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Case Report

A new method for tensioning of a chronic tibial bony avulsion of the posterior cruciate ligament as a posteromedial bundle and augmentation by anterolateral bundle reconstruction in a bicruciate ligament injury: A case report

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ABSTRACT

Multiple ligament injury is associated with high instability; hence, it is necessary to restore stability through application of a reliable treatment strategy. We report our experiences in handling a case of ruptured anterior cruciate ligament (ACL) complicated by chronic bony avulsion of the posterior cruciate ligament (PCL). Favourable results were obtained as a result of ACR reconstruction following a new method for tensioning of the chronic tibial bony avulsion of PCL as a postero-medial bundle and augmentation by PCL anterolateral bundle reconstruction. Favourable posterior stability could be restored through application of this new technique incorporating post-reconstruction PCL reinforcement.

Introduction

Given that multiple ligament injury is associated with high instability, it is necessary to restore stability through application of a reliable treatment strategy. Particularly in cases complicated by anterior cruciate ligament and posterior cruciate ligament insufficiency, it is recommended that the anterior cruciate ligament (ACL) reconstruction be performed after securing the posterior stability caused by the posterior cruciate ligament (PCL) failure. We report a case of anterior cruciate ligament (ACL) injury accompanying a chronic tibial bony avulsion of the PCL that was successfully treated using a two-step procedure: ACL reconstruction using a new technique of retensioning of the chronic tibial bony avulsion of the PCL as a postero-medial bundle and augmentation by PCL anterolateral bundle reconstruction, with favourable results.

Case presentation

A 37-year-old female patient presented with a chief complaint of right knee joint pain and instability. Three years earlier, the patient had sustained trauma to her right knee due to an impact with a body board, and a local physician diagnosed the injury as a tibial bony avulsion of the PCL and administered conservative treatment. Following a fall down the stairs, the patient's right knee was twisted, and she subsequently underwent a medical examination in this department.

The initial examination revealed mild patellar floating after a patellar bounce test, and the joint range of motion of 120° in the patient's right knee joint. The results of the anterior drawer test, Lachman test, pivot-shift test, N-test, posterior drawer test, and sagging test were positive. Both the valgus and varus stress tests were negative. The anteromedial drawer and posterolateral drawer tests were not significant, compared to the normal anterior and posterior drawer tests. The dial test was negative. A side-to side-difference of 20 mm was noted with respect to the total displacement with manual max as measured using a KT-2000 device (Medmetric Corporation, San Diego, USA). The knee injury and

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osteoarthritis outcome score (KOOS), Lysholm knee scale, and Tegner activity scores were 76.8, 57, and 2 points, respectively.

Simple lateral X-ray imaging revealed detached bone fragments at the site of the PCL tibial insertion, and a side-to-side difference of 13.02 mm in posterior tibial displacement was observed using the Telos stress device with the posterior drawer. A computed tomography (CT) scan revealed the presence of two bone fragments that had been avulsed from the PCL tibial insertion site. In addition, the magnetic resonance imaging (MRI) scan revealed that the bone fragments on the tibial side were avulsed. A buckling image was found at the substantial portion of the remaining PCL, and the ACL was observed as an expanded image at the femoral insertion site (Fig. 1). Based on the above findings, the patient was diagnosed with anterior and posterior but no medial, lateral, and posterolateral instabilities due to a prior tibial bony avulsion of the PCL accompanying a ruptured ACL.

We decided to perform a surgical treatment based on the above diagnosis. The endoscopy revealed a damage to the articular cartilage (International Cartilage Research Society (ICRS) classification grade 2) in the medial femoral condyle, and the ACL was not attached on the femoral side. In addition, we confirmed the remnant of the PCL parenchyma. With the patient in a left lateral decubitus position, the right knee joint was raised and positioned so as to allow for both the anterior and posterior sides to be approached simultaneously (Fig. 2). Surgery was performed from behind following the Burks' approach,[1] exposing two large and small PCL-avulsed tibial bone fragments. The small fragments exhibiting less adhesion to the PCL were deemed to be unstable and were excised. The bone bed on the tibial side was refreshed using a surgical bar. A strong suture thread was used for the remaining PCL-avulsed bone fragments. A 4.5 mm diameter bone tunnel was created at the most posterior part of PCL tibial insertion site, which was considered to be the PCL posteromedial bundle (PMB). Additionally, PCL anterolateral bundle (ALB) reconstruction was performed as a reinforcement using the semitendinosus tendon. To preserve the PCL remnant on the femoral footprint, femoral ALB bone tunnel was created most anteriorly and distally within the PCL footprint. The tibial ALB bone tunnel was created most anteriorly and laterally within the tibial fracture bed. During the fixation, tension of manual max was applied to the ALB graft and the pull-out suture simultaneously, while anterior tibial translation was applied in order to eliminate the step-off at 90° of knee flexion. A pull-out fixation was performed for the tibial bony avulsion of PCL using small DSP plates (Meira, Co. Ltd, Nagoya, Japan) and a GTS cancellous screw (Meira, Co. Ltd, Nagoya, Japan). An ALB graft fixation was also performed using the same plate and screw. Three months after the initial surgery, an anatomical ACL reconstruction[2] using rectangular tunnel/bone-patellar tendon-bone was performed (Fig. 3).

