POSTERIOR CRUCIATE LIGAMENT AVULSION FROM THE TIBIA : FIXATION BY A POSTEROMEDIAL APPROACH

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The authors present their experience with a posteromedial approach for fixation of posterior cruciate ligement avulsion from the tibia. The approach is easy, safe and demands no great technical prowess or instruments. Some minor modifications and technical tips for a safer exposure and a better fixation are highlighted. This is a reproducible method for achieving good stability in these avulsion fractures, where early intervention prevents significant late disability. Even in cases delayed up to 3 months we advocate fixation after gradual intra-operative traction and multiple longitudinal stab incisions, if the ligament with the attached bony fragment has retracted proximally. A single 4-mm screw gives sufficient initial stabilisation to allow supervised mobilisation. A high index of suspicion should be maintained in all dashboard injuries presenting with femoral shaft fractures, especially when the patella is also fractured. The diagnosis may be missed in the acute setting if the bony avulsion is not adequately appreciated ; routine MRI in this situation is a good option.

INTRODUCTION

Injuries of the posterior cruciate ligament (PCL) are now gaining recognition as disabling problems that are often overlooked (10, 19), and many times the treatment is deferred due to an apprehension that the approach to the posterior aspect of the knee is difficult (1, 17, 22). In spite of their common association with ipsilateral injuries, intra-substance tears are usually not primarily diagnosed nor treated at initial presentation. Avulsion injuries from the tibial attachment constitute a small subgroup that differs from other PCL injuries in two ways. Firstly an early diagnosis is usually possible on standard radiographs where a bony fragment may be visible, and secondly the treatment protocol is fairly standardised. Surgical fixation of the bony avulsion by either a screw or K-wire is advocated and it has given almost uniformly excellent results (19), whereas non-surgical treatment has a significant incidence of morbidity in form of residual instability and early degenerative arthritis (10). Some orthopaedic surgeons are apprehensive about treating tibial avulsions of the PCL because of their unfamiliarity with the standard posterior approach to the knee (1, 23, 24) and the potential for damage to the important neurovascular structures. Many series dealing with PCL injuries have followed the standard posterior approach through the popliteal fossa as described by Abbott (1), which is a complex approach requiring a meticulous and time consuming dissection of the neurovascular bundle in the popliteal fossa. Trickey (24) described a modification of the above mentioned approach with the aim of decreasing the surgical dissection and time. However the medial head of gastronemius needed to be divided and the neurovascular bundle was still at risk due to its proximity. Ogata (18) and McCormick (16) described a posterolateral approach of the knee for the treatment of PCL inju-

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Table I. — Details of the 9 cases

S.No.	Age/Sex	Side	Associated injury	Time between injury and surgery	Follow-up	ROM	Instability
1.	51/F	R	Colles #	6 weeks	2.2 yrs	0-140	Nil
2.	22/M	R	Patella #	8 weeks	1.9 yrs	0-110	Nil
3.	22/M	L	–	6 weeks	3 yrs	0-145	Nil
4.	40/M	R	Meniscal tear	9 weeks	1.8 yrs		Nil
5.	28/M	R	Femur #	9 months	1.4 yrs	0-120	Nil
6.	17/M	L		5 weeks	1.6yrs	0-130	Nil
7.	25/M	L	# Patella	7 weeks	9 mo	0-120	Nil
8.	21/M	L	# Femur, # Patella	3 weeks	2 mo	0-90	Nil
9.	35/M	R	# Patella, & Meniscal tear	12 weeks	6 mo	0-120	Nil

ries. It required osteotomy of the fibular neck which endangered the nerve and required extensive mobilisation of the tendon of the popliteus. These factors increased the complexity of the approach besides affecting the postoperative rehabilitation.

Keeping this in mind, Burk and Schaffer (3) in 1988 described a simplified approach to the PCL which avoided the problems associated with the standard posterior approach. This has become the standard approach for approaching the PCL, either for fixing avulsions or for onlay reconstructive grafting. We have used this approach for the fixation of tibial avulsions of PCL and present our experience with this technically safe and easy exposure.

