CLINICAL ARTICLE

Isolated Partial Femoral Avulsion Fracture of the Posterior Cruciate Ligament in Adults

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Objective: To investigate the manifestation, mechanisms, and treatment of isolated partial femoral avulsion fractures of the posterior cruciate ligament (PCL) in adults.

Methods: From January 2011 to December 2018, we retrospectively reviewed the clinical data of three patients with isolated partial femoral avulsion fractures of the PCL who were admitted to our institution. All of these patients were admitted to our emergency department within 24 h after injury. After physical examination and radiographs were taken and reviewed, all patients were admitted and underwent surgical treatment. In a 26-year-old man who underwent arthroscopic surgery through the traditional medial and lateral approach before finally converting to open surgery with the posterior approach, the fragment that was finally removed was partially attached to the PCL. In the other two patients, women aged 63 and 68 years, who underwent arthroscopic surgery *via* the traditional medial and lateral approach, the fragments were large and attached to most fibers of the PCL. We fixed the fragments using hollow screws in arthroscopic view. In addition, in the 63-year-old patient, an anchor was embedded to restore the tension of the PCL. Four weeks after surgery, the patients started to wear long leg braces in full extension with the tibia blocked up by cushion. Physical examinations were conducted and radiographs were taken preoperatively and at 4 weeks and 3 months after surgery to evaluate the condition of the injury. The range of motion and the Lysholm knee scoring scale for the knee joint were compared before and after the surgery.

Results: For the three patients, the radiographs taken at 3 months postoperatively showed that the fixation of the screws did not fail, and the subchondral bone was generally normal compared to the preoperative radiographs. CT scanning at 3 months after surgery showed that the fracture healed in the original position of the avulsion site. For all patients, the affected knees presented as stable at physical examination 3 months after surgery; the Lachmann test and the anterior drawer test results were negative. In addition, the flexion–extension, internal rotation, and external rotation were approximately 0°–130°, 0°–30°, and 0°–40° in the 26-year-old patient, respectively. The flexion–extension, internal rotation, and external rotation were approximately 0°–100°, 0°–20°, and 0°–35° for the 63-year-old patient, respectively. The flexion–extension, internal rotation, and external rotation were approximately 0°–100°, 0°–15°, and 0°–20° for the 68-year-old patient, respectively. There was no pain or only little pain 3 months after surgery. There was no swelling or discomfort at the 3-month follow up. The Lysholm knee scores of the 68-year-old, 63-year-old, and 26-year-old patient were 80, 87, and 95 at 3 months after surgery, respectively, which were obviously improved postoperatively.

Conclusion: The manifestation of isolated partial femoral avulsion fractures of the PCL in adults is often related to the injury mechanism, and surgery is essential for the treatment of these patients. Most of these fractures can be repaired by arthroscopic surgery, but some have to be treated by open surgery.

Key words: Adult; Isolate partial femoral avulsion fracture; Posterior cruciate ligament

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Disclosure: The authors declare no conflict of interest. No benefits in any form have been, or will be, received from a commercial party related directly or indirectly to the subject of this manuscript.

Received 12 October 2020; accepted 20 January 2021

Introduction

The posterior cruciate ligament (PCL) is the strongest ligament in the knee[1]. The PCL, located on the posterior side of the knee joint, starts from the lateral surface of the medial femoral condyle, which obliquely runs backward and downward, and ends at the posterior part of the tibial intercondylar bulge and the posterior corner of the lateral meniscus. The PCL consists of two parts: the anterolateral bundle (located on the anterolateral side of the femoral anchor point) and the posteromedial bundle (located on the posterior medial side of the femoral anchor point). The PCL plays a key role in maintaining knee stability, including through the knee joint rotation function, flexion and extension activities, and the dynamic equilibrium. The main function of the PCL is to prevent the tibia from moving backward relative to the femur; it bears 85% to 100% of the intensity to resist tibial posterior displacement. Therefore, the PCL is prone to injury when the knee joint is in the flexion position and subjected to frontal violence or in the hyperextension position and subjected to violence. PCL injuries account for 4% to 38% of all knee injuries seen in accident and emergency departments[2].

