Arthroscopic single-bundle posterior cruciate ligament reconstruction using a hamstring autograft: results after early and delayed rehabilitation

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Background
Posterior cruciate ligament (PCL) reconstruction remains a challenging operation. There are many factors to be considered in this technique, including graft material selection and method of fixation. This prospective study compared the clinical results of single-bundle PCL reconstruction using a hamstring tendon autograft, with a minimum follow-up of 2 years.

Patients and methods
A total of 26 patients were included in the study: 13 patients who started physical therapy on the second postoperative day and 13 who had their knees immobilized in full extension for 3 weeks. All patients had an isolated chronic PCL rupture. The evaluation parameters included the International Knee Documentation Committee scores and the Lysholm knee scores.

Results
The results showed a significant difference in the functional scores between the two groups. In contrast to many recent reports that favor early range of motion exercises, the results of this study showed better clinical results with delayed rehabilitation.

Conclusion
Protection of the knee early in the postoperative period improves the clinical results.

Keywords:
arthroscopy, hamstring tendon, posterior cruciate ligament, reconstruction

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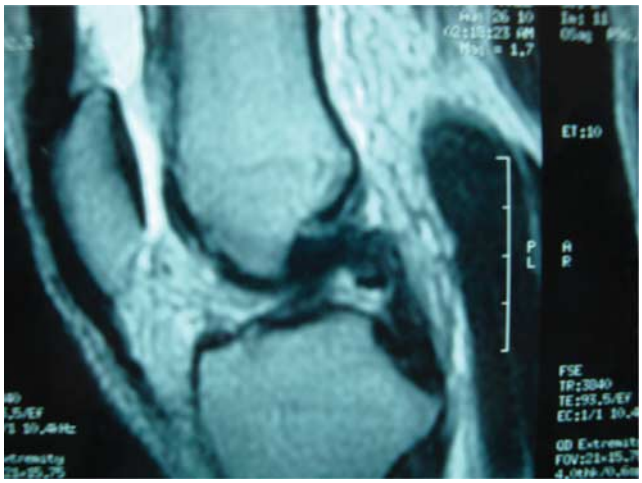
Introduction

The incidence of isolated posterior cruciate ligament (PCL) rupture is low [1]. PCL rupture is often associated with other ligament injuries. In a multiligament-injured knee, repair or reconstruction of all the disrupted structures is the treatment of choice [2,3], although some cases may be treated conservatively when they do not belong to grade III injuries [4]. Interest in PCL reconstruction increased with better understanding of the functional anatomy and biomechanics and improvements in surgical techniques. The technique of reconstruction has advanced such that arthroscopic procedures have become easier, although technically demanding. A number of graft materials and fixation methods have been reported along with single-bundle and double-bundle, transtibial, and tibial inlay techniques [5–9]. Today PCL reconstructive surgery often yields very good results, with a return to the patient's preinjury level of activity [10–12]. Surgeons tend to focus on advances in surgical techniques, graft materials, and methods of fixation. However, with regard to PCL outcomes, improved understanding of rehabilitation may be an equally critical factor in the ability to restore knee stability and function. The aim of this study was to compare the results of early and delayed rehabilitation after PCL reconstruction using a four-strand hamstring autograft.

Patients and methods

This series consisted of 26 patients who underwent PCL reconstruction with a four-strand single-bundle hamstring tendon autograft from March 2006 to June 2009. All patients were males; the average age was 29.4 years (range 24.1–42.4 years). The right knee was affected in 17 patients and the left knee in nine. In 24 patients, the mechanism of injury was high-energy trauma, and in two patients the injury was sports related. Associated injuries included two cases of acetabular fractures in the same limb and three cases of fracture of the ipsilateral shaft of the femur that were treated at the time of injury. All patients underwent preoperative MRI to assess the condition of the knee ligaments and cartilage (Fig. 1). The average time to PCL surgery was 8.5 months (3–12.4 months) after the time of injury. The posterior drawer test score was + 2 for 15 patients and + 3 for 11 patients (Table 1). The duration of follow-up was 2 years postoperatively. The patients were asked to follow-up at 3, 6, 12, and 24 months after surgery. All patients with a combined ligament injury were excluded from the study. One patient was excluded because of sepsis of the knee that required graft removal at 12 months from date of index surgery. The indication for surgery was the functional disability of the knee due to instability and pain.

