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Posterior tibial spine avulsion fractures treated by open reduction and internal fixation through Burks and Schaffer approach – An outcome analysis

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Abstract
The Posterior Cruciate ligament (PCL) is the stronger of the two cruciate ligaments of the knee. It is the primary constraint to the posterior tibial translation at 90º of knee flexion. PCL avulsion injuries are not uncommon in our country. We corrected such injuries with open reduction and internal fixation using Burks and Schaffe approach in 10 patients, followed up the patients adequately and reported their functional outcome in this study

Keywords: Open reduction, internal fixation, Burks, Schaffer approach

Introduction
PCL injuries are estimated to account for 20% of knee ligament injuries. That incidence is higher especially in cases resulting from high-energy trauma, suchas in motorcycle and car accidents. However, in the presence of PCL bone avulsion from its tibial insertion, a consensus exists towards surgical intervention. Though there are controversies, most authors have recommended operative management of a displaced bony avulsion of the tibial insertion of the PCL.

The surgical technique employed here consists of a posteromedial knee (Burks and Schaffer) approach, reinsertion and fixation of the PCL bone fragment into its anatomical bed located on posterior tibial surface and surgical fixation of the bony avulsion by 4mm cancellous screw .It has given almost uniformly excellent results, whereas non-surgical treatment has a significant incidence of morbidity in form of residual instability and early degenerative arthritis. Some orthopaedic surgeons are apprehensive about treating tibial avulsions of the PCL because of their unfamiliarity with the standard posterior approach to the knee 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, which is a complex approach requiring a meticulous and time consuming dissection of the neurovascular bundle in the popliteal fossa. Trickey 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. In Burks and Schaffer approach there is very minimal chance for neurovascular injury and safe exposure of the avulsed fragment. This procedure is reported as sufficient for reestablishing ligament integrity and function.

To identify the results and gain further confidence about the surgical management of the avulsed PCL this study was conducted and found that Open Reduction & Internal Fixation through Burks and schaffer's approach can provide excellent outcome in the management of the avulsed PCL from tibial attachment.

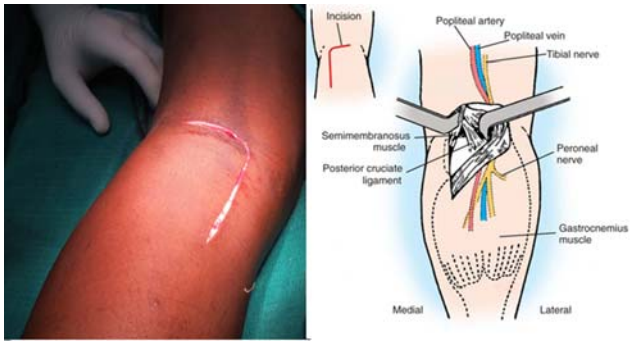
Material & Methods
In this series there were 10 cases. The average age of the patient was 27 years, extending from 24 to 45 years of age. In all the cases the injuries were less than 3 weeks old. There was no

history of surgery of the affected knee prior to this. It is to be mentioned here that the fracture fragment has to be large enough to be fixed by an at least 4 mm screw with washer. In this regards real image by x-ray can provide necessary information. Even though, in half of the cases where fracture fragment needed further evaluation, we did CT scan. From the history it was evident that the motor bike accidents were the main cause of the injury (80%), then dash board injuries (20%). Surgeries were performed under spinal anesthesia in 10 cases. In all cases tourniquet was applied.

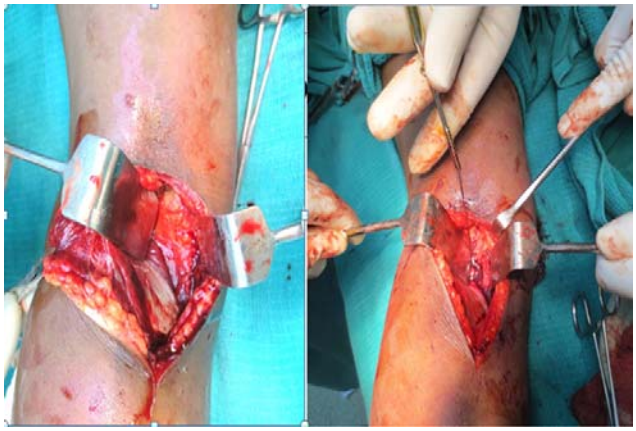
The patient was in prone position and fixation was done through Burks and Schaffer approach. A longitudinal skin incision was made along the medial aspect of the gastrocnemius muscle and extended proximally up to the flexion crease where it curved laterally, (Inverted L). Both the superficial and deep 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 manually with gentle flexion of the knee. The reduction was confirmed under C-arm image itensifier. Avulsed fragment 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.

