

## Evaluation of Arthroscopic posterior Cruciate ligament reconstruction by using Quadrable hamstring tendon autograft and endobutton fixation: minimal 2 years Follow-up

Mohamed Attia Abdel Moeti<sup>1\*</sup>, Abdel Salam Mohamed Hefny<sup>2</sup>, Ali Tawfik Al Alfy<sup>3</sup>, Mohamed Mahmoud Mansour<sup>4</sup>

<sup>1</sup>Associate Lecturer, Department of Orthopaedics, Zagazig university hospital, Egypt

<sup>2</sup>Professor of Orthopaedics, Zagazig university hospital, Egypt

<sup>3</sup>Associate Professor, Department of Orthopaedics, Zagazig university hospital, Egypt

<sup>4</sup>Lecturer of Orthopaedics, Zagazig university hospital, Egypt

**\*Corresponding Author:** Mohamed Attia Abdel Moeti, Associate Lecturer, Department of Orthopaedics, Zagazig university hospital, Egypt.

**Received:** February 20, 2016; **Published:** March 02, 2016

### Abstract

**Background:** The aim of this study is to prospectively evaluate the outcomes of PCL reconstruction by quadruple hamstring tendon autograft using endobutton fixation method at minimal 2-year follow-up.

**Materials and methods:** PCL injured patients either isolated or associated with other ligamentous injuries or meniscal lesions were included. Cases with Posterolateral corner injury, severe degenerative joint disease or limited range of knee motion were excluded. The quadruple-stranded gracilis tendon and semitendinosus tendon graft was about 11 cm in length. An arthroscopic transtibial single bundle technique, single incision and endobutton fixation method were applied. Clinical evaluations were performed for 16 patients. Assessment of patients included the posterior drawer test, Lysholm knee scores, International Knee Documentation Committee (IKDC) scores, functional hop test, x ray and MRI.

The Lysholm knee score, 87.5% of the patients displayed good or excellent rating in the final assessment. The IKDC final rating, 81% were normal or nearly normal. 94% of patients were graded normal or nearly normal by posterior drawer test. Conclusion: Arthroscopic PCL reconstruction using quadruple hamstring tendon autograft and endobutton fixation provides acceptable outcomes at a minimum 2-year follow-up. The quadrable hamstring tendon graft provides suitable graft size and results in minimal graft site morbidity. We recommend using quadruple hamstring tendon graft for PCL reconstruction to achieve good ligament reconstruction.

### Introduction

PCL injury and its ideal subsequent treatment have been a source of controversy for many years. [1] The PCL spans from the posterior aspect of the tibia to the medial femoral condyle. PCL is the strongest ligament about the knee. [2] The function of the PCL is primarily to restrain posterior translation with respect to the femur. The most common mechanism of injury is motor vehicle accidents with direct force to proximal anterior tibia. Diagnosis of PCL injury depends on examination and investigations, posterior drawer test is a specific one for PCL injury and x ray with MRI are the best investigation. [3] Surgical reconstruction is most commonly recommended if the PCL has greater than 10 mm of posterior translation or if there are multiple ligamentous injuries. [4] Debate exists to the best graft type or source, placement of tibial and femoral tunnels, number of graft bundles and degree of knee flexion during of fixation. Complications associated with PCL reconstruction include fracture, neurovascular injury, deep venous thrombosis, residual laxity and loss of range of motion. [5]

**Citation:** Mohamed Attia Abdel Moeti, *et al.* "Evaluation of Arthroscopic posterior Cruciate ligament reconstruction by using Quadrable hamstring tendon autograft and endobutton fixation: minimal 2 years Follow-up". *EC Orthopaedics* 3.2 (2016): 268-276.

Long-term follow-up of patients with non-operative treatment experienced a high ratio of poor functional outcomes and osteoarthritis [6]. While improved outcomes after PCL reconstruction have been reported in recent studies. Therefore, in patients with complete PCL tear conservative treatment has not been recommended [7]. Surgical outcomes of PCL reconstruction are variable and often unpredictable. The single-bundle technique is used for anterolateral bundle of PCL reconstruction because of its better biomechanical characteristics in comparison with the posteromedial bundle. [5] This study prospectively evaluated 16 patients who were operated for arthroscopic single-bundle PCL reconstruction with endobutton fixation method at femoral side via hamstring tendon autograft to assess patient outcomes and potential complications. The hypothesis of the study is that quadrable hamstring tendon autograft is a strong, safe, and acceptable option for PCL reconstruction.

