abstract

The authors present a report of a bicondylar tibial plateau fracture in an adolescent athlete after posterior cruciate ligament (PCL) reconstruction. The procedure was performed via arthroscopic transtibial PCL reconstruction with quadrupled semitendinosus and gracilis autograft. The patient recovered uneventfully postoperatively and was able to participate in high-level sports activity, such as baseball and track, with no limitations, no subjective complaints, and no episodes of instability. He continued to be asymptomatic up to 3.5 years postoperatively. Almost 4 years postoperatively, the patient reinjured the left knee during recreational noncontact football and was seen emergently. Plain radiographs, magnetic resonance image scan, and computed tomography scan at the time of injury showed a bicondylar tibial plateau fracture with intra-articular involvement. Operative intervention was undertaken for open reduction and internal fixation of the bicondylar tibial plateau fracture. A plate was placed along the medial aspect of the tibia with locking and nonlocking screws, and the joint line was restored appropriately. The patient recovered uneventfully and at the most recent follow-up had full active and passive range of motion, had no subjective or objective evidence of instability, and had returned to full activity with no restrictions. The patient had no history of multiple fractures or any medical or pharmacologic history that predisposed him to decreased bone density. This case shows a unique possible complication after transtibial PCL reconstruction in an adolescent patient. [Orthopedics. 2015; 38(3):e240-e243.]
Posterior cruciate ligament (PCL) injuries are relatively common in athletes, with approximately 18.5% of cases occurring as a result of participation in sports. These injuries are isolated in anywhere from 7.5% to 40% of cases. According to some estimates, approximately 3% of the general population and 2% of National Football League players have unrecognized PCL injuries.

The indication for reconstruction after PCL injury is controversial. The grade of injury is a crucial part of most treatment algorithms. Multiple studies support non-operative treatment of grade 1 and 2 injuries (0-5 mm and 5-10 mm of posterior tibial displacement, respectively). However, nonoperative treatment of PCL injuries has shown a trend toward degenerative changes in the medial and patellofemoral compartments of the knee. Operative reconstruction has been suggested for grade 3 posterior drawer excursion (>1 cm posterior translation), abnormal rotator laxity (>5°), significant varus-valgus laxity, or combined injury.

Several methods of PCL reconstruction have been advocated, including open tibial inlay-onlay, arthroscopic transtibial, and arthroscopic tibial inlay. These procedures are associated with unique complications, failures, and risk of reoperation.

The goal of this study was to present a possible complication via a case report of a bicondylar tibial plateau fracture after PCL reconstruction in an adolescent athlete. Awareness of this potential complication and its treatment will contribute to the overall knowledge of PCL injuries. Additionally, this study provided a context for a rare complication and may facilitate improved discussions with patients regarding treatment decisions. The patient was made aware that this case would be submitted for publication and gave consent.

**Case Report**

A 16-year-old baseball player ran into a catcher and presented to the authors’ clinic with mild knee pain, swelling, and a subjective feeling of instability. Physical examination showed 3+ knee effusion, stability to varus and valgus stress, and a 12- to 14-mm posterior tibial drawer with a soft endpoint. With internal rotation, the posterior drawer did not reduce. Magnetic resonance imaging scan showed an isolated tear of the PCL (Figure 1). After a thorough discussion of treatment options, the decision was made, in conjunction with the patient and his family, to proceed with operative reconstruction.

Arthroscopic transtibial PCL reconstruction with quadrupled semitendinosus and gracilis autograft was performed uneventfully. Graft fixation was achieved with an Intrafix screw (bioabsorbable) (DePuy Orthopaedics Inc, Warsaw, Indiana) on the femoral and tibial sides as well as backup fixation on the tibial side via tying the sutures over a post (4.5-mm partial threaded screw) (Figure 2). The tunnel diameter was 10 mm. The patient recovered uneventfully and returned to baseball and track, participating fully with no pain or subjective instability within 1 year. The left knee was asymptomatic 3.5 years postoperatively.

Almost 4 years postoperatively, the patient reinjured the left knee while landing during recreational noncontact football. Plain radiographs, magnetic resonance imaging scan, and computed tomography scan at the time of injury showed a bicondylar tibial plateau fracture (Figures 3-5). Open reduction and internal fixation of the bicondylar tibial plateau fracture was performed. The patient had a plate placed along the medial aspect of the tibia with locking and nonlocking screws (Figure 6). An anteromedial position was chosen to capture posterior fragments. At most recent follow-up of 9 months, the patient was doing well. He had full active and passive range of motion, with no subjective or objective evidence of instability, and had returned to full activity with no restrictions. The patient had no history of multiple fractures or any medical or pharmacologic history that predisposed him to decreased bone density.

