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### RESEARCH ARTICLE

## OPEN REDUCTION AND INTERNAL FIXATION OF PCL AVULSION FRACTURES USING SPRING PLATE THROUGH MODIFIED POSTERIOR APPROACH.

Moustafa Elsayed MD, Mohamed Kenawey MD, Mohamed Ali MD and Ashraf Marzouk MD.  
 Orthopaedic Department of Sohag University Hospital, Sohag, Egypt.

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##### Key words:-

Posterior cruciate ligament; avulsion fracture; springe plate.

#### Abstract

**Purpose and hypothesis:** To report clinical and functional outcomes following fixation of tibial avulsion fractures of posterior cruciate ligament (PCL) using spring plate through a modified open posterior approach.

**Methods:** This is a retrospective study of 10 patients with displaced PCL tibial avulsion fractures treated acutely by open reduction and internal fixation (ORIF) using spring plate. Hughston's criteria and knee radiographs were used for clinical assessment. Patients were assessed clinically at 2 weeks, and clinically and radiographically at 6 weeks, 3 months.

**Results:** According to Hughston's criteria, 9 patients (90%) showed good objective, 8 patients (80%) showed good subjective and 7 patients (70%) showed good functional results. Fair results were seen in 10% (one patient) objective, 20% (2 patients) subjective and 30% (3 patients) functional. There were no poor results.

**Conclusions:** This study supports that displaced avulsion fractures of the PCL should be treated with open reduction and stable internal fixation and introduce a new, stable and cheap method for fixation.

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#### Introduction:-

The posterior cruciate ligament plays a major role in posterior knee stability.[1, 4, 13, 15, 18] Avulsion fractures of its tibial attachment are rare injuries and might be missed on initial evaluation.[14] Early surgical treatment of displaced tibial PCL avulsions is necessary to restore knee stability.[9, 11] The optimal surgical treatment for isolated tibial avulsion fractures of the PCL is still controversial. Several techniques and fixation options have been described.[7]

Cannulated screw fixation is generally recommended for large fragments,[5, 6, 10] however, in case of small or comminuted fragment, suture fixation techniques through bony tunnels were reported.[12, 17] Biomechanical studies have demonstrated comparable results of screw fixation using open techniques or minimally invasive arthroscopic guidance.[16] The arthroscopic techniques remain appealing, but technically demanding and more expensive, therefore, open reduction and internal fixation (ORIF) of PCL avulsion fractures continues to be an important treatment option.[2]

**Corresponding Author:- Moustafa Elsayed MD.**

Address:- Orthopaedic Department of Sohag University Hospital, Sohag, Egypt.

In the current study, ORIF was performed using a spring hook plate via modified minimally invasive posterior approach to the knee. Our hypothesis was that the current technique can provide rigid fixation and allow early mobilization which is necessary for favorable outcomes.

#### **Methods:-**

This retrospective study was approved by our local research ethics committee. Eligible patients included all those who had isolated PCL tibial avulsion fractures. Exclusion criteria were associated intra or extraarticular injuries and evident osteoarthritis.

Ten patients with displaced PCL tibial avulsion fractures had ORIF using spring plate. All the cases were operated acutely (3–14 days post-injury). Preoperative MRI was obtained for all patients to exclude any associated intraarticular injuries.

#### **Operative Technique :-**

The patient was placed in the prone position on a radiolucent orthopaedic table with a pneumatic tourniquet on proximal thigh. A 6-cm midline vertical skin incision was made just below the transverse crease of the popliteal fossa. The deep fascia was carefully divided in the midline and the small saphenous vein and the sural nerve were identified and protected. The interval between the two heads of the gastrocnemius muscle was developed and they were retracted (Fig 1). Deep to the gastrocnemius heads, the neurovascular bundle was protected and retracted medially. The middle part of the posterior capsule of the knee with the back of the tibia were then exposed. Minimal midline longitudinal capsulotomy was made and the proximal part of the popliteus muscle with its fascia were split in line with the capsulotomy to fully expose the avulsed tibial bony fragment with the attached inferior PCL stump and exposing the posterior surface of the proximal tibia (Fig 2). The bony fragment was reduced to its bed and provisional fixation by K-wires was performed. The spring hook plate was prepared preoperatively using 3 or 4-holes AO small fragment 1/3 tubular plate. The end of the last plate hole was cut and the newly created two prongs were bent 90° making two small hooks (Fig 3). The plate was placed so that the hook rests on the fragment (Fig 4). The plate was fixed to the back of the tibia with 2 or 3 small fragment cortical screws. The first screw was directed distally to pull the hooks of the plate downwards, compressing the bony fragment against its tibial bed. The wound was then closed in layers (Fig 5).

