

SURGICAL TREATMENT OF AVULSION FRACTURES OF THE KNEE PCL TIBIAL INSERTION: EXPERIENCE WITH 21 CASES

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SUMMARY

We assessed 21 patients (16 males and 5 females), with mean age of 27.6 years who underwent surgical treatment for PCL avulsion fracture. In 57% of the cases, injuries were secondary to motorcycle accidents and 19% resulted from car accidents. Injuries on knee's anterior surface were detected in 72% of the cases. The surgical procedure involved posterior approach and bone fragment fixation using nut and screw in 18 cases, the trans-bone suture loop fixation in 3 cases with small bone fragments. In 91% of the cases, surgery was performed within the first two weeks following injury. The patients were objectively (posterior drawer test) and subjec-

tively (Lysholm scale) re-evaluated after a minimum follow-up period of 12 postoperative months. The statistical analysis of objective and subjective assessments did not demonstrate any significant difference ($p = 0.05$). The satisfactory results of the subjective clinical postoperative evaluation may have been due to the absence of peripheral ligament injury. However, the presence of residual tibial posteriorization suggests that the avulsion fracture of the PCL should be treated as bone-ligament injury, and not just as a bone lesion.

Keywords: Knee; Posterior cruciate ligament; Reconstruction; Bone fractures.

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INTRODUÇÃO

In literature, knee ligament injuries constitute a frequent topic in a large number of scientific publications, particularly the anterior cruciate ligament (ACL) injury. However, in recent years, knee's posterior cruciate ligament (PCL) injuries have received special attention, which is evidenced by the increasing number of scientific articles addressing that ligament^(1,2).

From an anatomical point of view, knee's posterior cruciate ligament (PCL) is fixed on the anterior half of the axial surface of femoral internal condyle, protruding at caudal and medial directions, by the intercondylar incisure towards its tibial insertion located posterior, inferior and juxta-lateral to the mid line of the tibial plateau. It acts as a major posterior knee stabilizer, limiting posterior tibial translation in relation to the femur⁽³⁻⁵⁾.

PCL injuries are estimated to account for 20% of knee ligament injuries. That incidence is higher especially in cases resulting from high-energy trauma, such in motorcycle and car accidents, while, in an athletic population, this injury is more closely associated to contact sports^(1,2).

For treating a PCL injury, alternatives such as tendon graft, fixation system, surgical technique are not yet regarded as a universally accepted treatment of choice. However, in the presence of PCL bone avulsion in its tibial insertion, a consensus exists towards surgical intervention, this being considered as the most favorable way from surgical and secondary healing perspectives^(6,7,8).

The surgical technique employed here consists of a posterior knee approach, re-insertion and fixation of the PCL bone fragment into its anatomical bed located on posterior tibial

surface. In literature, this procedure is reported as sufficient for re-establishing ligament integrity and function^(6,8,9).

This article aims to assess twenty-one cases of PCL avulsion fractures surgically treated, and to compare achieved clinical outcomes to objective (posterior draw test) and subjective (Lysholm scale) evaluations.

CASE SERIES

From January 1997 to December 2005, 21 patients with knee's posterior cruciate ligament avulsion fractures, in its tibial insertion, were submitted to surgical therapy. Sixteen patients were males, and 05 patients were females. Patients' ages ranged from 15 to 53 years (mean = 30 years), and 57% of the injuries were secondary to motorcycle accidents (Chart 1).

The injury was diagnosed by means of X-ray images of the knee at AP and lateral planes, and by physical examination made at the emergency room during primary care, and intra-operatively. Figure 2-A shows the PCL bone fragment avulsion in its tibial insertion evidenced by lateral-plane X-ray image. In this case series, no peripheral ligament injuries requiring surgical intervention were detected.

Description of the surgical technique

Anesthetized patients were positioned at horizontal ventral decubitus, and the limb to be operated was kept with a pneumatic garrote during the procedure. In 6 cases, the Trickey's access port⁽⁵⁾ ("S") was used, and in 15 cases, a simplified incision described by Burks⁽¹⁾ (inverted "L") was employed (Figures 1A and 1B).