### Methods

In a prospective study from 2013 to 2016, PCL reconstruction using hamstring tendon autograft was conducted on all of our patients with PCL tear. PCL tear was detected by posterior drawer test, positive posterior sag sign. The PCL tears were confirmed by stress x-ray lateral view. MRI investigations and diagnostic arthroscopy. Every patient with following was excluded: previous failed PCL reconstruction. Abnormal preoperative radiographs, limited range of knee motion, chondral damage, and abnormal contra lateral knee joints. Patients with grade 3 or 4 PCL tear without significant posterolateral lesion fulfilled the criteria for PCL reconstruction. According to mentioned criteria, 16 patients were enrolled in our study. There were 15 males and 1 female. Mean age was 29 years. Arthroscopic method was not performed in patients with acute injuries until the knee restores an approximately good range of motion (ROM) with negligible effusion and pain. All the reconstructions were performed by two orthopedic surgeons by using a unique surgical technique outcome of the reconstructions were assessed.

### Surgical technique

#### Patient Positioning

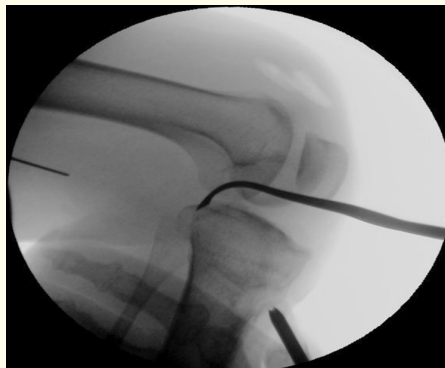
With the patient supine, a bilateral knee examination under anesthesia was performed to assess ligament integrity. The limb was then positioned in supine position with both knees 90 degree flexed and down the table, Arthroscopy set and C- arm were properly positioned in operation room. The limb was prepped, and draped.

#### Graft Preparation

The patient was placed supine with leg under tourniquet control and draped. First, a 2- to 3 cm-long longitudinal incision was made on the injured leg at the medial side of the tibial tubercle. The insertion site of the pes anserinus was exposed; the distal ends of the semitendinosus tendon and the gracilis tendon were peeled off with a 2- to 4-cm long periosteum flap to increase the total length of the tendons. Then both the gracilis tendon and semitendinosus tendon were procured with a tendon stripper. The graft is prepared using a graft preparation board. A 4-stranded graft part was made. The prepared total graft length should be 95–100 mm. The graft is folded in looped fashion and sewn together with a number 2 Fiber Wire suture with endobutton application.

#### Tibial Preparation

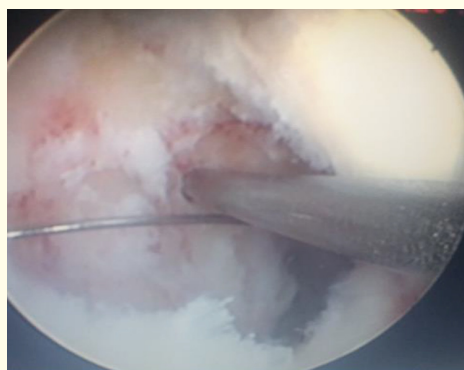
After a standard diagnostic arthroscopy. The PCL guide is inserted through the anteromedial (AM) portal and positioned at the base of the PCL facet, with the scope through anterolateral portal using 70 degree lens. Proper placement of the guide can be confirmed with fluoroscopy as needed. A PCL guide wire is then drilled from anterior to posterior through the tibia until the drill tip penetrates the posterior cortex. The PCL guide is used to protect the wire from plunging into the posterior neurovascular structures. The inner opening of the PCL tibial tunnel was just below the tibial plateau articular surface, at the lateral side of the posterior tibial pouch. The tunnel was angulated 55° to the long axis of the tibia, drilled with a reamer of a diameter equal to the distal end of the PCL graft. The tibial socket is then cleaned out using a shaver. Passing stainless steel wire are then placed into the socket and pulled through the joint out of the AL portal.