#### **Postoperative follow up:-**

We did not use any knee braces. Active range of motion was started immediately postoperatively. Partial weight bearing as tolerated using 2 crutches was allowed from the second postoperative day. Quadriceps strengthening exercises were started immediately as well. At 6-weeks postoperative follow up, knee radiographs were ordered and progression to full weight bearing was allowed.

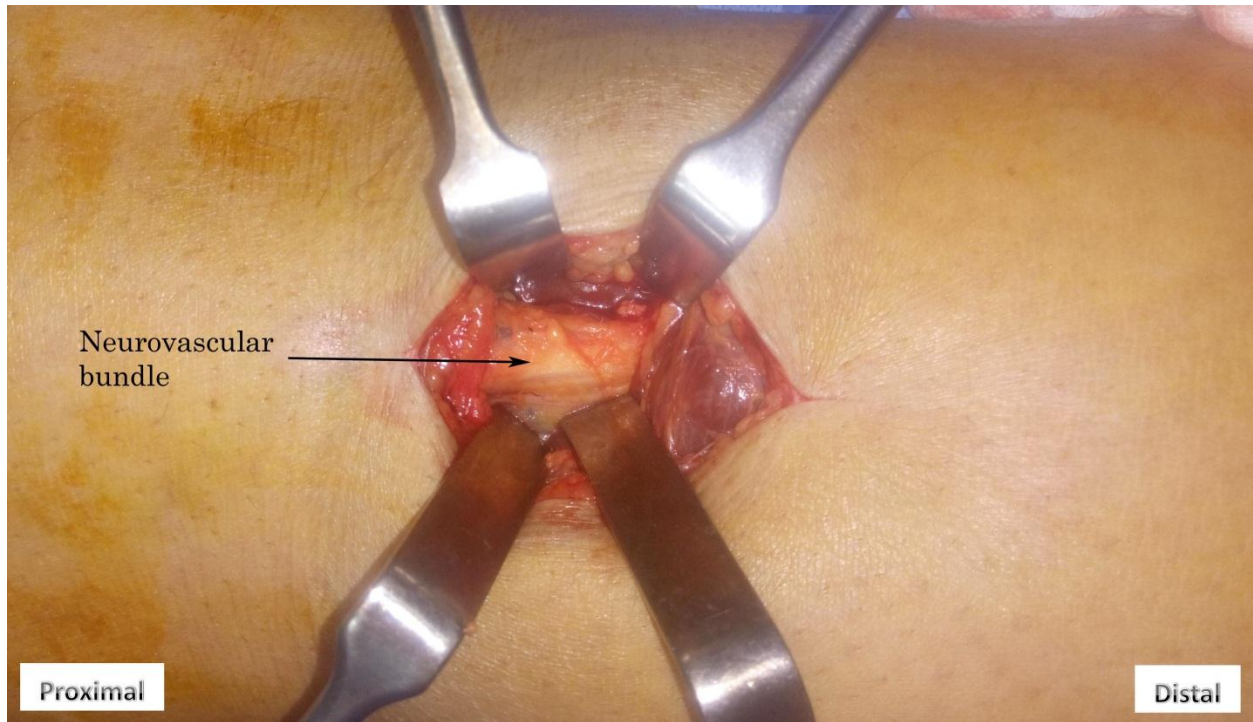
#### **Clinical Assessment:-**

Hughston's criteria[8] (Fig 6) and knee radiographs were used for follow up assessments. Patients were assessed clinically at 2 weeks, and clinically and radiographically at 6 weeks and 3 months.

