



ISSN (P): 2521-3466
ISSN (E): 2521-3474
© Clinical Orthopaedics
www.orthoresearchjournal.com
2021; 5(3): 89-92
Received: 13-05-2021
Accepted: 15-06-2021

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Surgical outcome of proximal tibial fractures treated with locking compression plate: A prospective study

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DOI: <https://doi.org/10.33545/orthor.2021.v5.i3b.296>

Abstract

Background: The knee joint is one of the major weight bearing joints in the lower extremity. Generally, these injuries fall into two broad categories, high energy fractures and low energy fractures. Fractures of the proximal tibia are the result of high energy injuries and because of lack of soft tissue coverage in this region. The majority of tibial plateau fractures are secondary to high speed velocity accidents and fall from height. Fractures result from direct axial compression usually with a valgus or varus moment and indirect shear forces.

Materials and Methods: The study was conducted between the period of November 2017 to April 2019 includes at Department of Orthopaedics, Bowring hospital, Bangalore. 20 patients with diagnosis of proximal tibial fractures were treated with locking compression plate. All Schatzker's classification type 1-6 proximal tibial fractures in adults aged 18 years and above of either sex were included in the study. All patients were followed up. With each follow up, clinical and radiological examinations were performed at 6 weeks, 3 months and 6 months.

Results: The study included 20 patients, 18 males and 2 female aged from 21-80 years with mean age of 40.02 years. The average time for fracture union in our series was 15.52 weeks. In present study, knee stiffness was observed in 2 patients. Our study yielded excellent to good results in 80% of cases.

Conclusion: Displaced tibial plateau fractures are best managed operatively. Optimal knee function is achieved by accurate anatomical reduction and secure fixation followed by early mobilization to attain functional arc of motion. For minimally-displaced fractures with minimal bone defects percutaneous fixation suffices, whereas for comminuted fractures, open reduction and internal fixation is mandatory. In our study, we found that proximal tibial locking plate provides complete union and early mobilization to attain better functional outcome.

Keywords: proximal tibial fractures, locking compression plate

Introduction

The knee joint is one of the major weight bearing joints in the lower extremity. Generally, these injuries fall into two broad categories, high energy fractures and low energy fractures. Fractures of the proximal tibia are the result of high energy injuries and because of lack of soft tissue coverage in this region, it is vulnerable and open fractures commonly encountered. In such cases, the treatment of damaged soft tissue is of primary concern [1]. The majority of tibial plateau fractures are secondary to high speed velocity accidents and fall from height [2]. Fractures result from direct axial compression usually with a valgus or varus moment and indirect shear forces [3]. The aim of surgical treatment of proximal tibia fracture is to restore congruent articular surface of tibial condyles maintaining the mechanical axis and restoring ligamentous stability eventually can achieve functional painless and good range of motion in knee joint. [4] The various clinical studies established that bone beneath a rigid conventional plate is thin and atrophic, which are prone for secondary displacement due to insufficient buttressing and secondary fractures after removal of plate, fracture site take longer period to osteosynthesis due to interruption of vascular supply to bone due to soft tissue and periosteal stripping. So, there was the birth of new concept of biological fixation using the plates, otherwise called Minimally-Invasive Percutaneous Plate Osteosynthesis (MIPPO). But, this was difficult as conventional plates needed to be accurately contoured to achieve good fixation, osteoporosis also posed the same problem of poor fixation with conventional plates, this lead to development of internal fixator [5].

Point-contact fix 1, later point fix 2. As more and more concepts about biological fixation became clearer, the innovation of plates progressed and lead to the development of less invasive stabilizing system. Research to combine these two methods has lead to the development of the anatomically-contoured locking compression plate^[6]. This new system is technically mature as it offer numerous fixation possibilities and has proven to worth in complex fracture situations and in osteoporotic bones.

Materials and Methods

This study was a prospective study done on 20 patients of proximal tibial fractures admitted during November 2017 to April 2019 chosen based on the inclusion and exclusion criteria. Patients were informed about the study in all respects and written informed consent will be obtained. The follow up period was 6 weeks, 3 months and 6 months.

