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Functional Outcome of Burk Schaffer's Approach for PCL Tibial Avulsion Fracture Fixed with Cancellous Screw

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Abstract

Background: Posterior Cruciate Ligament (PCL) is the main posterior stabilizer of the knee. Injuries of the PCL are rare. Isolated PCL disruption most commonly occurs as avulsion at its tibial insertion as compared with its femoral origin or as a mid-substance tear. In PCL bony avulsion, fixation of the avulsed fragment with cancellous screw is a recommended procedure. **Objective:** To evaluate efficacy of Burk Schaffer's approach in treatment of PCL tibial avulsion fracture with cancellous screw and evaluation of functional results according to Tegner Lysholm score. **Material and Methods:** We included 30 patients (Male 26 and Female 4) operated for isolated PCL avulsion from tibia during the period from 2015 to 2017. Patients were evaluated clinically by posterior drawer test, radiologically by X-ray and using functional scale of Tegner-Lysholm. MRI was advised for suspected other ligaments and meniscal injuries. All cases were operated with 4mm cannulated screw fixation by Burk and Schaffer approach. **Results:** Mean Tegner Lysholm score of 30 patients was 95.37 after 6 months of surgery, which was excellent. After 3 months 75% has grade 0 posterior drawer test, 12.5% has grade 1 and 12.5% has grade 2 laxity. **Conclusion:** Approach by Burk and Schaffer is safer and easier than the classical one. Open reduction and fixation with cannulated screw for tibial avulsion of PCL gives good functional outcome.

Keywords: Burk And Schaffer's Approach, Posterior Cruciate Ligament (PCL) Avulsion Fractures, Tegner Lysholm Score

1. Introduction

Posterior Cruciate Ligament (PCL) injuries account for approximately 20% of total ligament injuries of the knee[1]. Anatomically PCL acts as a posterior knee stabilizer and limits the posterior tibial translation[2,3]. The incidence is especially high in cases of high-energy trauma (motorcycle and car accidents) and athletic population involved in contact sports[4,5]. The most common mechanism underlying PCL avulsion fractures of the tibia in road traffic accidents is dashboard collision in which a direct force is applied to the proximal part of the tibia in an anterior-to-posterior direction, with the knee in flexion[6,7].

Nonsurgical treatment of displaced PCL avulsion fractures has a high incidence rate of non-union or malunion and can cause loss of ligament function, leading to further knee instability and traumatic arthritis. The treatment of tibial bony avulsion may vary from open reduction and internal fixation to arthroscopic fixation with screws or sutures[8-10].

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Many series dealing with PCL injuries have followed the standard posterior approach through the popliteal fossa as described by Abbott[11], which is a complex approach requiring a meticulous and time consuming dissection of the neurovascular bundle in the popliteal fossa. Trickey[12], Ogata[13] and McCormick[14] also described approaches in which the neurovascular bundle was still at risk. Burk and Schaffer[15] 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 on lay reconstructive grafting.

2. Aims and Objectives

1. To evaluate the functional results according to the Tegner-Lysholm score at 2nd, 4th and 6th months.
2. To study fixation modality of PCL Tibial avulsion fracture by 4mm cancellous screw.

3. Materials and Methods

This research is a prospective study design in a sample of 30 patients with PCL Tibial avulsion fracture attending Department of Orthopaedics of a tertiary care private hospital which was studied over a period from June 2015 to November 2017. The study was approved by the Institutional ethics committee. All patients were informed about details of study, and a valid informed consent was obtained.

All the patients were evaluated clinically by posterior drawer test, radiologically with x-ray (figure 4) and by functional scale of Tegner-Lysholm score preoperatively as well as postoperatively. MRI was advised for suspected other ligaments and meniscal injuries. All these cases radiographically demonstrated avulsion of the PCL and were fixed using Burk and Schaffers approach.

Inclusion Criteria are:

1. Age group between 15 to 60 yrs irrespective of sex.
2. Acute isolated PCL avulsions.
3. Duration of injury less than 6 weeks.

Exclusion Criteria are:

1. Any other comorbid condition of the same knee joint such as osteoarthritis of knee, local infection etc.
2. Previous ligamentous injury in the same knee joint.
3. Bilateral PCL injury.
4. Associated lower limb fractures.
5. Incidental finding of PCL injury found during diagnostic arthroscopy.
6. Associated injuries like osteochondral defects requiring drilling or mosaicoplasty, concomitant anterior cruciate ligament injury, ACL fractures, extra articular ligament injuries, associated meniscal tears requiring simultaneous meniscus repair.
7. Neurovascular compromise of both lower limbs.
8. Non-compliant patient with rehabilitation protocol.