After skin incision, the medial portion of the gastrocnemius muscle was flapped aside, and then medial arthrotomy and identification of

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Cases	sex	age (years)	mechanism of injury	injury on anterior leg surface	associated injuries
01	fem	33		present	-----
02	male	16	motorcycle	no	-----
03	male	26	trampling	no	femoral fracture
04	male	17	auto	present	patellar fracture
05	male	24	motorcycle	present	-----
06	male	16	auto	no	-----
07	male	15	motorcycle	present	-----
08	male	20	motorcycle	no	-----
09	male	31	motorcycle	present	-----
10	male	29	car	present	leg fracture
11	male	23	motorcycle	present	-----
12	male	32	motorcycle	present	-----
13	fem	42	trampling	no	-----
14	male	26	motorcycle	no	-----
15	fem	39	trampling	present	-----
16	fem	53	trampling	no	-----
17	male	44	motorcycle	present	-----
18	male	23	motorcycle	present	-----
18	male	28	motorcycle	present	-----
20	male	53	trampling	present	-----
21	fem	35	car	no	-----

Chart 1 - Descriptive data: sex, age (years), mechanism of injury, presence of injury on anterior leg surface, and associated injuries.

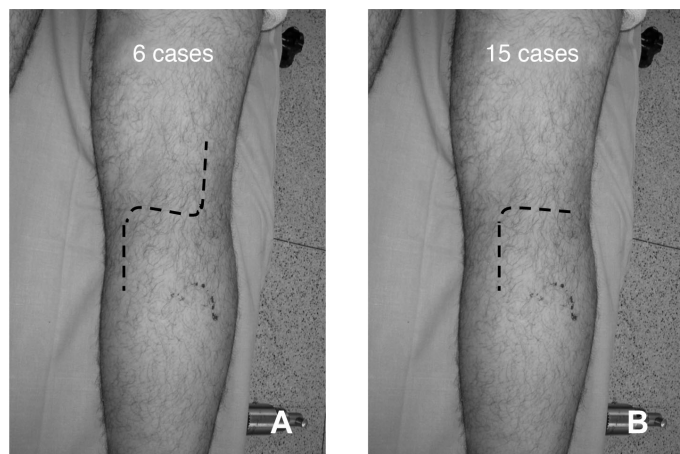


Figure 1 - Detail of skin incision adopted on posterior knee access port for the first 6 cases (A) and last 15 cases (B).

the PCL bone fragment avulsed from its tibial bed were provided. (Figures 2-B and 2-C).

Bone fragment fixation was performed whenever possible with stiff synthesis (screws and washer), as shown by Figures 2-B and C. However, in one case where the bone fragment was too small, and in other 2 patients in whom the epiphyseal plate was open, trans-bone string fixation with Ethibond wire nr. 5 was employed (Figure 3-A and B).

In 91% of the cases, the procedure was performed within two weeks from injury. During surgical procedure, the average garrote use time was below 30 minutes. At postoperative follow-up, the operated limb was kept in a plastered cast or

orthosis with the knee at neutral extension for 6 weeks, with partial load release being initiated at the end of the 3rd post-operative week. Then, a physical therapeutic rehabilitation program was established in order to gradually gain range of motion and muscle strengthening.

With a minimum follow-up time of 6-12 months, the patients were reassessed by means of the posterior draw test at neutral rotation, comparing the operated and control sides, Lysholm scale and simple X-ray test at AP and lateral planes.

RESULTS

Figures 4 and 5 show, respectively, the distribution of the number of cases according to age group and patient gender; the postoperative clinical evaluation by Lysholm scale and its correlation with posterior draw test at neutral position for the 21 study cases.

In 95% of the cases, the posterior draw test was not shown to be negative, evidencing a residual draw of + (0.5 cm) to ++ (1 cm). The results achieved in both evaluations - objective and subjective - were submitted to statistical analysis by Fisher's exact test.