*Figure 1: Showing proper position of PCL tibial guide.*

### Femoral Preparation

The native femoral AL bundle footprint of the PCL is exposed and some of the fibers are preserved to aid placement of the femoral socket. A guide wire is placed through an accessory, distal inferolateral portal and inserted into the femoral foot print. The inner opening of the PCL femoral tunnel was at the attachment site of the anterolateral bundle of the PCL, which was 6 to 8 mm to the cartilage margin and at the 1 or 11 o'clock position. The PCL femoral tunnel, was drilled from inside to outside. The diameter of the inside part was equal to the proximal end of the graft, and the diameter of the outside part was 4.5 mm. The length of the inside part was 20 to 25 mm, according to the width of the whole medial femoral condyle and tunnel length. Similar to the tibial side, a passing suture is then placed and pulled through the joint out of the AL portal for eventual graft passage. We connected the anterior suture of the tibial tunnel with the anterior suture of the femoral tunnel then we pulled the suture from the distal tibial tunnel that one would be connected with graft threads then we pulled the suture from the femoral tunnel then graft threads would be delivered outside femoral tunnel.



*Figure 2: Showing proper position of PCL femoral guide (inside out), stainless steel wire is passing through tibial tunnel and out of the anterolateral portal.*

Figure 2 showing proper position of PCL femoral guide (inside out), stainless steel wire is passing through tibial tunnel and out of the anterolateral portal.



**Figure 3:** Showing connecting the wire passing through tibial tunnel with the sutures passing through femoral tunnel at the antrolateral portal.

### Securing the Graft

The PCL graft composite, was put into the joint through the tibial tunnel and then into the femoral tunnel. The proximal threads was pulled outside the femur through the outer opening of the PCL femoral tunnel and fixed on a 6 mm-long endobutton. The graft length in the femoral tunnel will be about 20 mm. The endobutton at the proximal end of the composite will be flipped and, after retrograde graft pulling, it will lay over the outer cortical opening of the femoral tunnel to suspend the proximal graft end. The knee is cycled with 20 cycles of knee flexion, maintaining tension on the tibial side graft. This takes some creep out of the graft construct. With the knee at 80° of flexion, fixation of tibial side if the graft with biodegradable interference screw.



**Figure 4:** Intraoperative AP knee x ray showing proper tibial and femoral tunnels with Endobutton fixation and tibial biodegradable interference screw fixation Follow-up evaluation.

All of these patients were followed up to clinical and radiographic evaluation, such as the presence of any symptoms, activity level, the post operative ROM, the degree of laxity, subject functional evaluation, and radiographic investigations. The follow-up studies were performed by the main investigator. The results of such evaluations were recorded according to the guidelines of the international knee documentation. Committee (IKDC). [7] Generally final evaluation of the knee function was performed according to the patient's subjective assessment, ROM reported, symptoms suffered, and ligament laxity. The Lysholm knee score was applied to assess subjective symptoms [8]. The side-to-side difference at maximal manual exam was used to assess the anteroposterior translation for the degree

of ligament laxity. Posterior drawer test was applied to evaluate knee stability. Hamstring-area pain was subjectively analyzed by the patients to estimate the donor-site morbidity.