Isolated PCL injuries are uncommon, accounting for only 2%–7% of cases[3]. In most cases, PCL injuries are accompanied by other injuries, especially multiple ligament injuries like those of the anterior cruciate ligament (ACL)[4], the lateral collateral ligament (LCL), and the medial collateral ligament (MCL)[5]. Patients with PCL injuries suffer from knee joint pain, acute hemarthrosis, secondary injuries, and other symptoms, which seriously affect patients' normal life and cause joint dysfunction and can even result in osteoarthritis[2]. If PCL injuries are not treated in time, the stability of the knee joint will be impacted and degeneration of the knee joint will be accelerated, which will contribute to the failure of cruciate ligament reconstruction grafts.

In recent years, with the rapid economic and social development, the incidence of avulsion fractures of the PCL, caused by various factors such as traffic accidents and sports injuries, has been increasing. As reported in the published literature, PCL avulsion injuries are mainly caused by motor vehicle injuries, especially motorcycle injuries, working/recreational accidents, and sports-related trauma[6]. The underlying mechanisms of avulsion fractures of the PCL, including dashboard injuries, are a flexed knee with the foot in plantar flexion, hyperflexion, and hyperextension[7].

Tibial-sided avulsion fractures of the PCL are the most common form of PCL fracture, while avulsion fractures of the PCL from femoral insertion are rare. Furthermore, most of the cases of femoral insertion avulsion fractures of the PCL have been reported in children and adolescent patients. Adults are far less likely than children and teenagers to experience these injuries. In early reports (before 2012), most cases of adult avulsion fractures of the PCL from femoral insertion were in individuals below the age of 25 years[8–11]; it was suggested that this was attributed to the incomplete development of ligament insertion[10]. However, after a comprehensive search of the literature in recent years, we found that the number of patients aged above 25 years is rising. The mechanism of the injury does not appear to be as straightforward as previously suggested.

Although numerous case series have been published on the management and clinical outcomes of PCL avulsion fractures, no optimal treatment has been recommended. Despite successful traditional conservative management of avulsion fractures of PCL having been reported[12, 13], surgical reduction with fixation, which can restore PCL function and stability to the knee joint, has been suggested as the preferred treatment because of better outcomes, faster recovery, and fewer complications[14]. Although currently treatment for this kind of injury is similar to that for the femoral "peel off" injuries of the PCL, new techniques, including open reduction and internal fixation and minimally invasive arthroscopic repair approaches are continuously being developed.

Therefore, we retrospectively analyzed three patients with avulsion fractures of the PCL who were treated in our hospital between January 2011 and December 2018. These three consecutive adult patients with partial femoral avulsion of the PCL underwent arthroscopic surgery *via* the original medial and lateral approach. Therefore, the treatment of these cases was different from that of other cases reported previously. In this study, we reviewed the avulsion fractures of the PCL in the adults admitted to our hospital for treatment. The purposes of our study are: (i) to summarize the current understandings and the clinical features of avulsion fractures of the PCL in adults; (ii) to discuss the possible mechanisms of avulsion fractures of the PCL in adults; (iii) and to explore the treatment of avulsion fractures of the PCL in adults.

Materials and Methods

Inclusion and Exclusion Criteria

The inclusion criteria followed the PICOS principle: (i) patients aged more than 18 years with a diagnosis of partial femoral avulsion of the PCL; (ii) patients that underwent primary arthroscopic surgery; (iii) the measurement results were compared preoperatively and postoperatively; (iv) the main outcomes included radiographic evaluation, the Lysholm knee scoring scale, and the range of motion (ROM); and (v) our study had a retrospective design.

The exclusion criteria were: (i) patients with severe neurological deficit, systemic diseases, cardiac dysfunctions, and/or affective disorders; (ii) patients had a history of surgery around the knee joint; (iii) patients without integrated clinic data; and (iv) patients who preferred conservative treatment rather than surgery.

General Information

This was a retrospective study conducted by a clinical team from January 2011 to December 2018. Three patients with partial femoral avulsion of the PCL were admitted to our institution. The patients were aged 26, 63, and 68 years. Two

of the patients (female cases) were involved in low energetic car accidents on the road, while the 26-year-old patient (male case) suffered from an acute sport injury. In the two female patients, the tibial tubercles of the affected side were on the ground at first, and the knee was in a flexion position. The male patient did not complain about a finite injury before going to the emergency. He felt spasms in the left triceps surae when he turned from supine to right lateral position in bed. Around 5 min later, the left knee was locked and swollen and was fixed in approximately 90° flexion. The clinical manifestation included swelling, pain, and fixed gesture of affected knees. All patients were admitted to our emergency within 24 h of injury. Physical examination revealed that the injured knees were swollen and painful during activity and the patients could not stand. Different from the 26-year-old patient, the results of the Lachmann test and the anterior drawer test were positive for the two female patients.