DISCUSSION

Knee's posterior cruciate ligament (PCL) injuries account for about 20% of all knee ligament injuries, remaining prevalent among males and young adults².

Torisu⁽⁹⁾ assessed 21 patients with avulsion fracture of the tibial insertion of PCL, affecting males in 76% of the cases. Seitz et al.⁽¹⁰⁾ in a retrospective study with 26 patients, reported 73% of male cases, with a mean age of 23 years. In this study, patients' ages ranged from 15 to 53 years (mean = 29 years), and 76% were males.

The most common mechanism for PCL injury alone with or without avulsion fracture is classically called "panel trauma". In the vast majority of cases, this injury is secondary to motorcycle or car accident, where a tibial posteriorization force acts in a flexed knee. In these cases, the presence of ecchymosis and abrasions on the anterior surface of the proximal leg third are suggestive of the mechanism of injury; however, edema, joint swelling and muscle spasm may mask tibial posteriorization and the posterior draw test^(2,6,9,11).

In a study conducted on 36 patients with bone avulsion of the PCL in its tibial insertion, Torisu⁽⁸⁾ found that the injury was secondary to a motorcycle accident in 47% of the cases, and identified the presence of the injury on the anterior tibial surface in 47% of the patients. Seitz et al.⁽¹⁰⁾ retrospectively assessed 26 patients and found a similar mechanism of injury in 87% of the cases, and injury on the anterior leg surface in 100%. In our case series, 57% of the injuries were resultant from motorcycle accidents, and 17% have been caused by car accidents, while the presence of injury on the anterior leg surface was found in 62% of the cases.

In literature, surgical indications for PCL injuries treatment remain controversial, but in PCL avulsion fractures, surgical reinsertion of the avulsed fragment is a recommended procedure^(1,2,11).

Trickey⁽¹²⁾ described a technique using the posterior access port to knee, open reduction and fragment fixation. Later, Burks and Schaffer⁽¹³⁾ adopted the simplified access for



Figure 2 - Illustration of (A) baseline X-ray image of bone avulsion of PCL's tibial insertion at knee lateral plane, (B) posterior knee access and avulsed PCL fragment fixation, and (C) postoperative X-ray image of the avulsed fragment of the PCL in its tibial insertion with 3.5-mm cortical screw and washer at lateral knee plane.

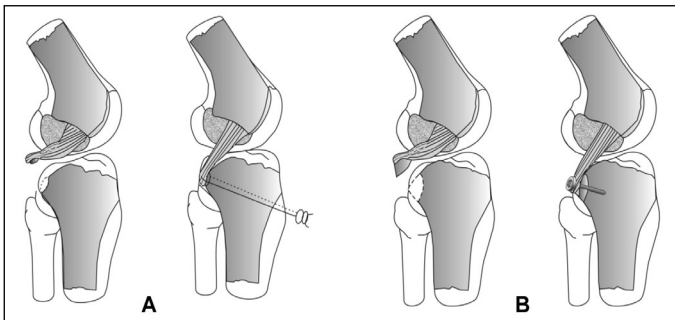


Figure 3 - Schematic illustration of knee's PCL bone fragment fixation in its tibial insertion performed with trans-bone string (A) and 3.5-mm cortical screw and washer (B).

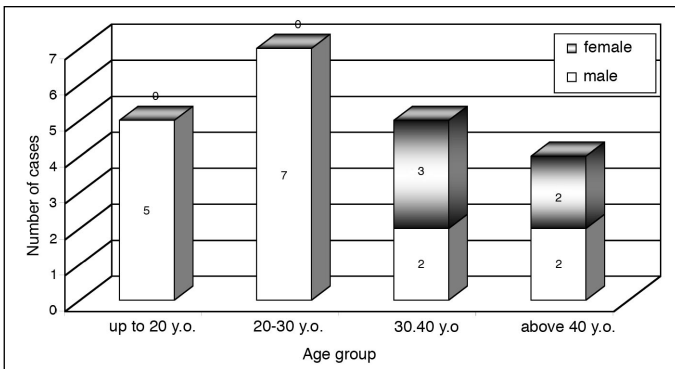


Figure 4 - Distribution of the number of knee PCL avulsion fracture cases correlating patients' gender in the four age groups (up to 20 years old, 20-30 years old, 30-40 years old and above 40 years old).