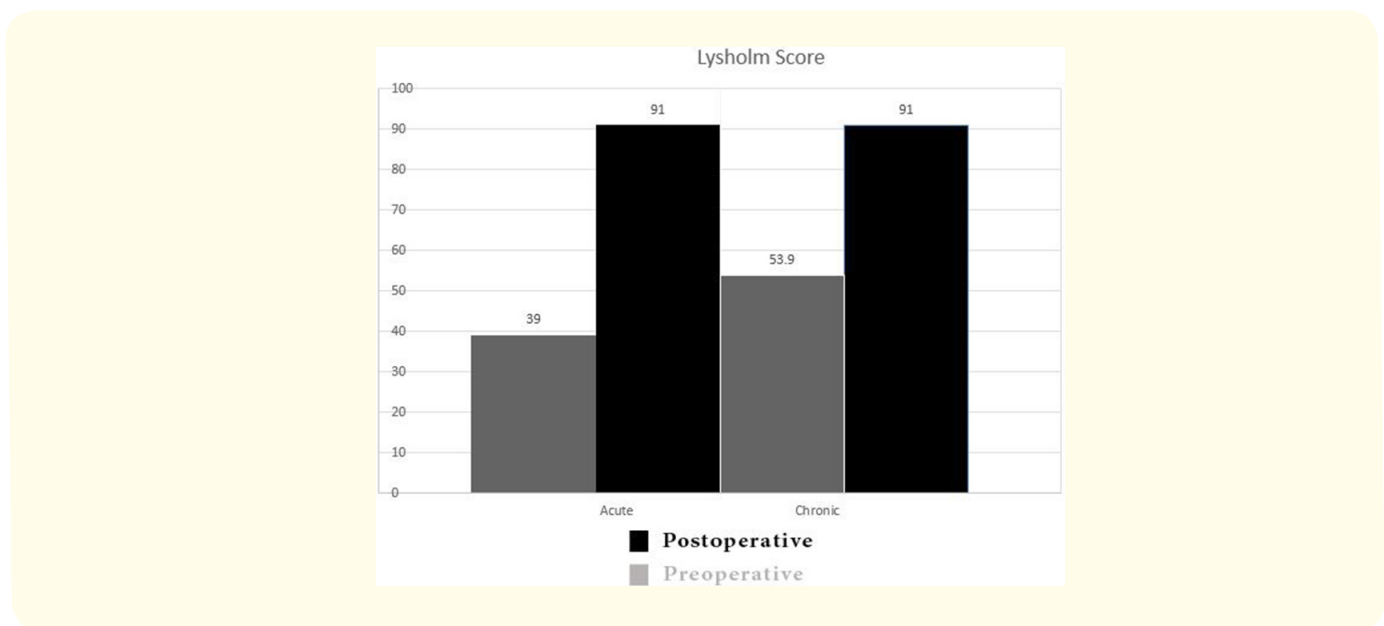
### Statistics analysis

Statistical analysis was performed by an independent statistician. The k2 test was used to compare the ligamentous laxity, the activity level, and the IKDC final rating outcomes between preoperative and last follow-up stage. The Mann–Whitney U test was used to compare Lysholm scores for the preoperative and postoperative assessments. The level of statistical significance is considered as P values\0.05.

## Results

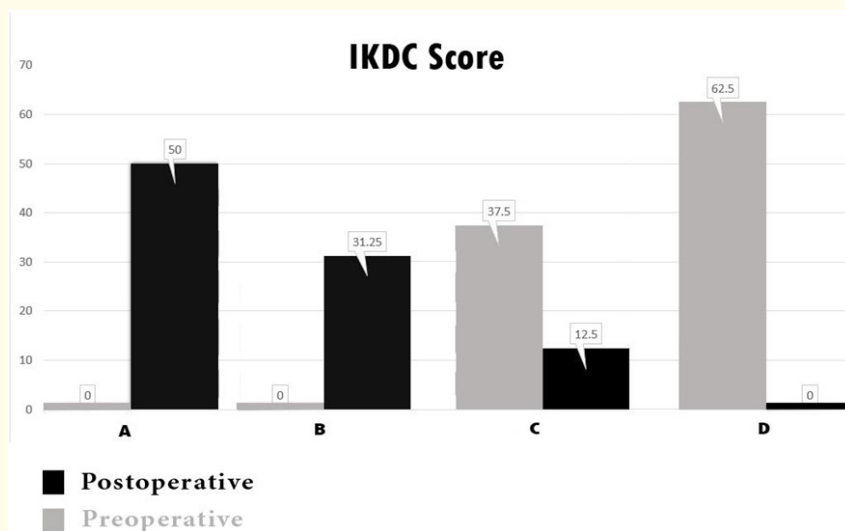
### Lysholm knee scores

The Lysholm knee scoring system was applied to assess subjective symptoms. The mean preoperative Lysholm score for 16 knees was 53 (range, 25–74); the mean postoperative Lysholm score was 91 (range, 64–100). After a minimum of 2 years of follow-up, 8 of 16 patients (50%) achieved excellent outcomes, and 6 patients (37.5 %) achieved good outcomes. Of the remaining patients, One patient (6.25 %) achieved fair outcomes and one patient had poor outcome (6.25 %) . A significant difference in Lysholm scores between preoperative and final follow-up evaluations was found (P\0.05).



### IKDC evaluation

Activity levels preinjury, preoperative, and at final follow-up Examination were assessed. All of the patients had strenuous or moderate preinjury activity levels. Whereas, at time of operation, only 2 of 16(12.5%) patients stated capability of strenuous or moderate physical activity, on the same time 8 f 16 patients(50%) could perform light and 6 of 16 patients (37.5%) sedentary activity. However, at final follow-up examination, 14 (87.5 %) of 16 patients had strenuous or moderate activity, and only 2 patients (12.5%) were limited to light activity. Patient activity levels thus stated considerable improvement after reconstruction (P = 0.0001).