4. Surgical Technique

Under suitable anesthesia, under tourniquet control, patient positioned in prone position an inverted L shaped incision taken with a horizontal limb just proximal to the flexion crease of the knee and a vertical limb overlying the medial aspect of the gastrocnemius muscle (Figure 1). Dissection carried to deep fascial layer. An interval created between medial head of gastrocnemius muscle and semimembranosus muscle. Posterior joint capsule is reached through this interval (Figure 2). A longitudinal cut in the capsule gives good exposure of the PCL insertion over tibia. The avulsed bony attachment of the PCL was reduced with gentle flexion of the knee and temporarily stabilized with K-wires prior to fixation with one or two 4-mm partially threaded cancellous screws (Figure 3) closure done in layers limb immobilised with posterior tibia support brace for 4 weeks. Physiotherapy started after 4 weeks which included active range of movement and quadriceps strengthening exercises and nonweight bearing walking with walker for 4 weeks further.

Full weight bearing walking started at the end of 8 weeks. In patients who showed delayed union on x-ray, the weight bearing was further delayed by additional 2 weeks. At follow up the standard X-rays were done at 6 weeks, 3 months, 12 months and further if they still had

Figure 1. Showing posterior knee with flexion crease and incision marking of Burk Schaffer Approach.

Figure 2: Demonstrating gastrocnemius muscle retracted laterally, semimembranosus muscle retracted medially exposing the posterior joint capsule.

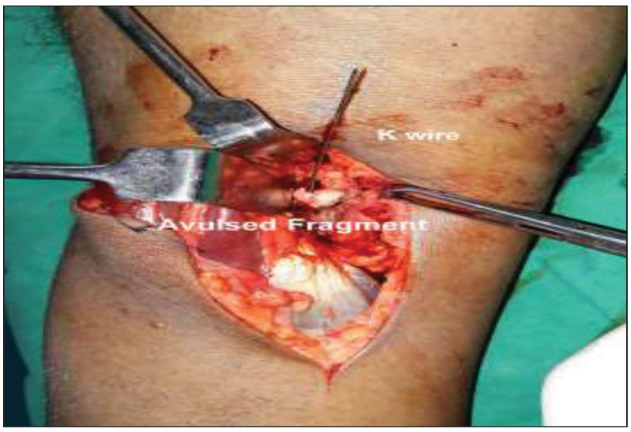

Figure 3. Demonstrating the bony avulsed fragment of PCL fixed with k-wire.

Figure 4. Pre-operative X-ray showing the avulsed posterior cruciate ligament fragment.

Figure 5. Post-operative X-ray with cancellous screw fixation of the displaced avulsed fragment.

symptoms, and evaluated for signs of healing. From 3 months onwards, functional outcome were assessed using the Tegner Lysholm score.

5. Observation and Results

The study conducted includes 26 males (86.67%) and 4 females (13.33%) (Chart 1). The age of patients ranged from 16 years to 55 years (Mean age - 32.1 years). The right knee was involved in 14 patients (46.67%) whereas the left knee was involved in 16 patients (53.33 %). The mechanism of injury was road traffic accidents in 19 patients (63.33%), Sports Injury in 8 patients (26.67%) and household falls in 3 patients (10%) (Table 1). The mean surgery time was 58.33 min (35-95 min).

Table 1. Age distribution

Age group	Number of patients	Percentage
16-25	9	30%
26-35	12	40%
36-45	6	20%
46-55	3	10%
Total	**30**	**100%**

At the end of 3 months, radiographs of the knee taken showed fracture healing in all patients. There were no major complications such as infection, deep vein thrombosis, or neurovascular deficit. After 3 months 70% has grade 0 posterior drawer test, 20% has grade 1 and 10% has grade 2 laxity, however no patient had any

complain of instability. Mean Tegner Lysholm score of 30 patients significantly increased from 36.90 pre-operatively to 91.30 at 2 months post-operatively to 95.37 at 6 months post-operative period (Table 2-4). One case had wound necrosis at corner which has been treated with freshening of edges and resuturing. Table 5 and Table 6 show the distribution of study participants as per the pre-operative and post-operative Tegner-Lysholm score.

Table 2. Mode of injury

Mode of injury	Number of patients	Percentage
Road Traffic Accidents	19	63.33 %
Sports injuries	8	26.67%
Household falls	3	10%
Total	**30**	**100%**

Table 3. Posterior drawer test after 3 months

Posterior Drawer Test	No. of Patients	% of Patients
Grade 0	21	70%
Grade 1	6	20%
Grade 2	3	10%

Table 4. Mean Tegner Lysholm score

Mean Tegner Lysholm score	Pre-operative	Post-operative (after 2 months)	Post-operative (after 6 months)
	36.90	91.30	95.37

Table 5. Preoperative Tegner Lysholm score

Tegner Lysholm Score	Number of patients	Percentage
Excellent	0	0
Good	0	0
Fair	5	16.67%
Poor	25	83.33%
Total	**30**	**100%**

Table 6. Post-operative Tegner Lysholm score (after 6 months)

Tegner Lysholm Score	Number of patients	Percentage
Excellent	26	86.66%
Good	2	6.67%
Fair	2	6.67%
Poor	0	0
Total	**30**	**100%**

