexion. *J Orthop Res.* 1999;17(6):817–822.
5. Makino A, Muscolo DL, Costa Paz M, et al. Reconstrucción Artroscópica del LCP con doble Fascículo Nota Técnica Rev. *Arg De Artroscopia.* 2000;7(1):58–62.
6. Fanelli GC, Larson RV. Practical Management of Posterolateral Instability of the Knee. *Arthroscopy.* 2002;18(2 Suppl 1): 1–8.
7. LaPrade RF, Muench C, Wentorf F, et al. The Effects of Injury to the Posterolateral Structures of the Knee on Force in a Posterior Cruciate Ligament Graft: Biomechanical Study. *Am J Sports Med.* 2000;30(2):233–238.

8. Ranalletta A, Brigatti N, Rossi N, et al. LCP Area de inserción Tibial. *Rev Arg De Artroscopia*. 2001;8(1):12–19.
9. Ticker J, Christopher D Técnicas en Cirugía de la rodilla. In: Harner y (Ed.), 8: 83.
10. Voigth M, Tipell El Ejercicio Pliométrico en la Rehabilitación. Técnicas de Rehabilitación en Med Deportiva (2nd Edn) Edic (Ed.), Paidotribo, Spain, pp. 107–115.
11. Clancy W, Shelbourne K, Zorllner G, Keenej, et al. Treatment of Knee Joint Instability Secondary To Rupture Of The Posterior Cruciate Ligament. Report A New Procedure. *J Bone Join Surg Am*. 1983;65(10):310–322.
12. Green RB, Noble P, Woods G, et al. Rehabilitation of de Posterior Cruciate Deficient Knee: A Biomechanical Simulation. *Orthop Trans*. 1989;13:319.
13. Strobel MJ, Weiler A, Schultz M, et al. Fixed Posterior Subluxation in Posterior Cruciate Ligament – Deficient CNES. *Am J Sports Med*. 2000;30(1):32–38.
14. Hofmann F, Udo B, Gerhard R, et al. Arthrosko pische tibiale and femorke 2–Bundeltechnik des hinteren kreusbandorsatzes Arthroscopy 2000. Spizinger Verlang, Heidelberger, Berlin, Germany, 2000;13:41–46.
15. Sinovian P Ans Worth D Técnicas en Cirugía de la Rodilla 9: 106.
16. Prentice WE, William E. Técnicas de Rehabilitación en med Deportiva (2nd edn), Paidotribo, Spain, 2004;pp. 225.
17. Galloway MT, Grood ES, Mehalik JN, et al. Posterior Cruciate Ligament Reconstruction and *in Vitro* Study of Femoral and Tibial Graf Placement. *Am J Sports Med*. 1996;24(4):437–445.
18. Meglan D, Lutz, Stuart M. Effects of Closed Kinetic Chain Excercises for ACL Rehabilitantion upon the Load in the Capsular and Ligament us Structure of the Knee. *Orthop Trans*. 1993;18:307.
19. Oman, Janine, Prentice EW. La Isocinesia en rehabilitación. Técnicas de Rehabilitación en med Deportiva (2nd edn), Paidotribo, Spain, pp. 94–105.