Figure 1



An MRI showing a posterior cruciate ligament tear with an intact anterior cruciate ligament.

Figure 2

Arthroscopic pseudolaxity of anterior cruciate ligament with rupture of posterior cruciate ligament.

Table 1 Posterior drawer test scores preoperatively and postoperatively in both groups

	Degree of posterior drawer				
Groups	0	+	+ +	+ +	+ + +
Early rehabilitation					
Preoperative	–	0	–	7	6
Postoperative	–	5	7	–	1
Late rehabilitation					
Preoperative	–	0	–	8	5
Postoperative	–	10	3	–	–

Figure 3

A posterior cruciate ligament footprint with a guide pin at the 1:30 position in the right knee.

Surgical technique

Under either general or spinal anesthesia, a thorough physical examination was carried out to identify patients with combined ligament injuries. A tourniquet was applied to the involved leg, which was then exsanguinated and the tourniquet inflated. Diagnostic arthroscopy was performed. The anterior cruciate ligament appears lax in the PCL-injured knee (Fig. 2). This pseudolaxity has been described by many authors [13,14] as disappearing with an anterior force applied to the tibia.

The semitendinosus and gracilis tendons were harvested through an anteromedial incision. The tendon ends were sutured with number 2 ethibond whipstitch style sutures. The tendons were then folded midway, thus creating a four-strand graft. The graft was sized before use and was pretensioned.

The PCL stump was debrided. A posteromedial portal was used to elevate the posterior capsule and expose the distal insertion of PCL. An attempt was made to reconstruct the anterolateral bundle of PCL by placing the tunnels toward the anterior portion of the femoral footprint (Fig. 3) and the lateral and distal portion of the tibial footprint of PCL. With the scope placed in the anterolateral portal, a PCL aiming device was used in the anteromedial portal (Fig. 4). A guide wire was passed for the tibial tunnel. The exit point was 1.5 cm below the joint surface, lateral to the midline. The position was checked by image intensification. A tunnel was then drilled to a size that matched the diameter of the graft. A curette was placed through the posteromedial portal over the tip of the guide wire while drilling to prevent inadvertent advancement of the wire with risk of injury to the popliteal vessels. The femoral tunnel was fashioned by inserting the femoral drill guide through the anteromedial portal on the PCL stump, ~8 mm from the articular cartilage. It was placed in the half past one or the half past ten position, depending on the right or left knee. The tunnel diameter was fashioned according to the size of the graft.

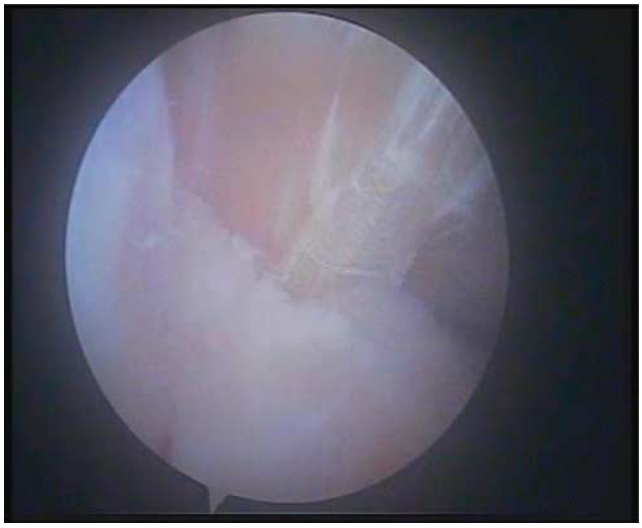
A looped wire was passed through the tibial tunnel, then was grasped under visualization through the anteromedial