Surgical Procedure

Anesthesia and Position

All operations were performed in the supine position with epidural anesthesia.

Approach and Exposure

For the two older female patients, arthroscopic treatment of the avulsed fractures was performed the following day. We performed an arthroscopic surgery *via* the traditional medial and lateral approach (Fig. 1A). After cleaning parts of the synovial membrane and debriding the defect, we put the knee in flexion of 30°, hooked the fragment, and pushed it into the defect of the fossa. The margin of the fragment just fit the defect. Then a 1-mm K-wire from a portal 5-mm medial to the anterolateral portal was inserted into the center of the fragment and fixed to the defect of the medial condylar (Fig. 1B). With the K-wire as a guide, we drilled a hole and used a hollow screw (2 mm in diameter) to fix the fragment to the defect (Fig. 1C). The length of the screw was 30 mm. For most of the PCL, the original tension was recovered. However, for the 63-year-old patient, the fibers attached to the PCL were still lax compared with other parts (Fig. 1D). We embedded an anchor at the posterior part of the fossa defected area through the anterolateral portal, used the PDS thread as a guide to pass the thread of the anchor through the flax fibers, and tied a knot (Fig. 1E–I). Intraoperative hand-drawn pictures describing the

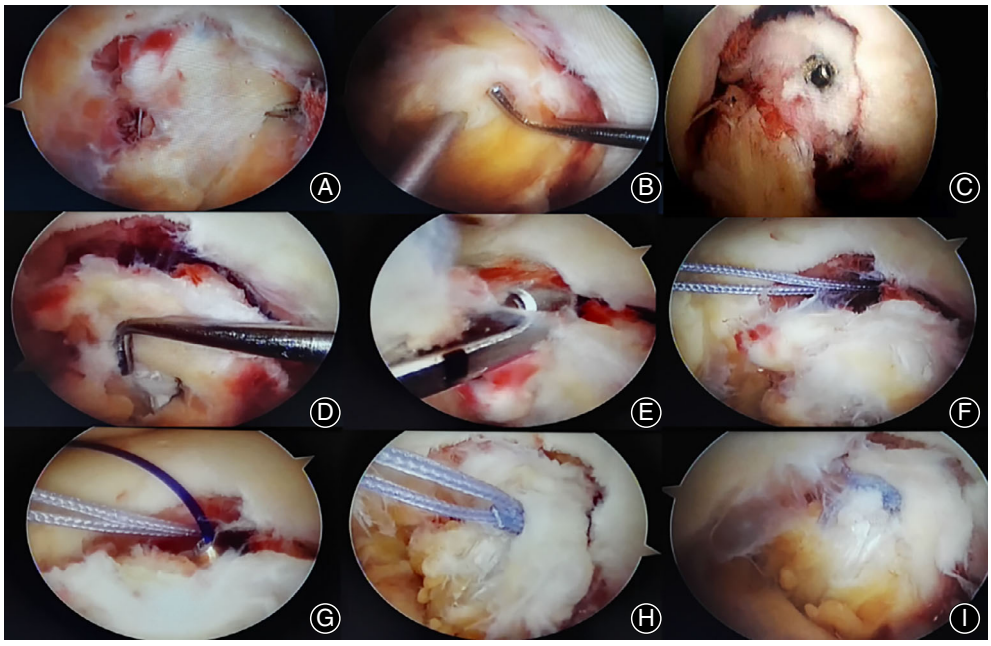

Fig. 1 Arthroscopic view of the two elderly female patients intraoperatively. (A–C) Arthroscopic view of the 68-year-old female patient. (A) The fragment was at the medial part of the fossa; most parts of the footprint of the posterior cruciate ligament (PCL) femoral insertion were involved. (B) The surgeon used a K-wire penetrating the fragment and femoral defection as a guide. (C) The surgeon used a 2-mm-diameter hollow compression screw to fix the fragment. (D–I) Arthroscopic view of the 63-year-old female patient. (D) The fragment was at the medial part of the fossa; most parts of the footprint of the PCL femoral insertion were involved. (E) The surgeon used a K-wire penetrating the fragment and femoral defection as a guide and a 2-mm-diameter hollow screw to fix the fragment. (F) The posteromedial fibers were partially lax. The surgeon embedded an anchor at the posterior part of the fossa defect. (G, H) The surgeon used PDS thread as a guide to suture the lax fibers of the posteromedial bundle and restored the tension of the fibers. (I) Final view of the fixation after the suture of the anchor. The fragment was fixed at the original position of the defect, and the PM fibers all regained some tension.