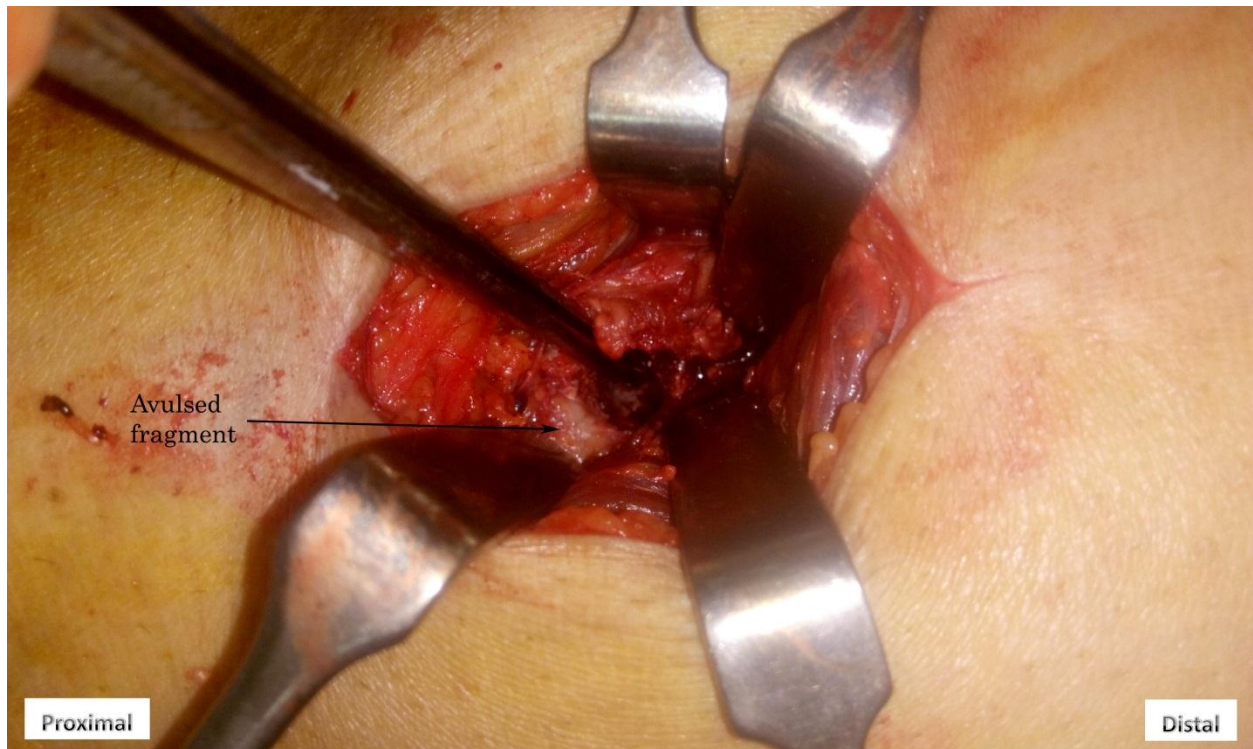
#### **Results:-**

Ten patients (9 male and one female patients) with tibial avulsion fractures of the PCL were surgically treated using ORIF with a spring hook plate. The mean age was 34.7 years (range, 19–50years). The right knee was affected in 5 cases. The average follow-up period was 5 months (range, 3–7 months). Radiographic evaluation showed satisfactory healing of all fractures by 6 weeks postoperative follow up (Fig. 2).

According to Hughston's criteria, 9 patients (90%) showed good objective, 8 patients (80%) showed good subjective and 7 patients (70%) showed good functional results. Fair objective results were seen in 10% (one patient), fair subjective results in 2 patients (20%) and fair functional outcome in 3 patients (30%). There were no poor results. No postoperative complications were noted.



**Figure 1:-** The two heads of gastrocnemius muscle are retracted medially and laterally to expose the neurovascular bundle.



**Figure 2:-** Minimal midline longitudinal capsulotomy is made to fully expose the avulsed tibial bony fragment with the attached inferior PCL stump.





Figure 3:- The spring hook plate.

