Fixation of delayed union or non-union posterior cruciate ligament avulsion fractures

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ABSTRACT

Purpose. To report the outcome of fixation for delayed union or non-union posterior cruciate ligament (PCL) avulsion fractures.

Methods. Seven men and 4 women aged 24 to 35 (mean, 28) years underwent lag screw or suture fixation for non-union or delayed union of avulsion fracture of PCL tibial attachment after a mean delay of 8.6 (range, 4–14) months. Patient satisfaction was assessed using a visual analogue scale (VAS). Functional outcome was evaluated using the Lysholm scale.

Results. The mean follow-up period was 17 (range, 8–36) months. The mean Lysholm score improved from 82 preoperatively to 92 at the final follow-up (p=0.34), the mean range of knee motion improved from 82º to 87º (p=0.008), and the mean VAS score for patient satisfaction improved from 4.3 to 7.4 (p=0.0004). All patients but one achieved bone union after a mean of 7.5 (range, 7–9) weeks. Functional outcome was excellent for 6 patients, good for 4, and fair for one. Posterior drawer test was positive (grade I laxity) in 3 patients whose outcome was good for 2 and fair for one. The latter had non-union after Ethibond suture repair for a comminuted fracture. There were no instances of wound complications or implant loosening.

Conclusion. Fixation with lag screw or suture combined with bone grafting for delayed union or non-union of PCL avulsion fractures achieves acceptable functional outcome.

Key words: joint instability; posterior cruciate ligament

INTRODUCTION

Avulsion fracture of the posterior cruciate ligament (PCL) insertion site on the tibia is rare, and its diagnosis is often missed.¹ The PCL plays an important role in stabilising the knee.²,³ Posterior displacement of the tibia on the femur with the knee in flexion may occur after a dashboard injury or sudden hyperextension of the knee. Pain, knee swelling, abrasion, tenderness to deep palpation of popliteal fossa, and presence of
the posterior drawer sign are common symptoms. Untreated patients usually present with pain in damp weather, occasional giving way, restriction of full flexion, anteroposterior instability, and inability to change direction suddenly. Surgical fixation for isolated avulsion of the PCL tibial attachment is controversial, especially in delayed cases. PCL avulsions with large bony fragments necessitate open reduction and internal fixation, and early fixation of PCL avulsion is recommended. Injury to the PCL involves a force directed against the flexed knee that strikes the anterior surface of the proximal end of the tibia and drives it backwards. Motor vehicle accidents are the commonest cause. This study reports the outcome of 11 patients who underwent fixation for delayed union or non-union of PCL avulsion fractures.

MATERIALS AND METHODS

Between November 2009 and January 2012, 7 men and 4 women aged 24 to 35 (mean, 28) years underwent lag screw (n=9) or suture (n=2) fixation for non-union or delayed union of avulsion fracture of PCL tibial attachment after a mean delay of 8.6 (range, 4–14) months following road traffic accidents (n=9) or falls (n=2). The patients had pain, instability, posterior tibial translation of ≥10 mm, and no or mild osteoarthrosis. Patients underwent rehabilitation and gait training prior to surgery when having severe muscle atrophy, hyperextension gait, and restricted range of knee motion. Patients with varus/valgus osseous malalignment, knee range of motion of <45°, and moderate-to-severe osteoarthrosis were excluded, as were those with associated injuries to the anterior cruciate ligament or collateral ligaments.

Clinical examination included anterior and posterior drawer tests, Lachman test, pivot shift test, varus and valgus stress tests at 0° and 30°, and quadriceps active test. Anteroposterior, lateral at 30° knee flexion, weight-bearing postero-anterior at 45° knee flexion, and patellar femoral axial radiographs were taken, as were magnetic resonance images (Figs 1 to 3). Common soft-tissue injuries were noted to have healed and included abrasions on the anterior surface of the upper tibia (n=7), associated tear in the posterior horn of the medial meniscus (n=3), and lateral meniscus tear (n=1).

The avulsed bony fragment of the PCL was fixed through the modified posteromedial approach of the gastrocnemius. A reverse L-shaped incision was made along the medial border of the medial head of the gastrocnemius, and the posterior capsule was vertically dissected medially to the posterior intercondylar sulcus. Fracture edges were freshened and fixed on the tibial bed with lag screws or suturing through 2 parallel drill holes in the tibia (as the fragment was small and comminuted) in a postero-anterior direction. Bone grafting from the ipsilateral iliac crest was performed. There was some difficulty in pulling the fragment down to the original fossa, and the fragment was fixed as distal as possible with

Figure 1  Avulsion fracture of the posterior cruciate ligament fixed with a single lag screw.
the PCL in appropriate tension. Detachment of the posterior horn of the medial meniscus was noted in 3 patients, and the posterior capsule was torn in 3 patients, which was repaired.