Inclusion Criteria: All Schatzker's classification type 1-6, proximal tibial fractures in adults aged 18 years and above of either sex were included in the study. Patient willing for treatment and giving informed written consent.

Exclusion Criteria: Age group <18 years. Patient not fit for surgery, managed conservatively for other medical reasons, all open fractures of proximal tibia, patient with pathological proximal tibial fractures other than osteoporosis and extra-articular fractures of proximal tibia. Data was analysed using following statistical methods- Diagrammatic presentation, percentages and mean \pm SD.

Positioning: After induction of anesthesia, patient should be positioned on the operating table such that at least 110° of knee flexion can be obtained by dropping affected leg at the end of the table. A rolled flannel blanket is placed under the ipsilateral buttock. This serves to place the transcondylar axis of distal femur parallel to the floor and assist the rotational alignment during multifragmentary tibial fractures. External rotation of the limb is also prevented by using such a roll. Triangle bumps made from sterile gowns dropping the end of the table and placing the leg over the side of the table may facilitate this degree of knee flexion. The use of a padded kidney rest at the lateral aspect of the proximal thigh, often at the level of the tourniquet can be used to maintain knee flexion and prevent external rotation of the hip in deep knee flexion. Care must be taken not to place any pressure on the neurovascular bundle in the popliteal fossa. Limb is prepared and draped as per standard aseptic technique. A thigh tourniquet was routinely applied.

Operative procedure of minimally-invasive percutaneous plate osteosynthesis of tibial fractures- Anteroposterior and lateral radiographs have been obtained to establish the fracture pattern, classification and surgical planning. Spinal anaesthesia/epidural anaesthesia was administered. Tourniquet was used in all cases. All operations were done under image intensifier. The main fracture fragments were aligned using manual traction and close reduction maneuvers. A 3-4 cm skin incision was made proximal and distal to the fracture. Plate was applied on anteromedial/anterolateral aspect of tibia. An extraperiosteal, subcutaneous tunnel was created with a periosteal elevator. Pre-contoured 4.5 mm proximal or distal anatomic locked plates, which included both locking and compression screw holes were used and passed along tunnel. Once satisfactory plate positioning was achieved, plate was secured by passing 3 mm Kirschner wires through the most proximal and distal holes. A second plate of similar size and length was placed using the

same holes on the Kirschner wire. This acted as an external guide to localise the screw holes and skin incisions without need of fluoroscopic control. One proximal and distal screw was inserted. Additional screw were then applied using same technique. In general, locking screw were used in the juxtaarticular and diaphyseal segments, while non-locking screw were selected for reduction in large fragments as lag screw. Complications of fixation failure such as plate bending, plate fracture, locking screw failure and skin irritation, infection and secondary surgical procedures were also documented.