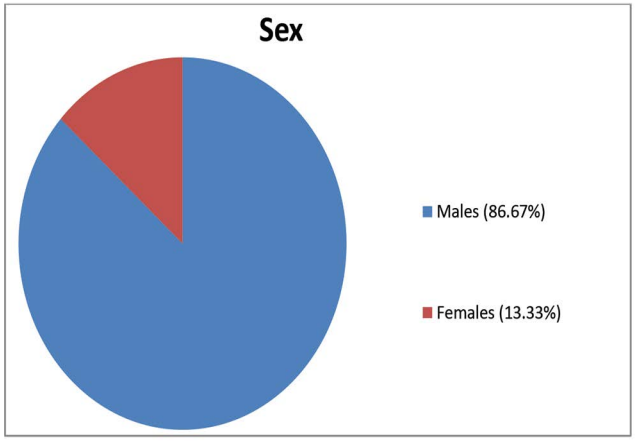

Chart 1. Sex percentage.

6. Discussion

PCL injuries account for approximately 20% of total ligament injuries of the knee[1]. Damage to PCL either due to bony avulsion or intrasubstance rupture if not treated can lead to chronic pain and patellar de generation due to posterior subluxation of tibia[16,17]. Bony avulsion fractures can be easily diagnosed on standard radiographs than intrasubstance tear and there is widely accepted treatment protocol regarding its fixation[18].

Many series dealing with PCL injuries have followed the standard posterior approach through the popliteal fossa as described by Abbott[11], which is a complex approach requiring a meticulous and time consuming dissection of the neurovascular bundle in the popliteal fossa. Trickey[12] described a modification of the above mentioned approach with the aim of decreasing the surgical dissection and time. However, the medial head of gastrocnemius needed to be divided and the neurovascular bundle was still at risk due to its proximity. Ogata[13] and McCormick[14] described a posterolateral approach of the knee for the

treatment of PCL injuries. 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. Burk and Schaffer approach is safe and easy. This simplified approach does not transect or expose neurovascular structures as in other procedures. This approach has been proven safe and less time consuming and provides direct access to PCL insertion over tibia[15].

Nonsurgical treatment of displaced PCL avulsion fractures have a high incidence rate of nonunion or malunion and can cause loss of ligament function, leading to further knee instability and traumatic arthritis. An operation is necessary for the treatment of bony avulsion fractures of the posterior cruciate ligament, regardless of the displacement Nicandri *et al*[19]. Surgical methods include arthroscopic surgery or open reduction and internal fixation. Arthroscopic surgery is less invasive; however, because the end point of the posterior cruciate ligament is located deep on the posterior part of the tibial plateau, an arthroscopic operation would be relatively difficult and may result in loose fracture suturing and problems in postoperative rehabilitation, which causes some patients to exhibit limited knee range of motion after the surgery[20-22]. As open reduction and internal fixation have a clear surgical field exposure, the fractures can be reduced accurately under direct vision, with reliable fixation and early rehabilitation can be performed[23].

With regard to the open surgical approach, many different fixation methods have been described in literature. In 1997, Seitz *et al.* described fixation with K-wires and with cannulated screws, achieving comparable results[24]. Dhillon *et al.* in 2003 also reported good functional results using cannulated screws in all of their 9 cases with complete fracture healing and no pain at 6 months follow-up[25]. Similarly, Veselko *et al.* in 2003 reported good to excellent functional results using a cannulated screw with washer[26]. In 2011, Fu *et al.* described a surgical technique using anchors along with cannulated screws[27]. Chen *et al.* in 2016 described a technique using toothed plate and hollow lag screw. They achieved good functional results with average intra operative blood loss of 54.3 ml, average surgery time of 65.5 min and average post-operative lysolm score of 93.6[28].

With the posteromedial open approach, we achieved satisfactory reduction, results being comparable to the arthroscopic technique. Moreover, all patients included in our study were able to resume the previous athletic and strenuous activities at the end of 9 months. There are very few reported cases of complications associated with this technique. In 2016, Li *et al.* reported a case of a broken screw post fixation of the PCL avulsion fracture, which leads to the further meniscus and chondral damage[29]. Khatri *et al.* in 2015 reported two of their 27 patients developed arthrofibrosis post fixation[30]. In this study, one case had wound necrosis at corner which has been treated with freshening of edges and resuturing. None of the patients had any post-operative complications none had gross instability that necessitated PCL reconstruction at a later stage.

7. Conclusion

PCL Tibial avulsion fracture gives best results when treated surgically which can be done with either open techniques or arthroscopic techniques. Arthroscopic repair has steep learning curve. Open procedure can be done by Classical S shaped direct posterior approach (Abbott and Carpenter) or by Burk and Schaffers approach. This approach is comparatively easier, requiring less time, with less neurovascular risk. There are excellent results using one or two 4mm cannulated cancellous screw for fixation of PCL Tibial avulsion fracture.

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