The knees were immobilised in a plaster cast in 30° flexion for 4 weeks, and then knee mobilisation with a removable knee brace was started, along with isotonic knee exercises for quadriceps and hamstrings. Partial weight bearing was started at week 6. Full weight bearing was allowed at month 2. Bone union was defined as absence of pain, stable knee, full weight bearing without support, and bone consolidation on radiographs. Patient satisfaction was assessed using a visual analogue scale (VAS). Functional outcome was evaluated using the Lysholm scale.7

Pre- and post-operative Lysholm score, range of

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Figure 2  Avulsion fracture of the posterior cruciate ligament fixed with double lag screws.

Figure 3  Avulsion fracture of the posterior cruciate ligament showing altered signal intensity and fixed with a lag screw and washer.
knee motion, and VAS score for patient satisfaction were compared using the paired t-test. A p value <0.05 was considered statistically significant.

**RESULTS**

The mean follow-up period was 17 (range, 8–36) months (Table). The mean Lysholm score improved from 82 preoperatively to 92 at the final follow-up (p=0.34), the mean range of knee motion improved from 82º to 87º (p=0.008), and the mean VAS score for patient satisfaction improved from 4.3 (standard deviation [SD], 1.2) to 7.4 (SD, 0.8) [p=0.0004]. All patients but one achieved bone union after a mean of 7.5 (range, 7–9) weeks. Functional outcome was excellent for 6 patients, good for 4, and fair for one. Posterior drawer test was positive (grade I laxity) in 3 patients whose outcome was good for 2 and fair for one. The first 2 had residual anteroposterior instability, restricted motion of full flexion, and intermittent swelling of knee. The latter had non-union after Ethibond suture repair for a communited fracture. He had a Lysholm score of 82 and had residual instability and difficulty running downstairs; displacement of bony fragments was visible on radiograph at month 6. The patient was advised to refrain from running and jumping. There were no instances of wound complications or implant loosening.

**DISCUSSION**

There are few studies of delayed union or non-union of PCL avulsion fractures. It is not considered to be worthwhile. However, delayed presentation does not necessarily contraindicate open reduction and internal fixation, which achieves best clinical outcome for acute cases. The wide posterior approach is commonly used despite technical difficulties. The modified open posterior approach combined with early range-of-motion exercises enables <10º flexion difference and >2º extension difference compared with the normal side. The posteromedial approach of the gastrocnemius is easy, time-saving, and safe, as neurovascular structures are retracted along with the medial head of the gastrocnemius. Fixation with a lag screw, staple, or suture achieves good outcome.

In 21 cases of delayed or non-union PCL avulsion fractures, 8 were repaired surgically and achieved complete resolution of symptoms, although 4 of them had residual anteroposterior instability. Three of our patients had residual anteroposterior instability of 4 to 5 mm, but had good to fair functional outcome at the final follow-up. Their preoperative magnetic resonance images showed abnormal density in the PCL fibres, probably owing to stretching of the PCL fibres or partial tear. Nonetheless, in one study 10 patients achieved good to excellent functional outcome after lag screw fixation despite residual anteroposterior instability (mean laxity, 2.4 mm), and their mean Lysholm score was 91. In another study, 3 patients had a laxity of 3 to 4 mm, but their functional outcome was good, with the time to union being 7 to 9 weeks. The healing time and functional outcome were similar to our series.

One limitation of this study was the small sample size for subgroup analysis. The method of treatment was not randomised and mainly based on the characteristics of the soft tissues and fractures. The International Knee Documentation Committee score

<table>
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<tr>
<th>Table</th>
<th>Patient characteristics and outcomes</th>
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<tr>
<td>Sex/age (years)</td>
<td>Injury mechanism</td>
</tr>
<tr>
<td>M/26</td>
<td>Road traffic accident</td>
</tr>
<tr>
<td>M/30</td>
<td>Road traffic accident</td>
</tr>
<tr>
<td>M/30</td>
<td>Road traffic accident</td>
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is more objective than the Lysholm score and should have been used. Stress radiographs are more accurate and should have been used to assess posterior stability.

CONCLUSION

Fixation with a lag screw or suture combined with bone grafting for delayed union or non-union of PCL avulsion fractures achieves acceptable functional outcome. Partial or complete tear of the PCL may lead to inferior outcome.

DISCLOSURE

No conflicts of interest were declared by the authors.

REFERENCES