#### **Knee function due to patient subjective evaluation**

In comparison with the preinjury condition, 14 patients (87.5%) subjectively reported their knee function as normal or near normal. Symptom: Of 16 patients 13 (81.25 %) suffered no pain along moderate or strenuous physical activities. ROM: 13 (81.25%) of these series experienced full ROM. 6–15 degree deficit in flexion from the contralateral limb was found for 2(12.5 %) of the patients. One patient (6.25 %) reported abnormal knee ROM which was defined as flexion deficit of more than 15 degree. All patients has full extension range of motion post operatively.

#### **Ligament examination**

All patients have grade c (10-15mm) or d(more than 15mm) Posterior drawer test preoperatively. Post operative examination showed that 12 (75 %) of the patients exhibited a 0-5 mm ligament laxity. 3(18.75%) patients revealed a 6-10 mm ligament laxity and one patient (6.25%) showed a 10-15 mm ligament laxity.

#### **Donor-Site morbidity**

2 (12.5%) patients complained of moderate tenderness, around hamstring insertion.

#### **Functional test**

Functional 1-leg hop test results at the final follow-up examination demonstrated that 12 (75 %) patients hopped 90 % of the distance hopped with their healthy limb. 3 (18.75 %) patients achieved 76–89 % of the distance hopped with their normal leg. 1 (6.25 %) patients attained 50–75 % of the distance achieved by their normal limb.

#### **Final IKDC score**

Before reconstruction, all of patients (100 %) were assessed as abnormal or severely abnormal (grade C or D). In contrast, 14 of the 16 patients (87.5 %) were rated as normal or nearly normal (grade A or B), and 2 (12.5%) were noted as abnormal at final follow-up examination. In comparison with preoperative data there was a statistically significant progress in final rating of the normal–nearly normal against the abnormal–severely abnormal. (P\0.05).

### Complications

One patient has serous discharge and effusion 9 months after operation which was resolved by antibiotics. No patient had any joint abscess or deep wound infection. None of our patients had hardware removal.

### Discussion

The use of allograft versus autograft tissue for ligamentous reconstruction is still debated in the literature. Some authors advocating autograft as the gold standard and yet others have been demonstrating decreased pain and stiffness with equivalent objective and subjective outcomes with allograft compared to autograft. Autograft is particularly limited in the case of multiligamentous injuries that require multiple grafts, and harvesting can cause donor-site morbidity. However, allograft also has limited availability and this availability can vary greatly by geographic region. [8-11] A meta-analysis of 12 studies of autograft used in isolated PCL reconstruction found that hamstring tendon was used in 72 % of patients, followed by B-PT-B in 16 %, and QT-B in 12 %. The extensor mechanism acts synergistically with the PCL to prevent posterior tibial translation; thus, weakening the quadriceps is a theoretical.

Concern when using it as an autograft. So, less popular than other graft options. (12-13-14) Autograft tissues have no risk of transmission of an infectious disease; they exhibit faster incorporation with adjacent tissues, have no risk of immune-mediated tissue rejection and not exposed to sterilization, which could have a negative impact on both the biomechanical and biological properties of the graft. Autograft hamstring harvest has been associated with symptomatic neuroma, numbness, arthrosis, symptomatic hardware requiring removal, posterior knee pain, and terminal flexion hamstring weakness. [15] The maximum tensile stress of PCL and 4SHG are 1,800 and 4,000 N, respectively. The initial strength of 4SHG looks enough to reconstruct the injured PCL. However, in fact, the tendon-bone interface cannot be restored to its normal histological structure after ligament reconstruction using the existing treatment methods, leading to decreased strength of grafts. In addition, it is well known that autografts have to undergo 'ligamentization' process including revascularization, cell proliferation and remodeling about 1 year after reconstruction, and they are prone to collapse and laxity in this course. [16-18] Multi stranded hamstring tendon grafts have been shown as an outstanding graft choice in patients with PCL ruptures. By means of the hamstring tendon graft method, there is no further incision to be made in the supra patellar area, which as a consequence improved cosmesis. On the other hand, earlier rehabilitation programs, in our study, would appear to be easier for the involved knee. In comparison with the patellar tendon-bone graft or quadriceps tendon graft method, the hamstring tendon graft technique prevents a further incision and extensor mechanism troubles, with which patellar pain has been a major problem. [19-21]