Operative procedure by open reduction and internal fixation of tibial fractures by locking compression plate- Anteroposterior and lateral radiographs have been obtained to establish the fracture pattern, classification and surgical planning. Spinal anaesthesia/epidural anaesthesia was administered. Tourniquet was used in all cases. All operations were done under image intensifier. The anterolateral parapatellar approach was used most frequently because of frequency of lateral tibial plateau fractures. With knee in 30° flexion and S-shaped incision starting 3-5 cm proximal to the joint line staying just lateral to the border of patellar tendon. Curve the incision anteriorly over the Gerdy's tubercle and extended distally, staying about 1 cm lateral to anterior border of the tibia. The lateral tibial condylar fragment was replaced to lock the articular fragments together. The lateral margin of the articular surface reduced under the femoral condyle for support. As the fragments were elevated and reduced, temporarily fixed them with multiple small Kirschner wires. The contoured T or L buttress plate lateral tibial BP/LCP was applied for definitive fixation. This plate was applied to the anterolateral tibial condyle and contoured precisely to conform to the condyle and proximal metaphysis. It was secured to the condyle with appropriate cancellous/locking screw of sufficient length to engage opposite medial cortex. Cortical/locking screws (4.5 mm/5 mm) were used to attach the plate to the shaft of tibia. A small thin periosteal elevator was inserted through the window into the cancellous subchondral bone, depressed fragments were elevated to the normal level of the articular surface and supported with autogenous iliac bone grafts if required. Using fluoroscopic guidance, fractures were reduced and held with large bone reduction clamps. Kirschner wires were used as temporary fixation. Then, a contoured large fragments BP/LCP was applied to the tibial metaphysis and extended it down to the tibial shaft far enough to securely stabilize the fracture. Medial BP was applied first. The fracture was assessed for stability. If additional stability was needed, a pre-contoured BP was placed over the lateral side alternatively. A single LCP was applied on lateral side. Large cancellous screws were inserted in the proximal part of BP and the distal portion was attached with cortical screws. Once the fracture had been adequately stabilized, all temporary fixation devices were removed. The capsular incisions were closed with interrupted sutures and the skin and subcutaneous tissue was closed over a #10 or #12 suction drains. The limb was kept immobilized in long knee brace and kept elevated over one/two pillows.

Postoperative management- The limb was kept immobilized in long knee brace and kept elevated over one/two pillows. Intravenous antibiotics will be continued for first 5 days and then shifted to oral. Posterior splint given if protection of fixation was desired. The suction drainage will be removed after 48 hours depending on the amount of collection. Check x-ray on 3rd postoperative day. Quadriceps exercises and ankle mobilization started within 48 hours of surgery. Knee bending and toe-touch walking with a walker on second or third postoperative day if the fixation allowed. Preoperative X-Ray of

Dressing will be done on 2nd, 5th and 8th postoperative day. Sutures will be removed on 12th postoperative day. Progressive weight bearing will be allowed as tolerated by patients. Full weight bearing was permitted after clinicoradiographic evidence of union.

Follow-up- Duration after surgery- 6 weeks/3 months/6 months. Radiographical evaluation- Check x-ray knee joint with proximal two-third leg anteroposterior and lateral.

Results

In the present study, on evaluation of age distribution, we found that all the 20 cases in the study, most of the patients belong to category 40-50 years (10 patients, 50%) mean age was 40.02 years. Gender distribution, we found that of 20 cases in the study, most of the patients were male (18 patients, 90%). Out of 20 patients, most of patients were injured by vehicular accident (15 patients, 75%). Most of the patients had right-sided injury (14 patients, 70%). Most of the patients were of Schatzker type 6 fractures (14 patients, 70%). Most of the patients were fixed by ORIF (18 patients, 90%). Most of the patients had good range of is operated using anterolateral approach with ORIF 130° (6 patients, 30%). Most of the patients had no complication only two had knee stiffness (10%). Duration of fracture union, 18 weeks (10 patients, 50%). Most of the patients had excellent results (11 patients, 55%).

Discussion

In our study following details were observed Type 1 fractures one in number, male patient; due to fall is operated using anterolateral approach with ORIF.130° ROM without any deformity and no complications, excellent result.

Type 2 fractures, 1 in number, male patient, due to fall, operated using anterolateral approach with ORIF.130° ROM without any deformity and no complications, excellent result.

In our study, no type 3 fractures seen.

Type 4 fracture four in number, 3 male patients with RTA and 1 due to fall. All cases were operated with ORIF with an average 90° ROM, knee stiffness in one case. In our study, no type 5 fractures were seen.

Type 6 fractures 14 in number, 12 male patients with 11 right-sided injury, 12 due to RTA and 2 female with left-sided injury due to fall, 14 cases were operated using anterolateral approach with ORIF with an average 100° ROM with knee stiffness in one case. 3 cases anteromedial approach with ORIF and MIPPO in 3 cases with an average 110° ROM.

