Original Research Article

Role of posteromedial plating in condylar fractures of Tibia in adults

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Abstract

Background: The purpose of this study was to evaluate role of Posteromedial Plating in condylar fractures of Tibia, especially patients with posterior tibial shear fractures.

Materials and methods: This prospective study included 12 patients with mean age 40 years (range 30 to 50 years) who sustained high velocity posterior tibial plateau fracture-subluxations with/ without associated Bicondylar fractures (Moore I & II Types, Schatzker's Groups – IV, V and VI). Surgical management included stabilisation plating through a posteromedial/ posterior approach and additional postero lateral or antero lateral approach as needed. The patients were followed up at six week, three month, six month and one year postoperatively and assessed using Oxford Knee Score and Lyshom Score.

Results: The mean OKS score was 40 (range 36 to 44) at the end of one year. The main clinical measures were early post-operative non weight bearing ROM, post-operative complication and functional outcome. The time to full weight bearing, the rate of post-operative complications and functional outcome was significantly better as evident by over 94 % showing good to excellent OKS and Lyshom scores.

Conclusion: A posterior/ postero medial approach for posterior tibial plateau shear fractures (which are otherwise irreducible by conventional approaches) and buttress/ antiglide plate are usually needed to reduce the fractures anatomically, achieving absolute stability and mobilize early NWB, ROM of the knee joint to optimize the functional outcomes and minimize the complications, without the need for revision surgery.

Key words

Tibia plateau fractures, Medial condyle, Posterior tibial fractures, Posteromedial plating, Posteromedial approach, Posterior approach.

Introduction

Surgical treatment of complex tibial plateau fractures involving the posterior condyles has been a challenge for orthopaedic surgeons. With conventional approaches (anteromedial or anterolateral approaches), accurate reduction of posterior tibial plateau fractures is technically difficult. Thus, posterior approaches were introduced, that allowed better visualization of the posterior tibial plateau structures and their osteosynthesis with 'supporting plates' [1].

High energy tibial plateau fractures are infrequent and technically demanding to treat - especially the posterior tibial plateau, shearing type, with coronal plane displacement. These fractures have recently been emphasised by two studies, which highlighted their clinical relevance [2, 3] and showed that less invasive surgery and indirect reduction techniques are often inadequate. They are Schatzker type 4 fractures, with coronal split in the medial tibial condyle; usually unstable. Knee joint is subjected to loads four to six times of body weight during walking. In standing position, medial tibial plateau carries 75 ± 12% of the total force transmitted across the knee joint. Higher loads on the medial side of the joint and lack of a buttress; contrary to that provided by fibular head on the lateral side; necessitate rigid fixation of these fractures by posteromedial plating [4].

West J.R., et al. [5] of State University of New York have shown that posteromedial 'T' plate instead of antero posterior (AP) screws can improve the strength and stiffness of posteromedial fragment fixation in tibial plateau fractures. While posteromedial approach adds complexity to the operation, the added strength of the fixation may offset the added time and technical skill required.

Hohl [6] described unicondylar coronal plane split fractures of the medial tibial plateau; noted them as fracture-dislocations. Anterolateral and anteromedial approaches are unsuitable for posterior plateau fractures. Recently, Lobenhoffer, et al. [7], Wang, et al. [8] described the postero lateral and postero medial approach for posterior bicondylar tibial plateau fractures. These approaches have been used in isolation or as a dual-incision approach [9-15].

Objectives of the Study

- To evaluate the role of posterior plating in posterior condylar fractures of tibia, by either direct posterior approach or posteromedial approach
- Restoration of the articular surface of the proximal tibia to enable proper function of the knee joint is the main objective of this study. Early rehabilitation and return to work or sport with good physical therapy are other objectives.

Materials and methods

A prospective study conducted on 12 adult patients with posteromedial tibial plateau fractures treated at Orthopedics Department, Government General Hospital affiliated to Rangaraya Medical College, Kakinada from June 2015 to July 2017.

Inclusion criteria were 1) Schatzkers type IV, V, and VI; 2) closed fractures and 3) adults. It excluded 1) Schatzkers type I, II, III; 2) pathological fractures of tibial plateau; 3) seriously ill and 4) polytrauma patients. There were 9(75%) males and 3(25%) females between the age group of 20-60 years with an average age of 40years. 5(41.67%) patients had right side involvement and 7(58.33%) had left side Involvement. All 12 cases injury occurred due to road traffic accident (100%). The study was approved by ethics committee department. The selected patients fulfilling the selection criteria were briefed about the nature of the study and a written informed consent was obtained.

