

Isolated posterior cruciate ligament injuries associated with closed tibial shaft fractures: a report of two cases

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Abstract

Introduction Knee ligament injuries associated with tibia shaft fractures are usually neglected and treatment is delayed. To our knowledge, no case presentation discusses the clinical result of closed tibial shaft fracture with concomitant ipsilateral isolated PCL injury. In this literature, we report the clinical result of two cases that sustained closed tibial shaft fracture with concomitant PCL injury and discuss the treatment options.

Materials and methods We report the clinical result of two cases that sustained closed tibial shaft fracture with concomitant posterior cruciate ligament (PCL) injury. Case 1 received open reduction with plate fixation for the tibial shaft fracture, and he also received arthroscopic reconstruction of PCL with bone-patellar tendon-bone graft due to neglecting PCL injury 5 months later after fracture fixation. Case 2 sustained left tibial-fibular shaft fracture with iso-

lated PCL injury confirmed by magnetic resonance image on the first day of injury. She received tibia fixation with intramedullary nail and conservative treatment with bracing and rehabilitation for PCL injury.

Results In case 1, the male patient only focused on fracture healing without any knee rehabilitation. His knee flexed deeply for protected weight bearing in the injured leg which may have exacerbated the posterior instability and reduced the possibility of PCL healing. The end result of knee function was poor even though PCL reconstruction was done later. In case 2, the female patient with diagnosed posterior cruciate ligament injury on the day of injury, her knee was immobilized in brace with full extension, which improved PCL healing. In addition, she received rehabilitation of quadriceps strengthening, and hamstring muscle contraction was avoided in her daily activity. After rehabilitation, the female patient did not complain of severe subjective instability even with an obvious posterior translation on posterior drawer test.

Conclusions We need to perform a careful physical examination of ipsilateral knee in cases of leg fractures, and MRI of knee before surgery if any doubt exists. However, a further research is needed to conclude on the best operation and rehabilitation program in patients with combined tibial shaft fracture and PCL injury.

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Introduction

Knee ligament injuries associated with ipsilateral lower extremity fractures have been reported in the literature. [1, 6–9, 13, 14, 16, 19, 23, 24] The incidence of knee ligament

injuries have been documented in association with 27–55% of femoral shaft fractures, and 32–53% of combined femoral and tibial shaft fractures. The incidence of knee ligament injuries associated with tibial fractures which include fractures of tibial plateau, proximal tibia, and tibial shaft have been reported to be between 11 and 56% [13, 20, 21]. To our knowledge, no case presentation discusses the clinical result of closed tibial shaft fracture with concomitant ipsilateral isolated PCL injury. Two reports [20, 21] focus on the incidence of tibial shaft fractures with concomitant knee ligament injuries. Thiagarajan [21] reviewed fifty patients with isolated open tibial shaft fractures and reported 18 patients (36%) had ipsilateral knee ligaments injuries. Five patients were diagnosed to have posterior cruciate ligament (PCL) injuries, 3 patients presented isolated PCL injury, and the other two sustained multiple ligament injuries. Templeman [20] examined manually fifty patients with fractures of tibial shaft under general anesthesia, and found eleven (22%) patients sustained ipsilateral knee ligament injuries. Among the 11 patients, all patients injured their medial collateral ligament, and three patients sustained PCL injury. There was no case presenting isolated PCL injury with closed tibial shaft fracture in Templeman's

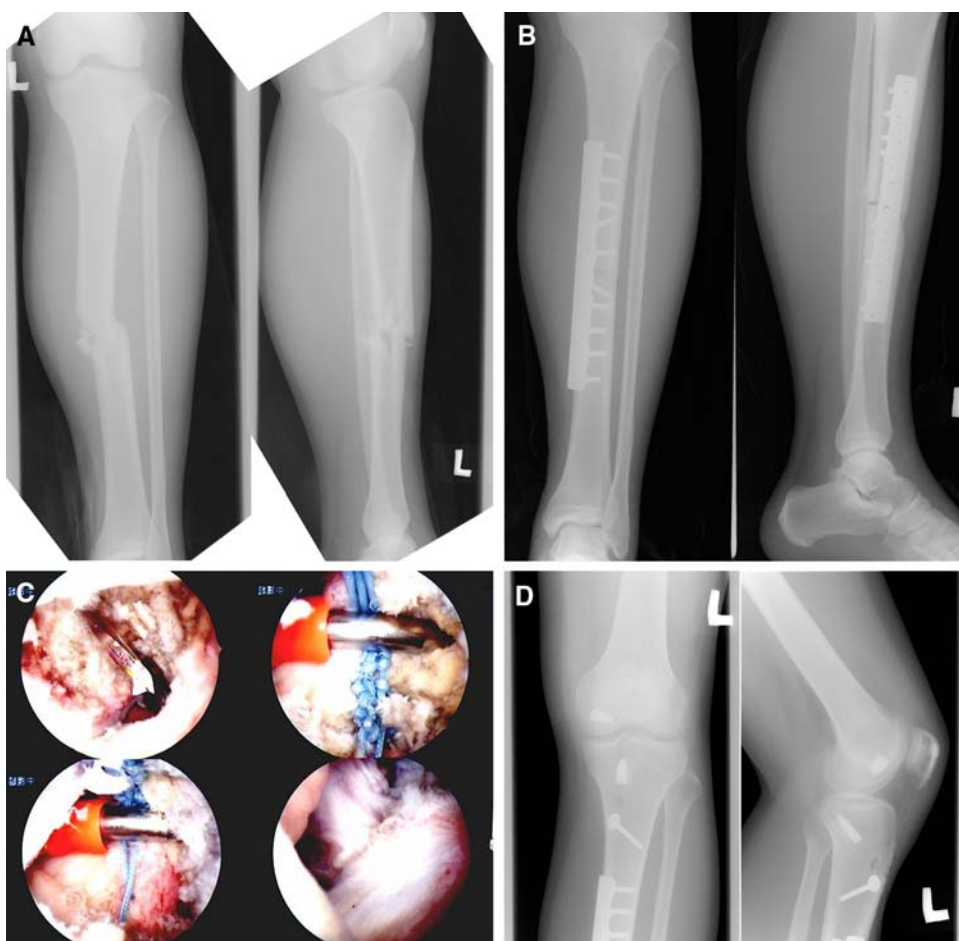
report. We report the clinical result of two cases that sustained closed tibial shaft fracture with concomitant PCL injury and discuss the treatment options.