Therefore, during operation, PCL stump and its surrounding synovium are retained in order to promote grafts healing and incorporation, and moreover, PCL stump may provide mechanical support for the reconstructive ligament. PCL reconstruction using quadrable hamstring graft alone can obtain better therapeutic effects because the mechanical strength of quadrable hamstring graft combined with PCL stump is enough to act as PCL role. In this study, compared with preoperative assessment, the stability and function of the affected knee were significantly improved after PCL reconstruction using quadrable hamstring graft by remnant preservation technique. Our results are consistent with those of some other results. [22-24] The hamstring tendon graft technique results in better initial fixation strength than the patellar tendon graft procedure, more compatible with accelerated rehabilitation protocols. Likewise, because of multi stranded characteristic of hamstring tendon graft which will be provided a larger surface area, it can promote revascularization. [25,26] Before surgery, all of the patients suffered from knee instability with persistent pain, swelling, or giving way during physical activities. Our results showed that 93.75 % of the patients had no pain during moderate or strenuous physical activities after operation. 87.5% of the patients complained no swelling of the involved knee during moderate or strenuous physical activities. 93.5% percent reported no giving way during their physical activities. By use of the hamstring tendon graft, the quadriceps muscle rehabilitation possibly more accelerated to resume the extensor muscle strength as soon as possible. Our trial revealed that 2 years after reconstruction, 87.5% of the patients could reach to more than 75 % of their extensor muscle strength, in comparison with the normal limb. Activity-related discomfort at the donor place was uncommon. The pain could be resolved throughout 3 months after surgery. In our survey, at 2-year follow-up, 75 % of the patients recovered sufficiently in flexor muscle strength, in comparison with contra lateral

side. No morbidity was found in association with harvesting of the hamstring tendon. It seems, however, that a lot of patients reduced their activity level between reconstruction and follow-up, probably explaining the rare incidence of complete restoration of knee function after operation. Many studies displayed that PCL injury is a cause of degenerative changes in the knee, primarily involving the medial, patellofemoral, and lateral compartments, respectively. This rate increases with time between injury and operation, severity of ligament laxity, and duration of follow up time. [28-27] In this trial, we have assessed the outcomes of quadruple-strand hamstring tendon graft for PCL reconstruction. Only the patients who underwent arthroscopic reconstruction of isolated PCL injury without any associated injuries were included in this study. The semitendinosus and gracilis tendon graft is sufficient in terms of graft size, and it has resulted in the least harvesting morbidity.

### Conflict of Interests

None of the authors have any conflict of interests associated with this study.

### Conclusion

We recommend using quadruple hamstring tendon graft with endobutton fixation for PCL reconstruction to achieve good ligament reconstruction, as our patients experienced a clinical improvement based on posterior stability, range of motion, Lysholm and IKDC scoring.

### Bibliography

1. James P Stannard and Richard M. "Anatomic PCL Reconstruction, The Double Bundle Inlay Technique". *Operative Techniques in Sports Medicine* 17.3 (2009): 148-155.
2. Kannus P, et al. "Injuries to the posterior cruciate ligament of the knee". *Sports Medicine* 12.2 (1991): 110-131.
3. Michael D., et al. "Evaluation and Management of posterior cruciate ligament injuries". *Physical Therapy in Sport* 13.4 (2012): 196-208.
4. Sung-Jae Kim., et al. "Arthroscopic posterior cruciate ligament tibial inlay reconstruction". *Journal of Arthroscopy and related surgery* 20.6 (2004): 149-154.
5. Bernard R., et al. "An Accessory Portal for PCL Tibial Insertion Visualization". *Journal of Arthroscopy and Related Surgery* 20.6 (2004): 155-158.
6. Delee JC and Drez D. "The PCL in Delee Orthopaedic Sports medicine". (2003): 2087-2110.
7. Ai't Si Selmi T., et al. "The evolution of osteoarthritis in 103 patients with ACL reconstruction at 17 years follow-up". *Knee* 13.5 (2006): 353-358.
8. Tegner Y and Lysholm J. "Rating systems in the evaluation of knee ligament injuries". *Clinical Orthopaedics and Related Research* 198 (1985): 43-49.
9. Montgomery SR., et al. "Surgical management of PCL injuries: indications, techniques, and outcomes". *Current Reviews in Musculoskeletal Medicine* 6.2 (2013): 115-123.
10. McAllister DR., et al. "Allograft update: the current status of tissue regulation, procurement, processing, and sterilization". *The American Journal of Sports Medicine* 35.12 (2007): 2148-2158.
11. Ahn JH., et al. "Posterior cruciate ligament reconstruction: double-loop hamstring tendon autograft versus Achilles tendon allograft—clinical results of a minimum 2-year follow-up". *Arthroscopy* 21.8 (2005): 965-969.
12. Lien OA., et al. "Clinical outcome after reconstruction for isolated posterior cruciate ligament injury". *Knee Surgery, Sports Traumatology, and Arthroscopy* 18.11 (2010):1568-1572.
13. Hudgens JL., et al. "Allograft versus autograft in posterior cruciate ligament reconstruction: an evidence-based systematic review". *Journal of Knee Surgery* 26.2 (2013): 2):109-115.