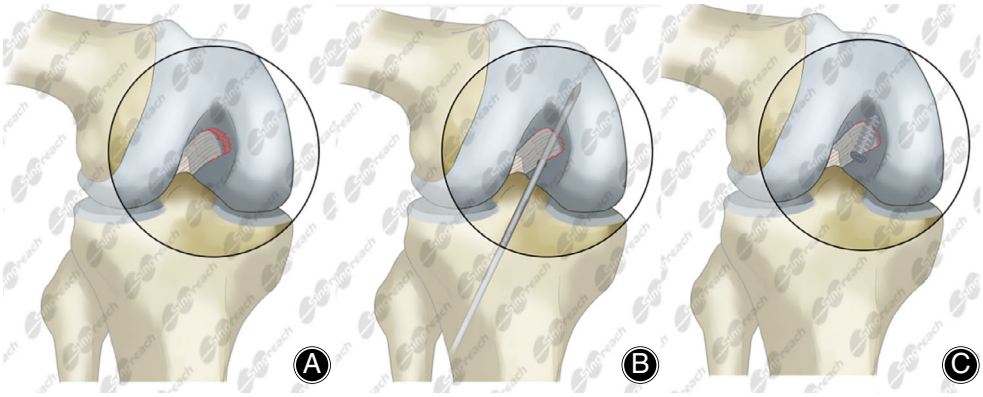

Fig. 2 (A) Femoral avulsion fracture of the posterior cruciate ligament (PCL) (one situation). (B) Kirschner wire guide temporarily fixed the fracture block. (C) Hollow nail fixation.

arthroscopic treatment of the avulsed fractures for these two patients are presented in Fig. 2.

For the 26-year-old male patient, the fragment was located in the front of the fossa (Fig. 3A). We were unable to remove the loose body using nucleus pulposus forceps and considered that the loose body might have been trapped in the soft tissue of the fossa. Hence, we removed the arthroscopy and attempted passive flexion and extension of the knee. Surprisingly, we were able to fully extend the knee. However, the fragment was no longer visible upon reinsertion of the arthroscope (Fig. 3B). Intraoperative radiographs showed that the fragment was in the posterior compartment of the intercondylar fossa, and it could not be located *via* the anterior approach. Therefore, we switched to open surgery *via* the posterior approach. The fragment was identified as cartilage partially attached to the PCL, which was avulsed from the inferior side of the lateral intercondylar fossa. The Lachman test was negative and less than one-fifth of the ligament was avulsed, so the avulsed fragment was removed (Fig. 3B). Intraoperative hand-drawn pictures describing the arthroscopic and open treatments of the avulsed fractures for this patient are presented in Fig. 4.

Intraoperative Stability Test

After the fixation, the tension of the PCL and the stability of the fracture were tested. The PCL maintained tension in the test in full ROM. The Lachman test was also performed to evaluate the stability of the knee joint.

Radiographic Evaluation and Postoperative Treatment

Radiographs were taken before surgery and 4 weeks and 3 months after surgery to evaluate the condition of the injury. Patients were instructed to continue non-weight-bearing with flexion restricted to 90° for 3 months after surgery. Patients started to wear long leg braces in full extension with the tibia blocked up by cushion after surgery for 4 weeks.

Lysholm Knee Scoring Scale

The Lysholm knee scoring scale was formulated by Lysholm and Gillquist in 1982. The specificity and sensitivity of the Lysholm knee scoring scale have been confirmed by clinical trials. The total score of the Lysholm knee scoring scale is 100[15]. If the score is less than 70, this means that the knee function has been significantly affected and effective treatment should be taken as soon as possible. The Lysholm knee scoring scale mainly includes eight aspects: support, limp, squatting, stair climbing, locking, instability, swelling, and pain. The higher the score, the better the knee function.

Range of Motion

The ROM[16] is one of the indicators for assessing the range and degree of joint motor function. The main purposes of

Fig. 3 Arthroscopic and gross view of the 26-year-old male patient. (A) The fragment was stuck between the medial condyle and the anterior cruciate ligament. (B) Gross view of the piece of avulsed cartilage removed from the left knee. Parts of the posterior ligament fibers were attached to the cartilage.