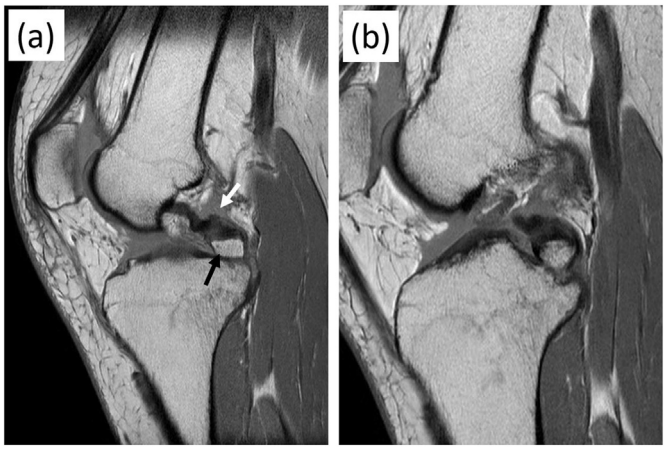

Fig. 1. (a) Pre-operative magnetic resonance imaging (MRI) sagittal view showing posterior cruciate ligament (PCL) buckling sign (white arrow) and tibial bony avulsion fracture of the PCL (black arrow). (b) Pre-operative MRI sagittal view showing anterior cruciate ligament (ACL) rupture at the femoral side.

Postoperative rehabilitation protocol

One year after the initial surgery (9 months after the second surgery), the patient was permitted to participate in sporting activities. During the first postoperative year, the side-to-side difference in the posterior tibial displacement via the Telos stress device with the posterior drawer test exhibited a marked improvement to 0.66 mm, limitations in the knee range of motion were eliminated, knee stability was improved subjectively, and the sagging observed prior to the surgery disappeared (Fig. 4). During an additional endoscopy performed during removal of fixation metal plates and screws, 2 years after surgery, both the reconstructed ACL and PCL maintained favourable tension and synovium coverage. Moreover, no new cartilage damage or meniscal lesions were observed (Fig. 5). The difference from the healthy body with respect to the total displacement by manual max as measured by the KT-2000 device (Medmetric Corporation, San Diego, USA) was 2 mm. The KOOS, Lysholm knee scale, and Tegner activity scores were 91.7, 89, and 5 points, respectively and demonstrated major improvements.

Discussion

We present a case of acute ACL rupture occurring in conjunction with PCL failure due to chronic tibial bony avulsion of the PCL. Because the patient participated in sporting activities with a failing PCL, performing ACL reconstructive surgery alone could have been considered. However, according to Weber et al.,[3] pre-surgery evaluation of the state of PCL failure is important, as performing an isolated ACL reconstruction procedure while overlooking any posterolateral instability can lead to a poor outcome.

The PCL injuries contribute more to knee joint instability than do ACL injuries. Moreover, it has been reported that, in cases involving marked posterior instability, ACL reconstruction when performed first, is done when the tibia is in a state of subdislocation and cannot be recommended. Hence, ACL reconstruction is typically performed after restoring PCL functionality.[4] Marked posterior instability was also observed in our case, and we performed reconstruction while prioritizing to control this instability. Performing ACL and PCL reconstructive surgeries simultaneously has become more common in the recent years,[5] but in consideration of the possibility of knee joint contracture, another report[6] has stated that the most desirable approach was to refrain from simultaneous ACL and PCL reconstruction, and instead consider reassessing the anterior stability 3 months or more after PCL reconstruction and performing ACL reconstruction if sufficient medical and social adaptation is present. In this case, posterior Burks' invasion[1] and two-step ACL reconstruction were performed to achieve repair and fixation and to mitigate the risks of joint contracture and malalignment of the repaired bone fragments.