14. Wu CH., *et al.* "Arthroscopic reconstruction of the posterior cruciate ligament by using a quadriceps tendon autograft: a minimum 5- year follow-up". *Arthroscopy* 23.4 (2007): 420-427.
15. Nakamura N., *et al.* "Evaluation of active knee flexion and hamstring strength after anterior cruciate ligament reconstruction using hamstring tendons". *Arthroscopy* 18.6 (2002): 598-602.
16. Hamner DL., *et al.* "Hamstring tendon grafts for reconstruction of the anterior cruciate ligament: biomechanical evaluation of the use of multiple strands and tensioning techniques". *The Journal of bone and joint surgery. American volume* 81.4 (1999): 549-557.
17. Harner CD., *et al.* "The human posterior cruciate ligament complex: an interdisciplinary study. Ligament morphology and biomechanical evaluation". *The American Journal of Sports Medicine* 23.6 (1995): 736-745.
18. Jung YB., *et al.* "Characterization of spontaneous healing of chronic posterior cruciate ligament injury: analysis of instability and magnetic resonance imaging". *Journal of Magnetic Resonance Imaging* 27.6 (2008): 1336-1340.
19. Chen CH., *et al.* "Arthroscopic reconstruction of the posterior cruciate ligament: a comparison of quadriceps tendon autograft and quadruple hamstring tendon graft". *Arthroscopy* 18.6 (2002): 603-612.
20. Aglietti P., *et al.* "Patellar tendon versus doubled semitendinosus and gracilis tendons for anterior cruciate ligament reconstruction". *The American Journal of Sports Medicine* 22.2 (1994): 211-217.
21. Shino K., *et al.* "Arthroscopic posterior cruciate ligament reconstruction using hamstring tendons: one-incision technique with Endobutton". *Arthroscopy* 12.5 (1996): 638-642.
22. Pinczewski LA., *et al.* "Arthroscopic posterior Cruciate ligament reconstruction using fourstrand hamstring tendon graft and interference screws". *Arthroscopy* 13.5 (1997): 661-665.
23. Ahn JH., *et al.* "Posterior cruciate ligament reconstruction: double-loop hamstring tendon autograft versus Achilles tendon allograft—clinical results of a minimum 2-year follow-up". *Arthroscopy* 21.8 (2005): 965-969.
24. Lin YC., *et al.* "Arthroscopic transtibial single-bundle posterior cruciate ligament reconstruction using patellar tendon graft compared with hamstring tendon graft". *Archives of Orthopaedic and Trauma Surgery* 133.4 (2013): 523-530.
25. Rowden NJ., *et al.* "Anterior cruciate ligament graft fixation. Initial comparison of patellar tendon and semitendinosus autografts in young fresh cadavers". *The American Journal of Sports Medicine* 25.4 (1997): 472-478.
26. Pinczewski LA., *et al.* "Integration of hamstring tendon graft with bone in reconstruction of the anterior cruciate ligament". *Arthroscopy* 13.5 (1997): 641-643.
27. Yasuda K., *et al.* "Graft site morbidity with autogenous semitendinosus and gracilis tendons". *Archives of Orthopaedic and Trauma Surgery* 23.6 (2014): 1723-1730.
28. Wang CJ., *et al.* "Outcome of arthroscopic single bundle reconstruction for complete posterior cruciate ligament tear". *Injury* 34.10 (2003): 747-751.

**Volume 3 Issue 2 February 2016**

**© All rights are reserved by Mohamed Attia Abdel Moeti., *et al.***