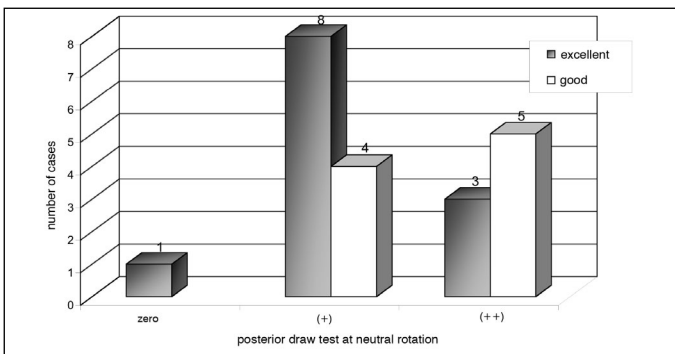


Figure 5 - Postoperative clinical evaluation by Lysholm scale (subjective) and its correlation with posterior draw test at neutral rotation (objective) in 21 knee's PCL avulsion fracture cases.

a posterior knee approach. In this study, the access port described by Trickey⁽¹²⁾ was employed for the first 6 cases. Upon familiarization with that port, the simplified access was adopted for the remaining 16 cases, resulting in less surgical trauma.

Many authors have emphasized that surgical reinsertion of the PCL fragment yields better results when compared to conservative treatment. Surgery enables measures such as a deeper tibial insertion site of the PCL, stiff fixation of the bone fragment, made by screws and washers, to aid PCL retensioning, and, consequently, a better clinical evolution^(9,10,12,14,15). Additionally, the time elapsed between injury and surgical procedure is an important factor that must be considered. When performed within the first two weeks after injury, surgery favors fragment reduction and fixation, providing an easier procedure. In this case series, in 95% of the cases, surgery was made within up to 15 days after injury, and the mean surgery time was 30 minutes. In recent years, some publications have assessed alternatives to fixate bone fragments, as well as new suggestions on how to surgically address this injury, such as reduction control under arthroscopic view^(2,10,16,17).

Inoue et al.⁽¹⁸⁾ conducted a prospective study intending to evaluate clinical prognosis of open reduction and PCL avulsion fracture fixation. This study shows that approximately 60% of the 31 studied patients showed a certain degree of posterior instability on operated knees when compared to intact knees, even after anatomical reduction and stiff fixation of the bone fragment.

In our case series, all cases have been rated as good and excellent in a subjective evaluation (Lysholm) in 43% and 57% of cases, respectively. The posterior draw test in neutral rotation showed a residual posteriorization of + (0.5 cm) and ++ (1 cm) in 57% and 38% of the cases, respectively. In case nr. 3, the patient presented with ipsilateral femoral fracture and was treated with external fixator. At postoperative clinical evaluation, no tibial posteriorization was identified, being rated as negative. However, the patient evolved with restrained range of motion (0° - 95°). The remaining cases have showed no associated injuries and did not present restrained range of motion at postoperative follow-up.

The statistical analysis showed no significant differences at 5% level among evaluations. The absence of peripheral ligament injury may have contributed for postoperative clinical outcomes to have a satisfactory subjective rating; however, the presence of a residual tibial posteriorization suggests that posterior cruciate ligament avulsion fracture should be addressed not as a purely bone injury, but also as a bone-ligament injury.

CONCLUSIONS

1. Surgical treatment of avulsion fracture of the knee posterior cruciate ligament provides satisfactory outcomes according to subjective analysis (Lysholm).
2. Clinical outcomes achieved at the objective evaluation suggest that this injury should be interpreted not only as a purely bone injury, but also as a bone-ligament injury.

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