MATERIALS AND METHODS

Over a two years period, 9 cases with radiographically demonstrated avulsion of the PCL were fixed using this approach. A standard pre-operative assessment of each case comprised of clinical examination to define the instability and other associated problems. Standard AP, lateral and tunnel views were taken in all cases, and CT scan was done in 4 and MRI in all 9 cases to better define associated injuries at the knee. Associated femoral shaft fractures were treated by interlocking nailing at the first stage ; within 14 days an arthroscopic examination of the knee was done to address and treat the intra-articular problems by standard methods ; the patient was then flipped into prone position and re-draped. A longitudinal skin incision was made along the medial aspect of the gastrocnemius muscle and extended proximally up to the flexion crease, where it curved slightly upward and laterally. Both the superficial and deep fascias were cut in the line of incision, and blunt dissection developed a plane between the medial border of medial gastrocnemius and semimembranosus muscle, until the capsule was exposed. The middle medial geniculate artery, which lies over the mid capsule, often needed to be ligated. The level of the joint was identified by gently doing flexion-extension movements, and a longitudinal cut in the capsule gave good exposure of the avulsed fragment. The avulsed bony attachment of the PCL was reduced with help of a hook and gentle flexion of the knee. This was temporarily stabilised with K-wires prior to fixation with one or two 4-mm partially threaded cancellous screws. After thorough lavage, the capsule was sutured back, and both the semimembranosus and medial gastrocnemius were allowed to fall back in to their normal position The skin was closed after approximating subcutaneous layers.

OBSERVATIONS

From January 2000 to November 2002, 9 cases with avulsion of the PCL with a bony fragment from its tibial insertion were operatively fixed by the senior author (table I). There were 8 males and one female, and their ages ranged from 20 to 51 years. Follow-up ranged from 2 months to 3 years. Associated injuries included fracture of the patella (4 cases), ipsilateral femur diaphyseal fracture (2 cases) and Colles' fracture (1 case). The duration between injury and surgery ranged from 3 weeks to 9 months. Routine lateral X-rays could identify the avulsed fragment in all cases (fig 1) ; CT scan was done as an adjunct to the X-rays in 4 cases (fig 2), while MRI was done in all (fig 3). On arthroscopy only two cases had a radial tear of

Fig. 1. — X-ray (lateral view) showing avulsed bony fragment of PCL. Note femoral interlocking nail *in situ*.

Fig. 3. — MRI showing intact PCL, but avulsed bony origin. Note bone oedema at avulsion site in tibia.

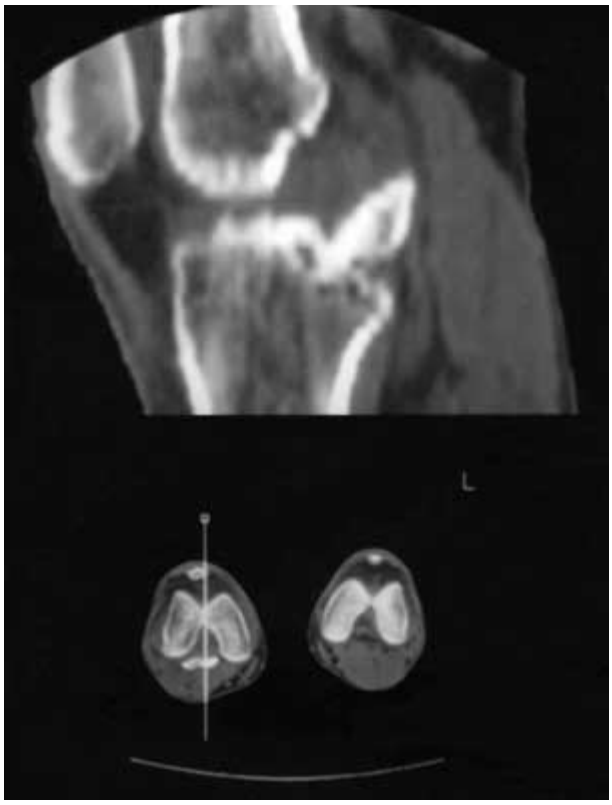

Fig. 2. — CT scan showing a large avulsed posterior fragment.

the medial meniscus. The femoral shaft fractures were fixed by intramedullary nailing, and patellectomy was done in one case of comminuted patellar fracture. Fixation by two screws was done in one case (fig 4 a, b), while one screw was considered sufficient for stability in the other cases.

In one case with 9 months of delay between injury and surgery, the PCL was found to be retracted and the bony fragment could not be pulled down to its bed easily ; this was managed by giving multiple longitudinal stab incisions in the PCL and applying sustained traction for 10 minutes ; the fragment was also fixed in a slightly more proximal position than normal, and we found no postoperative limitation of motion due to this.