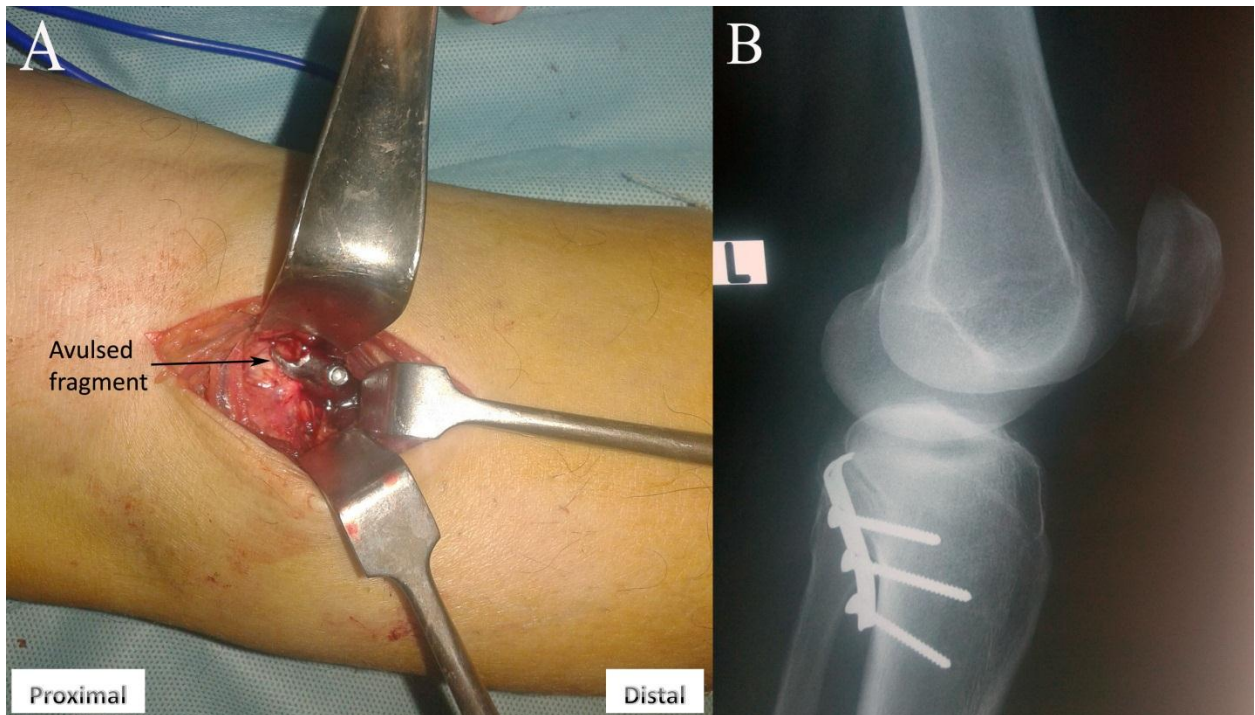


Figure 4:- The plate is placed so that the hook rests on the fragment. Intra-operative (A) and postoperative X-ray (B).



Figure 5:- The wound after closure.

Scale	Score	Subject
Excellent	4	Normal sports activity No symptoms Normal physical examination
Good	3	Normal sports activity Knee pain with intense activities Normal physical examination
Average	2	Normal sports activity Knee pain and swelling with intense activities Normal physical examination
Bad	1	Knee pain and swelling with moderate activities Flexum less than 20°
Failure	0	Restriction of sports Knee pain and swelling with daily activities Flexum more than 20°

Figure 6:- Hughston's scoring system.

**Discussion:-**

Surgical treatment of displaced bony PCL avulsion is recommended by most authors.[1, 4, 14] Several techniques and implants have been used for reduction and fixation, according to the size and the degree of comminution of the avulsed fragment and according to the expertise of the treating surgeon.[18-20]

Bianchi[3] used Trillat staples and screws for fixation of PCL avulsion in 27 acute cases. Postoperative above knee cast was applied for 6-8 weeks in all cases. The overall results in the objective category were 48% good, 44% fair, and 8% poor. Functional grading were 55% good and 45% fair, while subjectively patients reported 70% good and 30% fair results.

Bali[2] used screws and spiked washers for fixation in 42 patients. They applied long knee brace for about 3 months postoperatively. They compared the results in acute and chronic cases. Overall, the functional score was good in 27 patients (64.3%), fair in 12 patients (28.6%) and poor in 3 patients (7.1%). All poor results were seen in patients with delayed surgery.

Yang[20] operated 16 cases, using malleolar screws fixation in 14 patients and pull-through sutures were used in 2 cases because the size of the fractured fragments was too small for screw fixation. Postoperative cast was applied for 4-6 weeks in 11 patients. The results were 69% good subjective, 75% good functional, and 69% good objective. Fair results were 31%, 25%, and 31% respectively. There were no poor results.

The results of our study were superior to the previous studies. This can be explained by the stability of our fixation method which can be applied for all types of fragments; whether large, small or comminuted. The hook of the plate would entrap the fragment into the fracture site without the need for direct screw fixation. The plate was fixed to the posterior cortex of the proximal Tibia, which is a dense cortical area giving good purchase for 3.5 cortical screws. Therefore, with this stable fixation, postoperative knee bracing was not required and early mobilization and return of function could be achieved. Moreover, the direct posterior approach gave superior cosmetic result with less extensive dissection compared to the classic posterior approach to the knee which in addition minimized postoperative pain.

### **Conclusions:-**

The use of hook spring plate for fixation of displaced avulsion fractures of the PCL tibial insertion offers a stable and cheap technique for fixation with very good stability. The main limitations of our study was the small number of cases which was due to our strict exclusion criteria of patients with associated injuries.

**The authors declare that they have no conflict of interest.**

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