Clinical study with locker plate fixation tibial plateau fractures can benefit from locked plating in fractures with instability, metaphyseal comminution and osteoporosis. Gosling *et al*^[7] in a multicentric study reported 23% postoperative malalignment and 14% loss of alignment when high energy bicondylar proximal tibial fractures were treated with laterally placed LISS plate only. Phisitkul *et al*^[8] reported immediate postoperative and delayed loss of alignment in 22% and 8% of cases respectively, when lateral LISS plate was used in proximal tibial fractures. Marsh *et al.*^[9] presented a series of 21 complex tibial plateau fractures treated with monolateral external fixation and limited internal fixation and reported 14% rate of malalignment. Weigel and Marsh^[10] presented a five-year followup after treatment of 24 high energy tibial plateau fractures with limited internal fixation and monolateral external fixator. In a study by Shiva Naik *et al.*^[11], they showed the locking compression plate is an important armamentarium in treatment of fractures around knee especially in fracture is severely comminuted and in situations of osteoporosis. Jain *et al.*^[12] showed applied with proper

understanding of biomechanics, LCP is one of the best available options for management of challenging peri and intraarticular fractures especially in proximal tibia. In another study, comparing the fixation of proximal tibial fractures by non-locking buttress versus locking compression plate by Patil *et al*^[13] and co-workers had almost same results in both groups and concluded that considering its high cost, locking plate should only be used, where it is more advantages than conventional plate.



Fig 1: Using Anterolateral approach cuvileneur Incision is taken

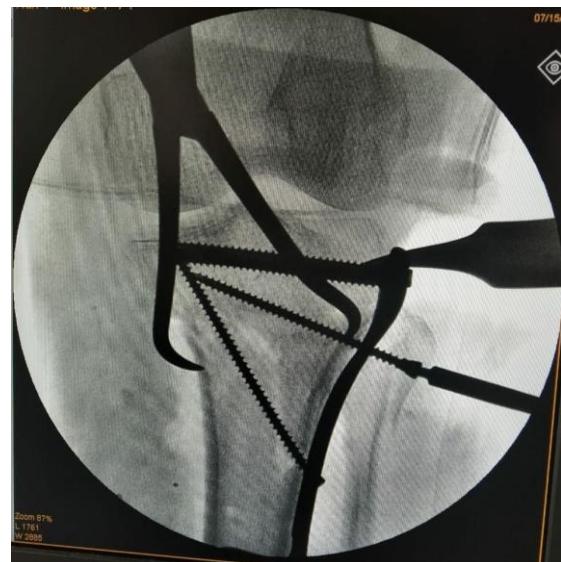


Fig 2: Redution done under C-Arm

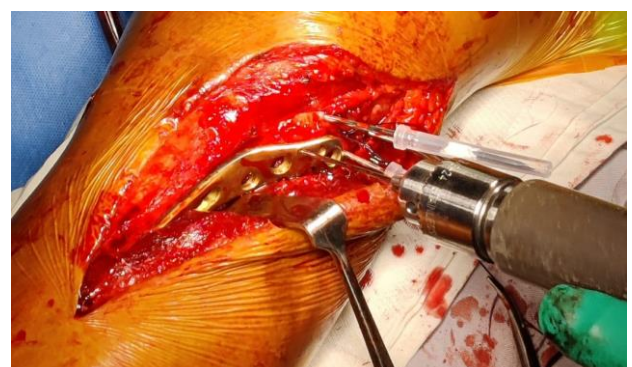


Fig 3: plate is placed



Fig 4: C-Arm Image of fixation

Conclusion

Displaced tibial fractures are best managed operatively. Optimal knee function is achieved by accurate anatomical reduction and secure fixation followed by early mobilisation to attain functional arc of motion. For minimally-displaced fractures with minimal bone defects, percutaneous fixation suffices, whereas for more comminuted fractures, open reduction and internal fixation is mandatory postoperative rehabilitation protocol in terms of non-weightbearing and achieving satisfactory range of motion needs to be strictly adhered to in order to obtain optimal functional results. In our study, we found that proximal tibial locking plate provides complete union and early mobilisation to attain better functional outcome.

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