PCL can be divided by functionality into ALB and PMB.[7–9] Although there was no significant difference in the clinical outcome as a result of comparing single-bundle and double-bundle reconstruction of the PCL,[10] biomechanical research studies have demonstrated that superior stability can be achieved through double-bundle reconstruction.[11] As the PCL receives an abundant blood flow, another report has stated that reinforcement surgeries using surviving tissues have achieved the same results as reconstructive surgeries.[12] This case involved Schenk classification[13] type

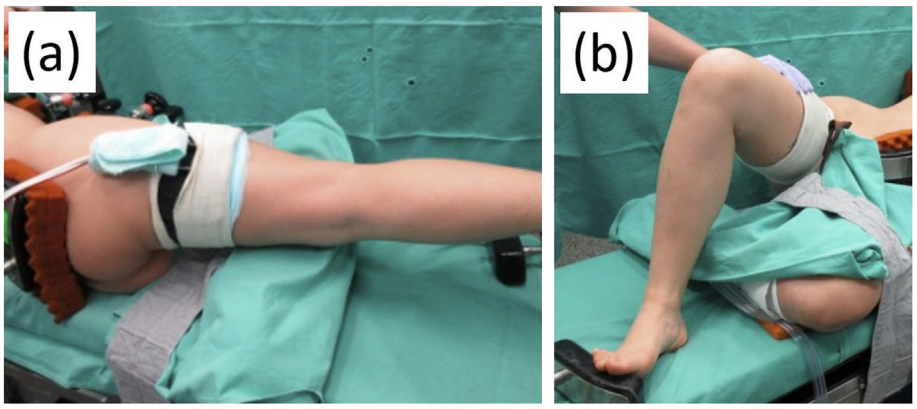

Fig. 2. The surgical position used is a side decubitus position. (a) Posterior expansion by way of Burks' invasion. (b) During arthroscopic posterior cruciate ligament (PCL) reconstruction.