portal, and then redirected through the femoral tunnel to be delivered externally on the femoral side. The sutures attached to the graft were then retrieved from the tibial side through the looped wire and were pulled from the femoral side. The graft was eventually passed through the tibia and then into the femoral tunnel. A 2-cm incision was made on the femoral side, and an interference screw was used to fix the graft in the femoral tunnel. Tension was placed on the tibial end of the graft, the knee was placed in 70° of flexion, and an anterior drawer was applied to the tibia to eliminate any posterior sag. The normal 1–2 cm step off of the tibia was felt between the medial femoral condyle and the medial tibial plateau. The graft was fixed with an interference screw in the tibial tunnel, and an additional post was used to make a secure fixation with the ethibond suture.

Figure 4

A tibial guide inserted through the anteromedial portal.

Figure 5



Arthroscopic view after the posterior cruciate ligament graft was tensioned.

The knee was then tested for stability and the graft examined arthroscopically (Fig. 5). Sterile dressings were used.

Postoperative management

The patients were randomly divided into two groups. The knee was protected in a functional knee brace for all 26 patients postoperatively. In 13 patients, the postoperative management included walking with partial weight bearing on the operated leg and physical therapy that started on the second postoperative day. Patients were allowed to perform limited range of knee motion out of the brace three times a day. Full weight bearing and full range of motion were allowed after 6 weeks. In the other group comprising 13 patients, weight bearing was delayed for 6 weeks, and the knee brace was locked in full extension for 4 weeks. Progressive range of motion was allowed after 4 weeks. Progressive weight bearing with crutches was allowed from week 7 until full weight bearing was permitted after 10 weeks.

The evaluation parameters included the International Knee Documentation Committee (IKDC) scores and the Lysholm rating scores, the latter of which was used for general knee evaluation. The results of the two groups were compared using Student's *t*-tests, and significance was set at the 5% level.

Results

One patient had a knee infection, and the graft had to be removed with debridement of the knee. The patient was excluded from the study.

In the first group, the range of motion was restored early with loss of full knee flexion in two patients and loss of hyperextension in one patient. In the second group, full flexion was lost in four patients and hyperextension was lost in one patient.

Improvement in the scores of the posterior drawer test was achieved in 12 of 13 patients of the first group and in all patients of the second group (Table 1).

The results of the functional assessment on using the IKDC scale showed greater improvement in the second group compared with the first group (Table 2).

The Lysholm score for the early rehabilitation group was 76 on average compared with 88 for the late rehabilitation group. Return to their former activity level occurred in seven patients of the early rehabilitation group and in 11 patients of the late rehabilitation group ($t = 2.62$, $P < 0.01$).

Table 2 International Knee Documentation Committee scores for both groups

IKDC	Early rehabilitation	Late rehabilitation
Normal	1	4
Nearly normal	5	7
Abnormal	5	2
Severely abnormal	2	0

IKDC, International Knee Documentation Committee.

Discussion

The improvements in results after PCL reconstruction have occurred because of better understanding of the biomechanics of the knee, use of better techniques, and better fixation of grafts. The optimal technique of PCL reconstruction is yet to be defined because of the need to consider several factors such as graft type and fixation methods (single-bundle or double-bundle fixation).

In this study, the IKDC scores were normal or near normal in six of 13 patients with early rehabilitation and in 11 of 13 patients with delayed rehabilitation. Few clinical studies have reported the outcomes of isolated PCL reconstruction. Mariani *et al.* [9] reported the results of 24 patients treated with an arthroscopic single-bundle reconstruction using patellar tendon autografts. At a 2-year follow-up, only 25% of cases were graded normal and 21% were graded abnormal on the IKDC scale. Zhao *et al.* [15] reported the results of 43 patients after 2 years who underwent single-bundle PCL reconstruction using 4–7 bundles of hamstring tendon grafts, with the results varying from normal (60%) to abnormal (30%) to severely abnormal ($\sim$10%) on the IKDC scale. Jin *et al.* [16] compared the double-loop hamstring tendon autograft with the Achilles tendon allograft. After a 2-year follow-up, 89% of cases in the hamstring group were nearly normal compared with 78% of the Achilles group.