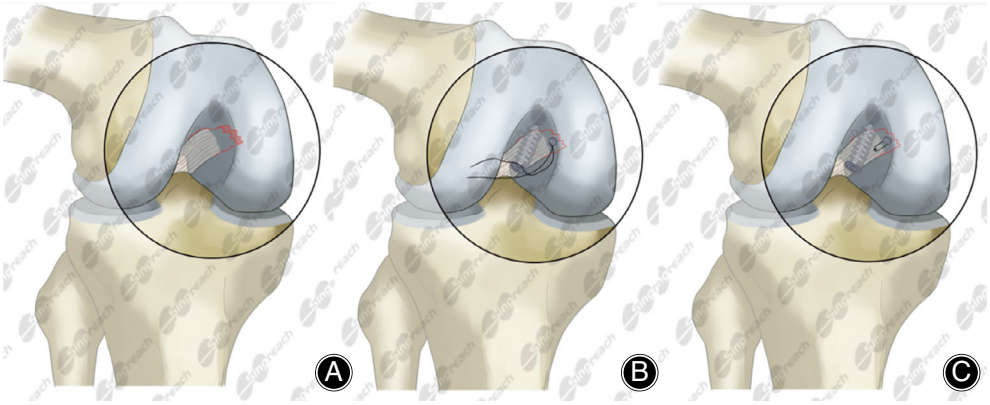

Fig. 4 (A) Femoral avulsion fracture of the posterior cruciate ligament (PCL) (another situation). (B) Hollow screw fixation and anchor embedding. (C) Anchor fastens loose ligaments.

using the ROM as an assessment tool are: to determine whether there is joint movement restriction; to understand the factors affecting joint movement; to determine the degree of joint movement restriction; to determine the appropriate treatment goal; to determine the degree of possible recovery; to provide objective choice among appropriate treatment methods; and to evaluate the effects of rehabilitation and training. The flexion–extension is 0°–130°, the internal rotation is 0°–30°, and the external rotation is 0°–40° of the normal knee joint.

Results

Radiographic Evaluation

X-ray and CT showed an avulsed fracture in the intercondylar fossa. The lateral side of the fossa cartilage was partially damaged (Figs 5,6). MRI showed that the fragment was attached to the femoral part of the PCL. The sizes of the avulsed parts of the PCL were different (Fig. 6). The two older female patients' CT showed that the avulsed parts were bigger and attached to most fibers of the PCL. The 26-year-old male patient's CT showed that the avulsed parts were small and only attached to one-quarter of the fibers of the PCL. All the avulsed fragments were formed from parts of the fossa cartilage and medial condylar bone. However, the male patient's fragments did not include much bone tissue compared with the two older female patients.

For the two elderly female patients, the radiograph taken at 12 weeks showed that the fixation of the screws had not failed, and the subchondral bone was generally normal compared to the preoperative radiograph (Fig. 7). CT scanning at 3 months after surgery showed that the fracture had healed in the original position of the avulsion site (Fig. 8).

Fig. 5 Preoperative X-ray images of the 63-year-old woman. The arrow shows the fragment avulsed from the intercondylar fossa. The fragment was at the medial part of the fossa in the anteroposterior view and at the posterior area of the knee in lateral view, just at the original position of the avulsion.

Lysholm Knee Scoring Scale

Before the operation, the Lysholm knee scores of the 68-year-old, 63-year-old, and 26-year-old patients were 45, 50, and 65, respectively. However, the Lysholm knee scores of the 68-year-old, 63-year-old, and 26-year-old patients were 80, 87, and 95 at 3 months after surgery, respectively, which were obviously improved postoperatively. Patients complained of no pain or little pain 3 months after surgery. Swelling or other kinds of discomfort were not apparent at the 3-month follow-up.

Range of Motion

For all patients, the affected knees presented as stable at a physical examination 3 months after surgery. The flexion–extension, internal rotation, and external rotation were approximately 0°–130°, 0°–30°, and 0°–40° for the 26-year-old patient respectively. The flexion–extension, internal rotation, and external rotation were approximately 0°–100°, 0°–20°, and 0°–35° for the 63-year-old patient, respectively. The flexion–extension, internal rotation, and external rotation were approximately 0°–100°, 0°–15°, and 0°–20° for the 68-year-old patient, respectively.