Immediate Management

All patients presented to emergency department were carefully examined as per ATLS protocol. The limb was quickly assessed for distal neurological and vascular status. The soft-tissue

integument injury grade, according to Tscherne-Oestern closed fracture classification was grade 0 in 3(25%) cases, grade I in 2(16.67%) cases, grade II in 7(58.33%) cases. The involved lower limb was immobilized in an above knee back slab and kept elevated. Pain and inflammation were managed using analgesics and anti-inflammatory medications.

Pre-operative management

Routine examination of blood and urine, radiographs, including antero posterior, lateral and both Oblique views of the knee joint were done. CT scan with 3D reconstruction, were taken to evaluate the severity of articular depression and cortical split, for accurate pre-operative planning.

Surgical procedure

The duration from the date of injury to date of operation ranged from 7-21 days (average 11 days). This was to wait until the swelling subsided and for assessment of skin status. The operation was performed under spinal anesthesia in all cases. The patient was placed in the 'floating supine position. A high thigh pneumatic tourniquet was applied to the injured extremity. A bump added under the ipsilateral hip for further internal rotation of leg. The lateral tibial plateau is exposed through a conventional anterolateral approach. After sub meniscus arthrotomy, the comminuted lateral plateau is visualized. The depressed articular fragments are elevated with a large amount of cancellous and subchondral bone. 'T' or 'L' shaped heavy plate with long screws is used to buttress the reduced lateral plateau fracture, hold the tibial condyles together and connect them to the tibial shaft.

The posterior condylar fragment was fixed with posteromedial plate using either direct posterior or posteromedial approach.

Surgical technique:

1) Lobenhoffer's direct, posterior approach
2) Postero medial approach of Wang, et al.

Lobenhoffer's Direct, Posterior approach [7, 16, 17]

Flexion crease of the knee, medial and lateral Gastro soleal heads, are marked. The incision is straight and vertical, of about 10 cm – 15 cm, just distal to the flexion crease and medial to the medial head of Gastrocnemius. Subcutaneous tissue and popliteal fascia are incised - saphenous vein and medial sural cutaneous nerve are usually not identified because the dissection stays medially. Medial head of the gastrocnemius is identified, mobilized with a Cobb's elevator and retracted laterally, cob is then replaced with a Homan's retractor as shown the figures 5,6,7 and 8 below; the head of the medial gastrocnemius is retracted laterally and hamstrings medially. Throughout the procedure, all neurovascular structures are retracted laterally under protection of the medial head of the gastrocnemius. Hyper extension of the knee, achieves anatomical reduction of postero medial fragment. A second Homan's retractor may be used to get full visualization of the posteromedial aspect of the proximal tibia. The insertion of the hamstrings is retracted medially with a Langenbeck retractor to identify the popliteus which is dissected through a vertical incision along its medial border to detach subperiosteally with a Cobb's elevator. Rarely, the tibial insertion of the hamstrings is partly incised and released, for better medial visualization.

Postero medial approach of Wang, et al. [8]

Incision starts 3cm proximal to the joint line and follows the postero-medial border of tibia. The saphenous nerve and great saphenous vein are identified and retracted along with anterior or posterior flaps. The Sartorius fascia is incised in line with the incision. The Pes-anserinus tendons are identified and retracted distal posterior or proximal anterior, while medial gastrocnemius and soleus are retracted posteriorly. This exposes the junction between the popliteal fascia (posterior and distal), the Semimembranosus muscle insertion (posterior and proximal), and the MCL. The periosteum is incised, longitudinally down to the bone while staying posterior to the posterior border of MCL. The insertion of popliteus muscle is elevated off from the posterior tibia, which allows direct

visualization of the triangular apex of the fracture at the meta-diaphyseal level.

Follow up

All patients were followed up for 6 to 18 months, and the mean follow-up duration was 12 months. The fractures united on average, at 24 weeks (range, 18-32weeks).

Average range of flexion of affected knee is 45-120 degrees at 12 month follow up and no loss of reduction or mal alignment (varus or valgus) occurred on follow up; none of them had leg-length discrepancy. One patient developed superficial infection, which settled with IV antibiotics and dressings. Another patient developed knee stiffness (ROM – 20 to 100 degrees). None of the patients had deep sepsis, DVT, neurovascular injuries or compartment syndrome. At final follow-up 24 months, none of the patients had radiological evidence of osteoarthritis; though follow up period was short.

The Functional outcome was analyzed using Oxford Knee Score (OKS), and Lyshom Score and radiological outcome by plain radiographs. The mean OKS score was 40 (range 36 to 44) at the final follow up and results were excellent to good in 92 % of cases (11/12) and fair in 8 % of cases (1/12).