The drawback of this study is the short follow-up period. Many studies report that PCL injury is associated with an increase in the incidence of degenerative changes in the knee [17], and we suggest a longer follow-up to compare the results with the documented literature.

Unlike the anterior cruciate ligament (ACL), surgical reconstruction of PCL achieves inferior results in terms of restoration of ligament stability [17]. The normal PCL is twice as strong as the normal ACL; therefore, the results of a four-strand PCL reconstruction are inferior to those of a four-strand ACL reconstruction.

Conclusion

PCL reconstructions performed according to different described techniques have yielded successful results. From this study, we conclude that slow and deliberate postoperative rehabilitation that permits healing can improve the chances of achieving successful outcomes.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Fowler PJ, Messieh SS. Isolated posterior cruciate ligament injuries in athletes. Am J Sports Med 1987; 15:553–557.

2 Fanelli GC, Giannotti BF, Edson CJ. Arthroscopically assisted combined anterior and posterior cruciate ligament reconstruction. Arthroscopy 1996; 12:5–14.

3 Fanelli GC, Giannotti BF, Edson CJ. Arthroscopically assisted combined posterior cruciate ligament/posterior lateral complex reconstruction. Arthroscopy 1996; 12:521–530.

4 Mariani PP, Becker R, Rihn J, Margheritini F. Surgical treatment of posterior cruciate ligament and posterolateral corner injuries. An anatomical, biomechanical and clinical review. Knee 2003; 10:311–324.

5 Ahn JH, Chung YS, Oh I. Arthroscopic posterior cruciate ligament reconstruction using the posterior trans-septal portal. Arthroscopy 2003; 19:101–107.

6 Clancy WG Jr, Shelbourne KD, Zoellner GB, Keene JS, Reider B, Rosenberg TD. Treatment of knee joint instability secondary to rupture of the posterior cruciate ligament. Report of a new procedure. J Bone Joint Surg 1983; 65:310–322.

7 Berg EE. Posterior cruciate ligament tibial inlay reconstruction. Arthroscopy 1995; 11:69–76.

8 Harner CD, Höher J. Evaluation and treatment of posterior cruciate ligament injuries. Am J Sports Med 1998; 26:471–482.

9 Mariani PP, Adriani E, Santori N, Maresca G. Arthroscopic posterior cruciate ligament reconstruction with bone-tendon-bone patellar graft. Knee Surg Sports Traumatol Arthrosc 1997; 5:239–244.

10 Fanelli GC, Edson CJ. Arthroscopically assisted combined anterior and posterior cruciate ligament reconstruction in the multiple ligament injured knee: 2- to 10-year follow-up. Arthroscopy 2002; 18:703–714.

11 Fanelli GC. Systematic approach to the multiple ligament injured knee. Arthroscopy 2003; 19 **(Suppl 1):** 30–37.

12 Fanelli GC, Orcutt DR, Edson CJ. Current concepts: the multiple ligament injured knee. Arthroscopy 2005; 21:471–486.

13 Schulte KR, Harner CD. Management of isolated posterior cruciate ligament injuries. Oper Tech Orthop 1995; 5:270–275.

14 Wang C-J, Weng L-H, Hsu C-C, Chan Y-S. Arthroscopic single- versus double-bundle posterior cruciate ligament reconstructions using hamstring autograft. Injury 2004; 35:1293–1299.

15 Zhao J, Huangfu X. Arthroscopic single-bundle posterior cruciate ligament reconstruction: retrospective review of 4- versus 7-strand hamstring tendon graft. Knee 2007; 14:301–305.

16 Jin HA, Jae CY, Joon HW. Posterior cruciate ligament reconstruction: double-loop hamstring tendon autograft versus achilles tendon allograft – clinical results of a minimum 2-year follow-up. Arthroscopy 2005; 21:965–969.

17 Wang C-J, Chen H-S, Huang T-W. Outcome of arthroscopic single bundle reconstruction for complete posterior cruciate ligament tear. Injury 2003; 34:747–751.