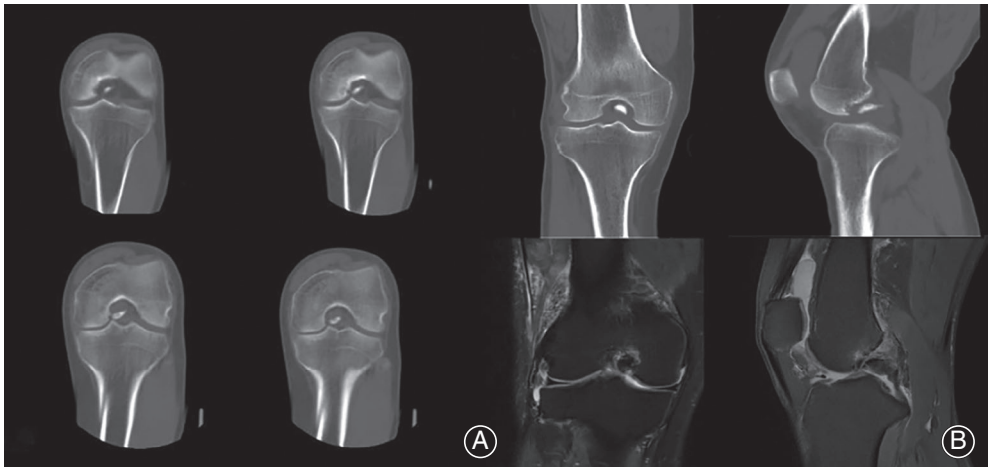

Fig. 6 (A) Preoperative CT of the 26-year-old man. The defect area was circular and approximately 1 cm in diameter and did not affect the weight-bearing cartilage. The fragment was thin, stuck between the medial condyle and the anterior cruciate ligament. (B) Preoperative CT and MRI of the 63-year-old woman. The fragment, which was large and thick, was avulsed from the intercondylar fossa. The avulsion injury involved the subchondral bone of the fossa; the injury appeared to have occurred at the bone of the fossa instead of at the ligament or cartilage of the footprint. The coronal image of the MRI showed that the posterior cruciate ligament (PCL) was not completely avulsed from the fossa, and the location of the fragment was at the original avulsion location, mostly attached to the PCL.

Discussion

Femoral avulsion fractures of the PCL are rare compared to other kinds of injuries of the PCL[10, 17]. We found that most of the cases reported in PubMed from 1975 to 2019 were in patients younger than 18 years old[18–22]. In contrast, only 11 cases over the age of 18 years old were reported previously (Table 1) [9–11, 21, 23–26]. There were only 3 cases reported in individuals over 40 years of age (42 years old[27], 82 years old[26], and 63 years old[28]). Most of the injuries were accompanied by other soft tissue injuries. Only 4 of all 10 adult cases were isolated partial avulsed fractures[8, 10, 11, 28]. Therefore, we conducted this study to investigate the manifestation, mechanisms, and appropriate treatment of isolated partial femoral avulsion fractures of the PCL in adults.

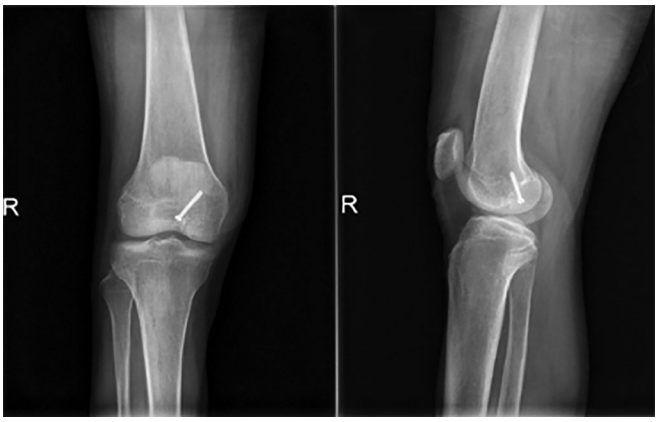

Fig. 7 Postoperative X-ray images of the 63-year-old female patient's knee. The fragment was just at the footprint of the posterior cruciate ligament (PCL) and fitted the defect. The hollow screw was embedded in the femoral bone. The fixation was strong and did not affect any soft tissue of the knee.