Results

This prospective study involved a total of 12 patients who sustained fracture of tibial plateau. In the present study 75% of the patients were males and 25% of the patients were females. The male to female ratio was 3:1. The data was analyzed and the observations were tabulated as below. Mean age of the patient in this study was 40 years (**Table – 1**).

In the present study 58.33% of patients presented with left side tibial Plateau fractures and 41.67 % of patients presented with right side tibial plateau fractures. Of the twelve patients, three had Schatzker type 4, eight had type 5 and one had type 6 fractures. Lobenhoffer's direct posterior approach was used to treat four fractures and Wang et al. posterior approach was used in eight patients. After surgery, the immobilization was continued for a period of 6 weeks for 2 patients, 3 weeks for 7 patients and only 10 days in 3 patients (**Table – 2, 3**).

Table – 1: Age distribution.

Age (Years)	Number of patients	Percentage
20 – 30	2	16.67
30 – 40	5	41.67
40 – 50	4	33.33
50 – 60	1	8.33
Total	**12**	**100**

Table – 2: OXFORD KNEE Score.

Score	Number of cases	Percentage
Score 0-19	0	0
Score 20-29	0	0
Score 30-39	1	8.33
Score 40-48	11	91.67
Total	**12**	**100**

Table – 3: Lysholm Score.

Score	Number of cases	Percentage
Excellent	10	83.33
Good	1	8.33
Fair	1	8.33
Poor	0	0
Total	**12**	**100**

Patients were followed at 6weeks, 3 months and 6 months. There was no clinical union until 3 months; complete union was achieved by 6 months-5 patients in 3 months and 7 patients in 6 months. In the study radiological union was noted among all patients (100%) at third follow up at 6 months.

Discussion

"The objective of treatment of tibial plateau fractures is anatomic reconstruction of the articular surface and stable fracture fixation with a focus on restoring stability, limb alignment

(avoiding Varus/ valgus), repair of all concomitant lesions (avoiding menisectomy) and early postoperative mobilization, thus prevention of the development of Osteoarthosis of the knee'' All these objects are best fulfilled by ORIF with Plate and screw fixation.

In the literature, several different surgical approaches have been described to address the complex high energy tibial plateau fractures with associated posterior shear fractures. A central midline incision with medial dissection and arthrotomy is proposed using an extensive midline approach with division of the patellar ligament or even an osteotomy of the tibial tuberosity [18, 19]. This approach, however, is accompanied with a high rate of wound-healing problems and seems to be too aggressive for this injury.

Alternatively, Lobenhoffer first described a postero-medial and later on a direct posterior approach to address this main fragment, which was also used by Fakler and Brunner [20-24]. With these approaches, however, the posteromedial, posterior fragment or the avulsed tibial eminence, could not be reduced and fixed. All fracture elements could be reduced using a combined anterior and posterior approach, with an optional dorsal or anterior arthrotomy as published by Georgiadis [12]. In summary, the drawbacks of all the described approaches are either limited access to all fracture elements, several incisions or extensive soft-tissue dissection.

In the past, most authors believed that posteromedial tibial plateau fracture was rare and difficult to treat [25]. With the increasing use of CT scan, 3-D reconstruction in patients with tibial plateau fractures; it was found that this kind of fracture was not rare . The posteromedial tibial plateau fracture has several unique characteristics. The fracture fragment is relatively big. Barei, et al. [2] found that the surface area of fracture fragment was 58% (19-98%) of the medial plateau surface and 23% (8-47%) of the entire plateau articular surface. Higgins, et al. [3] revealed that the average area of bone fragment was 25% of entire tibial plateau articular surface. The sagittal angle of fracture fragment is large and the displacement of articular surface is usually more than 5 mm [10]. For these reasons, this fracture is very unstable; conservative treatment failed to obtain stability. Because of instability, ORIF is advocated [26].

The anterior approach required extensive separation of the medial capsular ligament and osteotomy of the tibial tubercle in order to expose the posterior portion of the knee [5]. The injuries were severe and caused difficulties in exposing the posteromedial fracture fragment through this approach. Hsieh, et al. [23] used anteromedial approach for the treatment of 8 patients with posteromedial tibial plateau fractures. However, semitendinosus and semimembranosus muscles obstructed the anteromedial approach. When stripping posteriorly, it was also easy to injure the medial collateral ligament. There was high possibility of disturbing the blood supply to the soft tissues, especially when the soft tissues around the knee had suffered high energy injury.

Because the posteromedial tibial plateau fracture fragments are located posteriorly, some authors used posterior approach, such as described by Trickey [24] in the 1960s, which were more demanding and involved dissection of the neurovascular bundle. In order to protect the neurovascular structures, Bendayan, et al. [13] described a second posteromedial incision to reduce and stabilize a displaced posterior fragment. Direct visualization and satisfactory reduction were achieved. However, this technique required splitting the medial head of Gastrocnemius, which resulted in injury to the muscle.