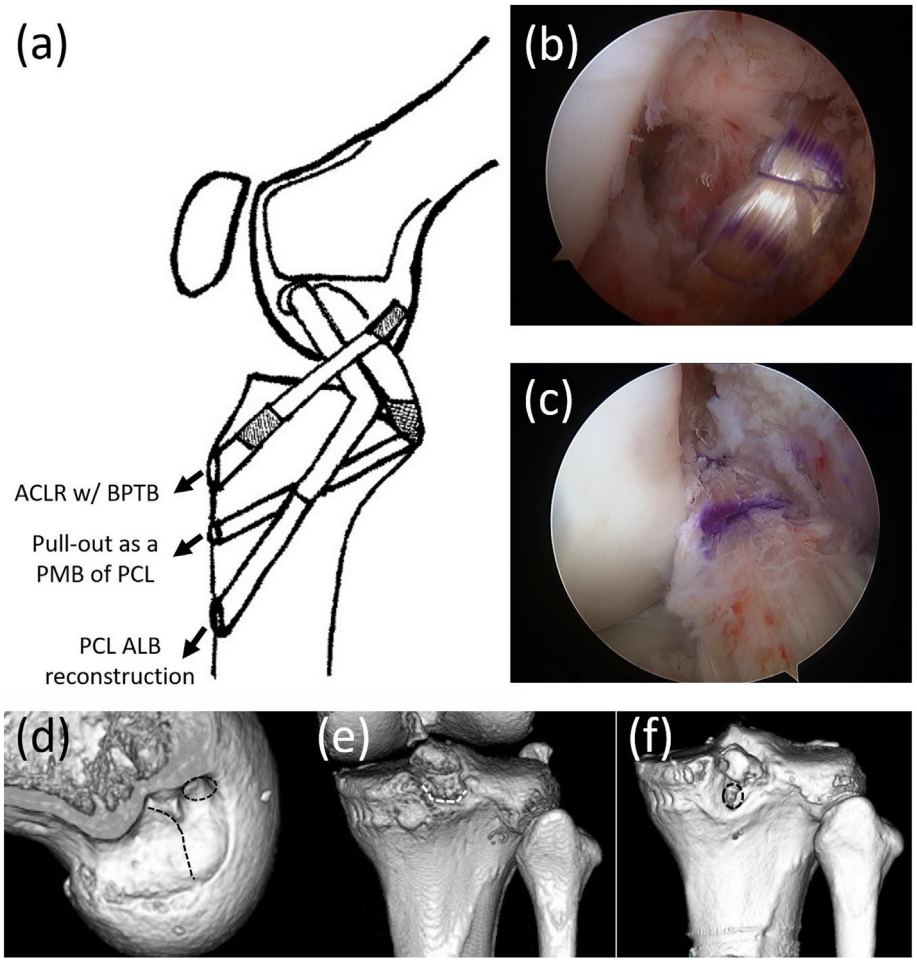

Fig. 3. (a) Schema. Tensioning of the remnant posterior cruciate ligament (PCL) via the pull-out method and reconstruction of PCL anterolateral bundle using hamstring graft are performed. Then, anterior cruciate ligament (ACL) reconstruction using BPTB graft is performed. (b) Arthroscopic view after pull-out fixation of tibial bony avulsion and posterior cruciate ligament (PCL) reconstruction. (c) Arthroscopic view after ACL reconstruction. (d) Postoperative 3DCT. To preserve the PCL remnant on the femoral footprint, ALB tunnel is created most anteriorly and distally within the PCL footprint. (e) Preoperative 3DCT shows tibial bony avulsion of PCL and its fracture bed. (f) Postoperative 3DCT. For the pull-out fixation of PCL tibial bony avulsion, tibial bone tunnel is created distally and medially to the fracture bed as a PMB. BPTB, bone-patellar tendon-bone. ALB, antero-medial bundle. PMB, postero-lateral bundle. 3DCT, three dimensional computed tomography.

II ACL and PCL injury without medial and lateral instabilities, and the remaining PCL was also sufficient. However, this was a case of prior bony avulsion of the PCL, and there was concern that early posterior stabilisation would be insufficient and synostosis would be delayed if only fixation of bone fragments was performed[14] (14) as would be done in case of a new injury. As we believed that early

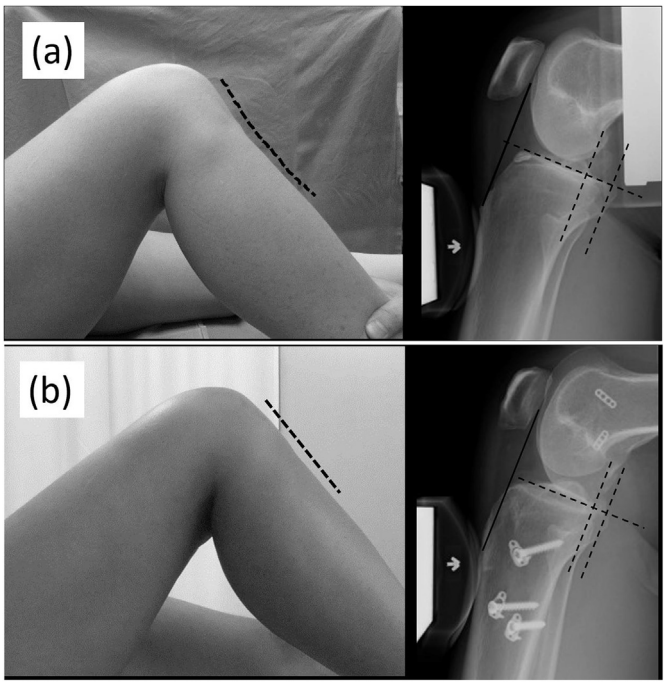

Fig. 4. (a) Preoperative image. Posterior sagging is prominent. Telos-stress imaging reveals marked posterior tibial movement. (b) Postoperative image. Posterior sagging is absent. Even in Telos-stress imaging, the posterior tibial movement is controlled.

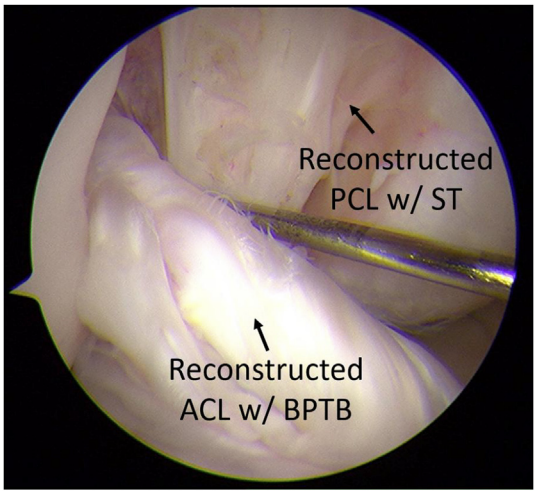

Fig. 5. Arthroscopic findings at second follow-up. Both reconstructed anterior and posterior cruciate ligament grafts show excellent tension, volume, and synovial covering.

reinforcement of posterior stability was necessary to obtain sufficient anterior stabilisation for the subsequent ACL reconstruction procedure, a reinforcement with PCL ALB reconstruction was performed. The bone fragments containing the entire PCL parenchyma were repaired as a PCL PMB, applying the anatomical double-bundle reconstruction concept. In addition, Jung et al.[15] reported a new technique for reinforcing the reconstructed ALB in cases with prior PCL injury by shifting the tibial insertion site of the remnant PCL tissue, applying the same procedural concept as in our case. However, as we have reported, we could not overlook the reports concerning avulsion fractures at the PCL insertion site.