**Discussion**

The discussion of complications after PCL injury includes ample data on complications of nonoperative treatment. This case shows a unique possible compli-
cation after transtibial PCL reconstruction in an adolescent patient. To the authors’ knowledge, this is the second report of a bicondylar tibial plateau fracture after this procedure. However, the authors believe that there is concern that the previous PCL reconstruction may have led to the tibial plateau fracture.

Return of quadriceps function to 100% of the contralateral limb appears to be an accurate predictor of return to play. Although patients show good subjective knee function, they may have continued objective signs of posterior sag and laxity. Theoretically, reconstruction may decrease the risk of degenerative changes in the medial and patellofemoral compartments with nonoperative treatment, but has the imperative risks associated with operative intervention.

Other literature mentions the tibial tunnel-graft angle, or “killer turn,” as it relates to graft failure and clinical outcome in a transtibial technique vs tibial inlay technique. These studies did not mention the transtibial technique and the potential risk that the tibial tunnel will increase stress and the risk of fractures postoperatively. The authors’ tibial tunnel placement was slightly more anterior than recommended, and the angle of their tunnel was more shallow than is typically recommended. The authors suspect that these 2 factors may have contributed to the eventual bicondylar tibial plateau fracture without significant trauma.

Some reports describe a fracture after anterior cruciate ligament (ACL) reconstruction, including femoral and tibial fractures. The complication is presumed to be rare, based on its low incidence and the common use of ligament reconstruction for knee injuries. Han et al cited 16 fractures reported in the literature after ACL reconstruction. Only 1 case was reported previously in the PCL literature. An open tibial inlay may have avoided this complication. However, that suggestion is based on the presumption that the tunnel increased stress, which is possible based on incompatibility between the low-impact mechanism of injury and the high-impact fracture pattern.

Another debate in the literature is the value of single-bundle vs double-bundle reconstruction techniques for PCL injuries. Most studies emphasized the ideal placement of the anterolateral bundle (single-bundle technique or restoration of posterior stability). These studies did not focus on the complications of single-bundle vs double-bundle techniques. The authors’ case used a single-bundle technique, and there is concern that a double-bundle technique with additional tunnels would leave a patient more prone to fracture. Han et al tested this hypothesis in a synthetic model and concluded that a single-bundle technique did not increase stress, whereas a double-bundle reconstruction had a statistically significant decrease in load to fracture and thus increased fracture risk. Additionally, the double-bundle technique offers no biomechanical advantage to tunnel separation of less than 3 mm. The authors are uncertain how this finding pertains to fracture risk, if at all.

Additionally, the method of femoral tunnel creation has been reviewed in the literature. This study focused on the graft-femoral tunnel angle, or the “critical corner” as it relates to outside-in vs inside-out techniques for femoral tunnel creation. This was a cadaveric model and thus provided no clinical information on complications. The lack of information is compounded by the nature of the complication in this case, which the authors consider a low-probability occurrence.

Limitations
This study has the inherent weaknesses associated with a retrospective case report. However, it provides orthopedic surgeons with knowledge of a possible rare complication associated with arthroscopic transtibial PCL reconstruction that has been shown with ACL reconstruction. Additionally, although a definitive link between reconstruction and postoperative fracture cannot be made based solely on this case, this report alerts future surgeons to the possibility and could lead to accumulation of data over time. This case could potentially affect preoperative planning.

Figure 4: Preoperative axial (A), coronal (B), and sagittal (C) computed tomography scans showing a bicondylar tibial plateau fracture.

Figure 5: Preoperative coronal (A) and sagittal (B) T1 magnetic resonance imaging scans showing a bicondylar tibial plateau fracture.

Figure 6: Postoperative anteroposterior (A) and lateral (B) radiographs showing open reduction and internal fixation of a tibial plateau fracture.
discussions with patients or surgical planning. Furthermore, the authors’ review of the literature seems to confirm that there are more questions than answers about this complication and identifies a need for further studies on postoperative complications in PCL reconstruction.

**References**