Stabilisation of the posteromedial tibial plateau fracture was controversial. Hsieh, et al. [23] placed lag screws from anterior to posterior for fixation of posteromedial tibial plateau fracture in 8 cases and the results were satisfactory. But most authors believed that it was prone to loss of

reduction with the only use of lag screws when the fracture fragment was big [27, 28]. Gosling, et al. [29] demonstrated that lateral locking screw plate could provide stabilization of the medial fracture fragment. However, the directions of screws were predetermined based on the design of the plate. The screws were usually in parallel with the fracture line of posteromedial fragment [30]. Therefore, satisfactory fixation cannot be achieved. In a biomechanical study, Yoo, et al. [31] revealed that posteromedial tibial plateau fracture fragments tolerated higher loads by using the lateral 3.5-mm conventional non-locking proximal tibial plate and posteromedial 1/3 tubular plate fixation.

Compared with anterior approaches, the value of posteromedial and posterolateral approaches is in accordance with biomechanics; easy anatomical reduction of articular surface, that could be stabilized with antiglide or buttress plate. When major fractures are located in posterior condyles of tibial plateau, one posterolateral or posteromedial approach could be adopted for ORIF first [32, 33, 34]. Dual incisions are inevitable in fractures obviously displaced to anterior and posterior (burst like), and proven ligament, meniscus injury needing reconstruction.

A number of posterior approaches have been described in the special literature that allow for visualization and adequate fixation of all the tibial plateau parts. However, the analysis of the available publications shows that these approaches are technically difficult. They do not eliminate the risk of damage to large vessels and nerves as well as they are insufficiently substantiated from topographic and anatomic positions. Therefore, the substantiation and improvement of the technique of performing posterior approaches to the knee in the patients of the mentioned profile as well as specifying the indications for each of them appear, to be promising directions of research in the area under consideration.

Zeng, et al. [35] compared anteroposterior lag-screws fixation, antero medial limited contact dynamic compression plate fixation, lateral locking plate fixation and posterior T-buttress plate fixation for the posteromedial tibial plateau fracture. It was confirmed that the posterior T-buttress plate fixation was biomechanically the most stable in-vitro fixation method for posteromedial tibial plateau fracture.

As the number of patients recruited into this study is relatively small, its power is limited. The limitation of this study is that the sample size is quite small. Based on the results of this study and the knowledge that most operations for ORIF Posterior Tibial plateau fractures are reported to produce 70 to 90 % good results in terms of instability and prevention of Osteoarthrosis (thus pain relief), 90 would have to be entered into each treatment group in order to detect a significant difference of 15% (with 80% power) in the pain results. In order to show a 40% difference (with 80% power) in postoperative knee instability, 23 patients would have to be entered into each group. Our results suggest that, if the different operations do produce different instability and prevention of Osteoarthrosis, then the difference is likely to be much less than 40%. Ninety patients would have to be entered into each treatment group in order to detect a significant difference of 20% (with 80% power). Thus retrospective surveys are of very limited benefit and prospective randomized studies must recruit large numbers of patients to detect significant differences, if indeed there are any, between different options.

Conclusion

Fractures of the posterior tibial plateau are challenging to treat, owing to their complexity and unfamiliar surgical approach. Anterior approaches have been main method for the past many decades. Though it is not possible to fix the posterior fractures with a Lag screw or a single lateral LCP; this method neither conforms biomechanics nor avoids the articular step.

Schatzker type 4 fractures are usually unstable fractures formed by high-energy trauma. Higher loads on the medial side of the joint and lack of a buttress, such as fibular head that provides to the lateral side, indicate rigid fixation of these posterior tibial plateau fractures i.e., postero medial plating. Compared with anterior approaches, the value of postero medial/ lateral approaches is in accordance with biomechanics, restoration of congruity, which could be stabilized with antiglide or buttress plate. Thick and rich blood supply of posterior tissues allows early operation.

Although our study sample is small, it was found that postoperative complications were low and short-term prognosis was satisfactory. It is concluded that posterior medial plating is the gold standard for the management of posterior medial condyle fractures as it provides direct visualization of the fracture, avoid dissection of neurovascular bundle. As a result, satisfactory reduction, stable internal fixation and good functional outcomes can be obtained by this technique. On the prerequisite of excellent reduction and fixation, we incline to adopt a single posterior approach to deal with tibial plateau fractures, although the comparison between anterior and posterior approaches should be analyzed and expounded further.

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