Summary

We were able to obtain excellent posterior stability through invasive corrective fixation of the bone fragments and PCL ALB-reinforced reconstruction as a PCL PMB for chronic PCL tibial bony avulsion fracture complicated by ACL injury. Subsequent ACL reconstructive surgery could also be performed without problems. This suggests the effectiveness of this approach as a new surgical procedure for addressing chronic PCL tibial bony avulsion fracture.

Funding

No funding was received for this study.

Conflict of interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.asmart.2018.11.002.

References

1. Burks RT, Schaffer JJ. A simplified approach to the tibial attachment of the posterior cruciate ligament. *Clin Orthop Relat Res*. 1990;254:216–219.
2. Shino K, Mae T, Tachibana Y. Anatomic ACL reconstruction: rectangular tunnel/bone-patellar tendon-bone or triple-bundle/semitendinosus tendon grafting. *J Orthop Sci*. 2015;20:457–468.
3. Weiler A, Jung TM, Lubowicki A, Wagner M, Schottle PB. Management of posterior cruciate ligament reconstruction after previous isolated anterior cruciate ligament reconstruction. *Arthroscopy*. 2007;23:164–169.
4. Mook WR, Miller MD, Diduch DR, Hertel J, Boachie-Adjei Y, Hart JM. Multiple-ligament knee injuries: a systematic review of the timing of operative intervention and postoperative rehabilitation. *J Bone Joint Surg Am*. 2009;91:2946–2957.
5. Levy BA, Dajani KA, Whelan DB, et al. Decision making in the multiligament-injured knee: an evidence-based systematic review. *Arthroscopy*. 2009;25:430–438.
6. Shelbourne KD, Carr DR. Combined anterior and posterior cruciate and medial collateral ligament injury: nonsurgical and delayed surgical treatment. *Instr Course Lect*. 2003;52:413–418.
7. Forsythe B, Harner C, Martins CA, Shen W, Lopes Jr OV, Fu FH. Topography of the femoral attachment of the posterior cruciate ligament: surgical technique. *J Bone Joint Surg Am*. 2009;91:89–100.
8. Lopes Jr OV, Ferretti M, Shen W, Ekdahl M, Smolinski P, Fu FH. Topography of the femoral attachment of the posterior cruciate ligament. *J Bone Joint Surg Am*. 2008;90:249–255.
9. Tajima G, Nozaki M, Iriuchishima T, et al. Morphology of the tibial insertion of the posterior cruciate ligament. *J Bone Joint Surg Am*. 2009;91:859–866.
10. Jain V, Goyal A, Mohindra M, Kumar R, Joshi D, Chaudhary D. A comparative analysis of arthroscopic double-bundle versus single-bundle posterior cruciate ligament reconstruction using hamstring tendon autograft. *Arch Orthop Trauma Surg*. 2016;136:1555–1561.
11. Wijdicks CA, Kennedy NI, Goldsmith MT, et al. Kinematic analysis of the posterior cruciate ligament, part 2: a comparison of anatomic single- versus double-bundle reconstruction. *Am J Sports Med*. 2013;41:2839–2848.
12. Irizarry JM, Recht MP. MR imaging of the knee ligaments and the postoperative knee. *Radiol Clin*. 1997;35:45–76.
13. Schenck Jr RC. The dislocated knee. *Instr Course Lect*. 1994;43:127–136.
14. Malempati C, Felder J, Elliott M, Brunkhorst J, Miller M, Johnson DL. Current arthroscopic concepts in repairing posterior cruciate ligament tibial-sided avulsions. *Orthopedics*. 2015;38:563–569.
15. Jung YB, Jung HJ, Tae SK, Lee YS, Yang DL. Tensioning of remnant posterior cruciate ligament and reconstruction of anterolateral bundle in chronic posterior cruciate ligament injury. *Arthroscopy*. 2006;22:329–338.