Manifestation, Mechanisms, and Treatment of Isolated Partial Femoral Avulsion Fractures of the Posterior Cruciate Ligament in Adults

The manifestation of isolated partial femoral avulsion fractures of the PCL in adults is often related to the injury mechanism. Usually, the manifestation includes swelling, pain, and strangulation of the affected knee joint, with or without Lachman and anterior drawer tests being positive on physical examination. Several mechanisms might be responsible for these injuries of the PCL, such as the motion of direct anterior tibial force to the flexed knee, knee hyperflexion with downward force on the thigh, or knee hyperextension[29, 30]. However, the mechanism of PCL femoral avulsion fractures is not so clear in the present cases. Xu *et al.*[10] hypothesized that the femoral bony insertion of the PCL in patients younger than 25 years might be weaker than that in older adults due to the incomplete development of the bony insertion, which was testified in the tibial insertion of PCL.

This presumption could explain the injury of the 26-year-old male patient. However, this could not explain the occurrence in patients older than 60 years. In our two older cases, we found that the avulsed fragment was involved in large pieces of subchondral bone. The injury seemed to occur in the bone of the condyle instead of at the bony insertion margin of the femur. This finding was similar to the

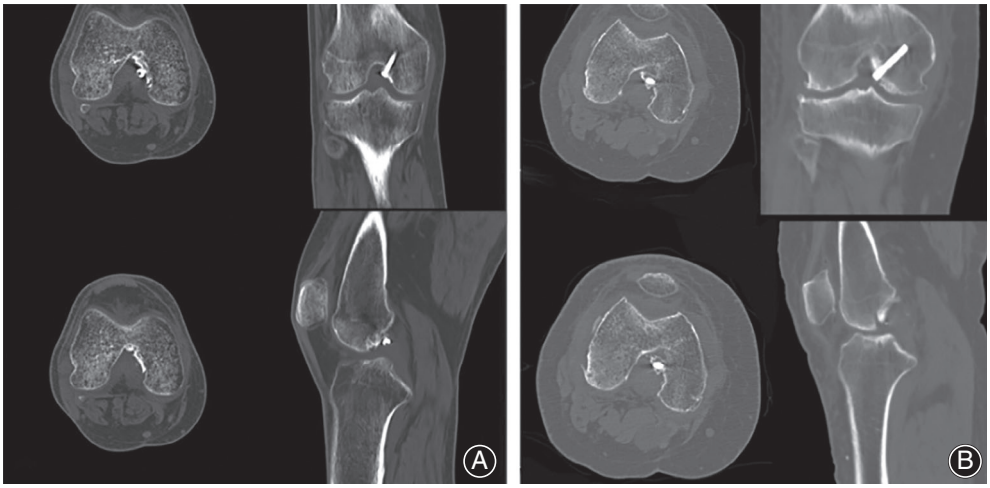

Fig. 8 The CT of the two female patients 3 months after surgery showed the fragments avulsed healed at the intercondylar fossa. The screws were fixed at the same location of the footprint. The patient could perform weight-bearing walking and the drawer test of the knee was negative. (A) The 63-year-old woman. (B) The 68-year-old woman.

case of a 63-year-old patient reported by Albtoush[28], whose subchondral bone was as large as those of the older patients in the present study. We presume that although the strength of the bony insertion of the PCL might be normal in old patients, the subchondral bone might not be as strong as in young people due to the decrease of the bone mass in old people. That was consistent with Masakazu *et al.*, who suggested that this injury occurring in older patients may have some relationship with risk factors of osteoporosis[26].

Treatment of Isolated Partial Femoral Avulsion Fracture of the Posterior Cruciate Ligament in Adults

The treatment of PCL femoral avulsion has varied among. In the 1970s, PCL avulsion from femoral insertion was treated with open surgeries[23, 25]. With the development of arthroscopic techniques, treatments for this kind of injury were developed to perform minimally invasive surgeries using arthroscopy[9–11, 21]. Mishra *et al.*[8] removed an avulsed fragment from the PCL in a patient who had injured his knee 1 year previously. They believed that the reduction and fixation in old injuries were useless when the stability of the knee was nearly normal. Lee *et al.*[11] also removed a fragment as the avulsion site was incongruent after the reduction, and they filled the defect with an osteochondral graft from a non-weight-bearing portion of the lateral femoral condyle. However, most have attempted reduction and fixation methods to restore the original anatomic pattern of the PCL[9, 10, 21].