Case reports

Case 1

A 28-year-old male, who had not sustained any lower leg trauma before, was involved in a traffic accident. He was sent to the emergency room immediately, and the radiography revealed fracture of the left tibial shaft (Fig. 1a). He received open reduction with 10 holes AO plate and screws fixation (Fig. 1b) on the same day. However, there was no record about knee injury during admission period. Following a period of crutch-aid weight bearing, he could ambulate without any support and progressive bone union at the fracture site was found 4 months after surgery. Six months after bone fixation, he still complained of pain, weakness and instability at the left knee during ambulation and climbing stairs. The physical examination of the left knee showed full range of motion, varus/valgus test (–/–),

Fig. 1 **a** Preoperative radiograph of Case 1 shows fracture of the left tibial shaft. **b** Anatomic fixation of the fracture of tibial shaft with 10 holes AO plate and screws. **c** Arthroscopic reconstruction of posterior cruciate ligament was done with Bone-Patellar tendon-Bone graft. **d** Postoperative radiograph shows 2 interference screws over femoral and tibial tunnels, 1 post screw over proximal tibia, and the AO plate for the tibial fracture



Lachman test (–), posterior drawer test (+, grade II-III), posterior sag sign (+). Under the impression of left knee PCL injury, he received arthroscopic PCL reconstruction using bone-patellar tendon-bone graft from ipsilateral knee (Fig. 1c, d). Two years after bone fixation, X-ray revealed tibia bone union and PCL graft incorporation to the bone tunnel without degenerative change, and he was admitted again to remove the fixation implant. Although the physical examination showed full range of motion and grade I posterior drawer test, he still complained about discomfort and weakness occasionally over the left knee after basketball games and long distance ambulation. In the latest follow-up, the subjective international knee documentation committee (IKDC) score was 72 points, and his knee function was graded as “fair”.

Case 2

A 19-year-old female was involved in a motorcycle accident, being hit by car. She was sent to our ER immediately,

and left tibia-fibula shaft closed fracture (Fig. 2a) was found under radiographic examination. In addition, swelling and effusion of the left knee joint was also found during physical examination. Under the impression of concomitant left knee ligament injury, she received magnetic resonance images (MRI) of the left knee on the next day, and it revealed effusion with isolated posterior cruciate ligament rupture of the left knee (Fig. 2b). After discussion with her family, she received open reduction with intramedullary nail fixation without cruciate ligament reconstruction or repair (Fig. 2c). Under general anesthesia, the stability test of the left knee after fracture fixation showed grade III posterior drawer instability. She kept full extension of the left knee with brace for 3 weeks, and then followed a careful postoperative rehabilitation program with range of motion and quadriceps muscle strengthening. After 6 months of rehabilitation, she had complete bone healing and full knee activity. One year after fracture fixation, she could return to work and exercise without subjective instability and pain even though persistent laxity was found during the stability

Fig. 2 **a** Preoperative radiograph showing displaced fracture of left tibia and fibula. **b** Magnetic resonance images of left knee revealed effusion with isolated posterior cruciate ligament rupture. **c** Open reduction and internal fixation of the fracture of tibial shaft with intramedullary nail and wires



physical examination. In the latest follow-up, the subjective IKDC score was 86 points, and her knee function was graded as “good”.