All patients regained 90^0 of knee motion within 6 weeks of surgery except the case with patellectomy, where mobilisation was delayed. Full flexion to 130^0 or higher was achieved at the end of 3 months. No residual instability was noted in any case, and at follow-up of 6 months (except in one case operated in Nov 2002) there was no pain or feeling of instability while negotiating stairs.

Fig. 4A. — Post operative X-ray (AP view) after fixation with 2 screws.

Fig. 4B. — Post operative X-ray (lateral view)

DISCUSSION

The posterior cruciate ligament (PCL) is the stronger of the two cruciate ligaments and is the primary restraint for posterior tibial translation during knee flexion (10). When it is ruptured, this results in posterior subluxation of the tibia, wherein an abnormal pressure on the patellofemoral joint is created, leading to chronic pain and early cartilage degeneration (4, 20, 24). There is no consensus about the primary repair of PCL injuries (21), although late reconstruction in experienced hands is regaining popularity. One fact is however clear ; tibial avulsion gives the best results after stable fixation (5, 6, 13), and if this injury is isolated, it can be treated at any center with a little experience and some understanding of the pertinent anatomy. Numerous series have consistently demonstrated excellent results with fixation and uniformly poor results with non-surgical methods (17, 19, 24).

The fixation of the avulsed tibial attachment of the PCL can be done either by open exposure or by arthroscopically assisted means (7, 8, 13, 14, 15). The latter is an ideal method provided the necessary expertise and equipment is available. Despite adequate experience, Kim *et al* (12) believed that the technique of arthroscopy-assisted reduction and fixation was difficult and had a steep learning curve. In our experience a similar fixation can also be achieved by open exposure through the posteromedial approach, which can be used at any center.

The classical posterior approach to the knee as described by Abott and Carpenter (1) requires dissection of the neurovascular bundle and is time consuming. Various others approaches described by Trickey (24), McCormick *et al* (16) and Ogata (18) have failed to significantly simplify the exposure ; Burks and Schaffer (3) described a simplified posterior approach to the knee which did not require the neurovascular dissection besides giving good exposure of the PCL and posterior horns of both menisci. We followed a similar approach for

fixation of the tibial avulsion of the PCL attachment and found it to be technically easy, time saving and safe. We also introduced two minor modifications to make the approach safer. First, the skin incision was relatively vertical with a minimal curve laterally at the level of the flexion crease. It need not be extended too laterally along the flexion crease as sometimes advocated, because a deeper dissection at this level could potentially endanger the neurovascular bundle. Secondly, the capsule was opened vertically under direct vision as lateral as possible after careful retraction of the medial gastrocnemius. This ensures a midline capsulotomy directly over the avulsed ligament and gives good exposure without excessive lateral retraction of medial gastrocnemius, which may be needed during fixation. Our screw placement was also not perpendicular to the posterior cortex as has been advocated ; we found that a 45° placement of the screw gave as good a purchase. As most fragments are small, and some may be comminuted, the use of one screw with the addition of a washer when needed, gives sufficient purchase in the majority of cases. A fully threaded cancellous screw should ideally be used.

A high incidence of femoral shaft and patellar fractures associated with a PCL failure was seen in this series ; this scenario, especially when seen after a motor vehicle accident should give rise to a high index of suspicion about PCL injuries. A haemarthrosis will ensue after patellar fractures, and examination of the knee is a problem. The authors recommend a routine MRI in this injury combination, especially when there is no bony avulsion seen in the lateral radiographs, to rule out intra substance tears.

Another factor that plays a role in postoperative rehabilitation is the role of associated injuries ; patellar fractures, if comminuted may need patellectomy and this delays early mobilisation. All our cases that had an associated patellar fracture had poorer ultimate knee flexion (table I). Femoral shaft fractures can be well managed by interlocking nailing and rehabilitation after this is fairly uncomplicated. Delay in treatment was observed in all our cases, but this was not found to be a significant problem when fixing the fragment.

In conclusion, surgical treatment of PCL avulsion from its tibial attachment gives good results after stable fixation. The posteromedial approach is a good option, and minimal dissection gives a safe and adequate exposure for screw fixation. A high index of suspicion should be maintained in all dashboard injuries presenting with femoral shaft fractures, especially when the patella is also fractured. The diagnosis may be missed in the acute setting if the bony avulsion is not adequately appreciated ; routine MRI in this situation is a good option.

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