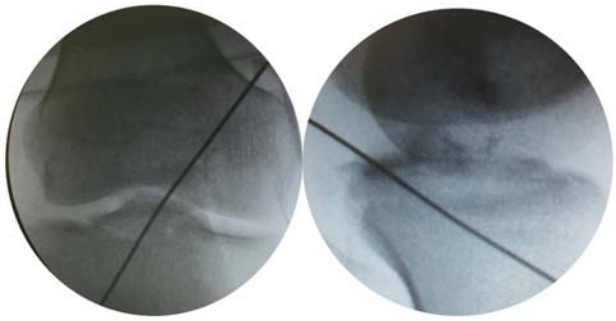
Pre-operative xray Lt knee AP & lateral view



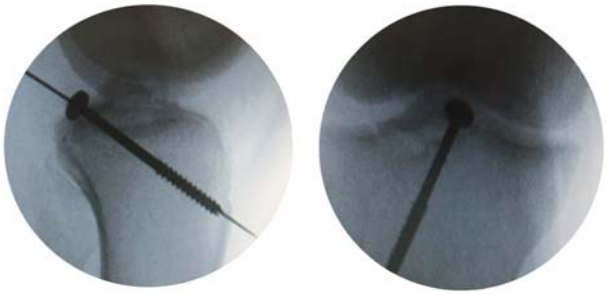
Skin Incision for Burks and Schaffer approach



The capsule is exposed and the avulsed fragment reduced and fixed with cannulated cancellous screws



Guide pin for cannulated screws inserted under C-arm guidance



Cannulated screws inserted under C-arm guidance

Post-operative xray Left knee-AP and Lateral views

First year Follow-up clinical photograph

First year follow-up clinical photograph

First year Follow-up xray image

The healed 'Inverted L' incision at first year follow-up

Observation and Results

Between July 2013 to December 2014, 10 men aged from 24 to 45 years underwent open reduction & Internal fixation by 4 mm screw and washer. Mean follow up period was 12 months. In this case series, in 90% of the cases, surgery was done within 15 days after injury, and the mean surgery time was 45 minutes. Associated injuries included ipsilateral undisplaced fracture of the patella (1 case), ipsilateral femur diaphyseal fracture (1 case) and ipsilateral Hoffa's fracture lateral femoral condyle (1 case). CT scan was done as an adjunct to the X-rays in 4 cases. The femoral shaft fractures were fixed by intramedullary nailing, Patella was treated conservatively and Cancellous screw fixation was done for lateral femoral condyle fracture. Fixation by two screws was done in one case (associated with Hoffa's fracture) while one screw was considered sufficient for stability in the other cases. All patients regained 90^0 knee motion within 6 weeks of surgery. Full flexion to 130^0 or higher was achieved at the end of 3 months. At 12 months of mean follow-up it has been seen that the tests for instability (posterior sag sign and posterior drawer test) were negative in 100% of cases, 90% achieved full ROM within 5 months post-op.

Discussion

The fixation of the avulsed tibial attachment of the PCL can be done either by open exposure or by arthroscopically assisted methods. Despite adequate experience, Kim *et al* 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 centre. Treatment is indicated in patients when there is posterior instability on physical examination and a bony fragment is seen on x-ray. The fragment also has to be large enough to be fixed. We selected only those cases where there is isolated PCL avulsion from tibial attachment (no other intra-articular structural damage/injuries).

We did CT scan of the knee to select the best fit fixation devices and in cases when there appeared any doubt about the details of the fragment. We have not done any MRI in this study as we know that the chance of intra-substance injury is a remote possibility in avulsion injury of any ligament. We performed the surgeries in acute phase of the injury; and fixed the fragments with 4 mm cannulated cancellous screws with washer. The Burks and Schaffer approach had a considerably reduced operating time and resulted in lesser complications since the thick muscle belly protects the neurovascular structures as the capsule is exposed. Dissection on this protected medial side of the popliteal fossa is therefore relatively safe. Though the surgeries were performed at the acute phase of injury, there were no arthrofibrosis.

The knee was immobilized in a plaster cast for 6 weeks, following that the patients are encouraged to start partial weight bearing, quadriceps muscle-strengthening exercises and gradual guarded flexion and extension with the support of a knee brace. At 12 weeks, the brace is removed and patients are encouraged to increase activity gradually. Progressive resistance exercises are continued up to 3 months.

The results were analysed with The Lysholm knee score.We had excellent outcome in all of our cases. Study shows there were no, or minimum instability following the procedure in our series and obtained solid bony union and functional capacity along with satisfaction. It is evident that the associated intra-substance injury if any has not affected the postoperative posterior instability of the knee.

Conclusion

In conclusion, open reduction and internal fixation for avulsed PCL from tibial attachment is a reliable and effective method of management for the avulsed PCL from tibial attachment. 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. The The Burks and Schaffer approach is a good option, and minimal dissection gives a safe and adequate exposure for screw fixation and a fairly reduced operative time. 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 CT or MRI in this situation is a good option.

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