Discussion

Knee ligament injuries associated with tibia shaft fractures are usually neglected and treatment is delayed [20, 21]. The incidence of knee ligament injuries have been documented in association with 22 and 36% tibial shaft fracture [20, 21]. The incidence of knee ligament injuries associated with tibial shaft fracture is lower than the incidence of femoral shaft, femoral and tibia fracture, and tibial plateau fracture, which might be due to the higher injury energy in the latter three injuries. And the incidence of ipsilateral ligament injuries associated with open tibial shaft fracture [21] is also higher than closed tibial fracture incidence (8%) in Templeman’s report [20]. In a motor vehicle accident, the possible injury mechanism of isolated PCL injury may be caused by a fall on the flexed knee or “dashboard injury” which means striking the flexed tibia on the dashboard. However, the exact mechanism of combined tibial shaft fracture and PCL injury is still unclear.

The relationship of the end result and management of the tibia shaft fracture with isolated PCL injury has not been clarified till now. The optimal treatment principles for the tibial shaft fracture with concomitant PCL injury have not been established also. The knee injury should not be neglected while treating tibial shaft fracture, and thorough preoperative physical examination to detect any instability and hemoarthrosis of ipsilateral knee is necessary. The preoperative MRI is preferred if any doubtful physical examination was found. Items that should be taken into consideration before surgery include (1) the necessity of the PCL reconstruction or not at the initial fracture management, (2) how and when to reconstruct the posterior cruciate ligament, (3) how to fix the fracture of tibia according to the choice of PCL treatment, intramedullary nailing or plating, and (4) how to arrange the postoperative rehabilitation program in different treatment options. The surgeons should make a complete preoperative plan and appropriate postoperative rehabilitation program.

The possible options include (1) tibia fixation with nail or plate without combined PCL reconstruction and continual rehabilitation to wait for and see the clinical symptoms of pain and instability, (2) plating + initial tibial tunnel reconstruction with bone-patellar tendon-bone or hamstring graft, and (3) intramedullary nailing + initial posterior approach inlay reconstruction with bone-patellar tendon-bone or hamstring graft [2, 4]. It is difficult to decide on the necessity of PCL reconstruction in isolated PCL rupture with tibial shaft fracture due to the natural history of the ruptured PCL still being debated [3]. Many authors [5, 10, 11, 15, 17, 22] have

recommended conservative treatment after isolated PCL injuries, which can regain satisfactory results even in athletes. They concluded that most patients with isolated PCL injury had excellent function results after quadriceps rehabilitation even with objective laxity. If the surgeon decided to treat PCL injury without reconstruction in the initial treatment, the knee brace was indicated to keep knee extension for 2–4 weeks and continue quadriceps strengthening. Thiagarajan [21] stated that isolated cruciate ligament injuries are best managed in symptomatic young patients once the fracture has healed. The PCL reconstruction might be indicated after bone healing, if the patient complains of persistent pain and dissatisfactory result after rehabilitation. However, if the preoperative MRI and physical examination revealed associated meniscal pathology or other knee lesions, surgical treatment of the PCL and associated lesions must be performed at the time of fracture management.

In our cases 2 with diagnosed posterior cruciate ligament injury on the day of injury, the knee was immobilized in brace with full extension. The position, which improved PCL healing, is suggested to prevent posterior sag, to achieve partial reduction of tibial translation, and eliminate the effect of gravity and hamstring contraction to pull the tibia posterior [11, 12]. The posterior subluxation could be reduced after a posterior tibial support brace treatment within an average treatment period of 180 days in Strobel’s [18] study. In addition, the rehabilitation should focus on quadriceps strengthening and avoid hamstring muscle contraction. After rehabilitation, the female patient did not complain of severe subjective instability even with an obvious posterior translation on posterior drawer test. In case 1, the male patient only focused on fracture healing and he did not perform any knee rehabilitation. His knee flexed deeply for protected weight bearing in the injured leg which may have exacerbated the posterior instability due to femoral sliding on the posterior inclination tibial plateau [11]. In such a knee flexion position, the ruptured PCL was displaced without fiber contact and the hamstring pulled the tibia translation posterior, which reduced the possibility of PCL healing. He still felt unsatisfied with his knee function even though PCL reconstruction was done later. Strobel [18] reported that the fixed posterior subluxation influences the clinical result of PCL reconstruction and he suggested performing anterior and posterior stress radiographs before PCL reconstruction to detect the fixed posterior subluxation. However, due to instrument limitation in our hospital, we did not perform stress radiographs in our two cases.

Conclusion

We need to perform a careful physical examination of ipsilateral knee in cases of leg fractures, and MRI of knee

before surgery if any doubt exists. A careful and proper fracture and knee ligament management plan should be done. According to our report and literature review, we suggest conservative treatment with immobilization for a full 3 weeks and avoidance of the flexion position of the injured knee, and focus rehabilitation on quadriceps strengthening. However, due to our study is just a case report with two cases, a further research is needed to conclude on the best operation and rehabilitation program in patients with combined tibial shaft fracture and PCL injury.

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