TABLE 1 Previous cases of femoral avulsion fractures of the posterior cruciate ligament in adults

Study	Year	Age (years)	Type of injury
O'Donoghue[23]	1950	20	Entire avulsion with ACL and MCL injury
Drucker[20]	1975	25	Partial avulsion with medial meniscus injury
Ross[22]	2003	21	Entire avulsion with ACL and MCL injury
Park[16]	2005	42	Partial avulsion with ACL and MCL injury
Lee[5]	2009	22	Isolate partial avulsion
Xu[2]	2012	22	Isolate partial avulsion
Giordano[11]	2011	21	Entire avulsion with ACL and MCL injury
Rosso[12]	2014	20	Entire avulsion with MCL injury
Mishra[4]	2016	32	Isolate partial avulsion with displaced fragment
Albtoush[14]	2017	63	Isolate entire avulsion
Masakazu[25]	2019	82	Isolate partial avulsion

ACL, anterior cruciate ligament; MCL, medial collateral ligament.

The most common technique has been to reduce the fragment of the fracture into the footprint of the fossa and fix it with the threads. In most cases, 2–4 holes have been drilled at the avulsed fragment, with the footprint then used and PDS thread as a guide to suture the fragment onto the defect area[10, 21]. However, this method required an open incision of the medial thigh. Rosso *et al*[9]. sutured the fragment using the thread and fixed the thread using two 2.9-mm Push-Lock anchors. They found that the anchor-thread fixation was as strong as the PDS guided suture, and this technique did not require drilling of holes at the defect or making an extra incision to tie the knot. Those techniques were suitable for thinner avulsed fragments. For larger avulsed fragments with thicker subchondral bone, the tension and direction of the PCL fibers could not be fully restored using those methods. In the cases in the present study, the fragments were integrated. The thread suture could not control the rotation displacement of the fragment or restore the tension of the PCL. Therefore, we chose to use the technique of hollow screw fixation, which could provide enough strength to control the separate and rotational displacement. This method of repairing the avulsed fracture of the PCL from tibial insertion was found to have good or fair results in up to 90% of cases[31].

As far as we know, this was the first time that this method was used to fix avulsed fragments of the PCL from femoral insertion. Former research of PCL function showed that posteromedial bundle injury caused small but significant increases in mean laxity at 0° and 10° knee flexion[29, 32]. After the hollow screw fixation, we also used an anchor to repair fibers of the posteromedial bundle that were avulsed from the footprint in one case (63 years old). After suturing, most of the posteromedial bundle fibers regained the tension at the knee when stretched in 0° position. This kind of mixed treatment (hollow screw and anchor suture) provided more stability for the avulsed fragment as well as better tension recovery of the PCL ligament compared with previous treatments. The fixation technique was performed in arthroscopic view and did not need an extra portal approach or require the knee to be in a special position. Therefore, the surgery was still minimally invasive with no increase in risk of PCL laxity. This method is more reliable in restoring the function of PCL compared with suture. However, for smaller fragments (as in the case of the 26-year-old), this method may not be used due to the size of the screw. However, an open surgery was preferred in this case.

Limitations

There were several limitations in our study. First, there were only three cases over the past 7 years with a complete diagnosis and treatment history available for inclusion in this study. More patients should be included in future studies to enhance the statistical efficacy of our result. Second, the follow-up time was short and there was insufficient relevant data; longitudinal observational studies should be continued to enrich the conclusion.

Conclusion

The mechanism of and appropriate treatment for isolated partial avulsion fractures of the PCL from femoral insertion in the adults are still under discussion due to the limited number of cases. The cases reported in this study indicate that this kind of injury could happen in young and older adults. The manifestation of isolated partial femoral avulsion fractures of the PCL in adults is often related to the injury mechanism. Usually, the manifestation includes swelling, pain, and strangulation of the affected knee joint, with or without Lachman and anterior drawer tests being positive on physical examination. Surgery is essential for the treatment of isolated partial femoral avulsion fractures of the PCL in adults. Due to the varied structures and shapes of the avulsed fragments, the mechanisms of the injuries are different between young and old patients. Treatments of this kind of fracture may need more fixation stability in older adults compared with younger patients. Most of these fractures can be repaired by arthroscopic surgery *via* the traditional medial and lateral approach. However, some cannot be treated by arthroscopic surgery because the fractures are small and are not visible in arthroscopy. In such cases, open surgery through the posterior approach is needed.

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