

Clinical and Radiological Outcomes of the Surgical Treatment for Medial Tibial Plateau Fractures

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Abstract

Medial tibial plateau fractures are intra-articular lesions to the most stable part of the knee joint carrying 60% of the bodyweight through one of the most stable joints of the human body. Therefore, they require high-energy trauma and are the rarest type among tibial plateau fractures. The aim of our study was to determine functional and radiological outcome and post-operative complications of the Schatzker IV tibial plateau fractures. It was a retrospective study involving 19 patients who underwent surgery for medial tibial plateau fracture between 2006 and 2015. The mean follow-up time was 5 years. The mean age was 39,7 years. 21% of patients had associated ligamentous injuries. Various fixation methods were used. We used the knee Rasmussen clinical assessment score and the modified Rasmussen radiological score to analyze both functional and radiological outcomes successively. The mean Rasmussen clinical assessment score was 25,67 with 31,6% of patients having excellent, 52,6% having good and 15,8% having medium clinical scores. The mean modified Rasmussen radiological score was 9,46 with 79% of patients having excellent and 21% having good radiological outcomes. Skin and soft tissue damage are the main post-operative complication. Delayed surgery until soft tissue injuries are healed offers a wise option to prevent this complication. It is mandatory to diagnose and treat associated ligamentous injuries to optimize functional treatment outcome.

Keywords: Medial Tibial Plateau Fracture; Surgical Treatment; Functional Results; Radiological Results

Introduction

Tibial plateau fractures are joint damaging lesions to the proximal tibia that may compromise the functional prognosis of the knee joint. Traffic accidents are the main cause behind their increased incidence. Medial tibial plateau fractures are relatively the least common type among tibial plateau fractures. Few studies have described this type of fracture.

In our study, we retrospectively analyzed anatomical and functional outcomes of the surgical treatment for medial tibial plateau fractures as well as post-operative complications.

Methods

Retrospectively, we analyzed patients with medial tibial plateau fractures who were treated surgically from 2006 to 2015. We used the Schatzker's classification for the tibial plateau fractures.

The patient inclusion criteria were Schatzker type IV fractures, minimal age of 18 years and patient follow-up time greater than 18 months. The exclusion criteria were all other types of tibial plateau fractures (lateral and bicondylar tibial plateau fractures), patients younger than 18 years and incomplete follow-up of postoperative function.

All patients included in our study were summoned for complete functional and radiological evaluation.

Functional and clinical evaluation

We used the Knee Rasmussen clinical [1] assessment score (1973) to evaluate patients' satisfaction with their knee function. It is a five-criteria scoring system rated out of six each. It includes two subjective complaints (pain and walking capacity) and three objective clinical signs (lack of extension, total range of motion and stability). Scores were graded as excellent (27 to 30), good (20 to 26), medium (10 to 19) and poor (< 10).

In our study, we considered excellent and good results satisfactory.

Radiological and anatomical evaluation

Radiographs of the knee joint obtained in the anteroposterior and lateral planes on the latest follow-up were used to assess four anatomical criteria:

- Articular depression: Any articular step off superior to 2 mm was defined as malreduction.
- Condylar widening: Measured on the anteroposterior view, is determined by the width of the tibial plateau compared to the width of the unilateral femoral condyles.
- Varus/valgus angulation: As the majority of our patients didn't undergo telemetry radiography of the lower limbs, we used the tibial plateau angle on the latest follow-up to define alignment of the proximal tibia on the anteroposterior view. the posterior slope angle (the angle between the tangential line of medial plateau and the perpendicular line of the anterior tibial cortex) on lateral radiographs defined on the other hand, the alignment of the proximal tibia on the sagittal plane.
- Secondary osteoarthritis: Progression of osteoarthritis to the knee joint between initial and latest radiographs using Ahlback classification [2] of the osteoarthritis was used to estimate this criterion.

We used the modified Rasmussen radiological [1] assessment score including the above mentioned four criteria. Scores were graded as excellent (10, 9), good (8, 7), medium (6, 5) and poor (< 5).

Articular reduction was considered satisfactory with residual articular step off inferior to 2 mm.

Tibial plateau angle less than 86° or greater than 93° and posterior slope angle less than 4° or greater than 12° were indicative of malalignment and were considered non satisfactory.

Results

It was a retrospective study including 19 patients with medial tibial plateau fractures indexed as type IV of the Schatzker classification. The mean age was 39,7 years varying between the age group 25 and 57 years. Out of 19 patients, 84% were males and there was a slight left sided predominance of 58% compared to the right side. Injuries were most commonly due to traffic accidents followed by domestic accidents.

As said before, all patients included had medial tibial plateau fractures. As for associated injuries, blisters were present in 3 cases and only one open case fracture (Cauchoix 1) was reported. Head of fibula was fractured with tibia in 15,7% of patients. Tibial spine fractures were seen in 63% of cases. Associated ligamentous injuries were observed in 4 cases (21% of patients): 3 patients had lateral collateral ligament injuries and one case presented with anterior cruciate ligament damage. Only one patient had a knee dislocation. He underwent urgent femorotibial external fixation using Orthofix® associated with percutaneous screw fixation of the medial tibial condyle (Figure 1).

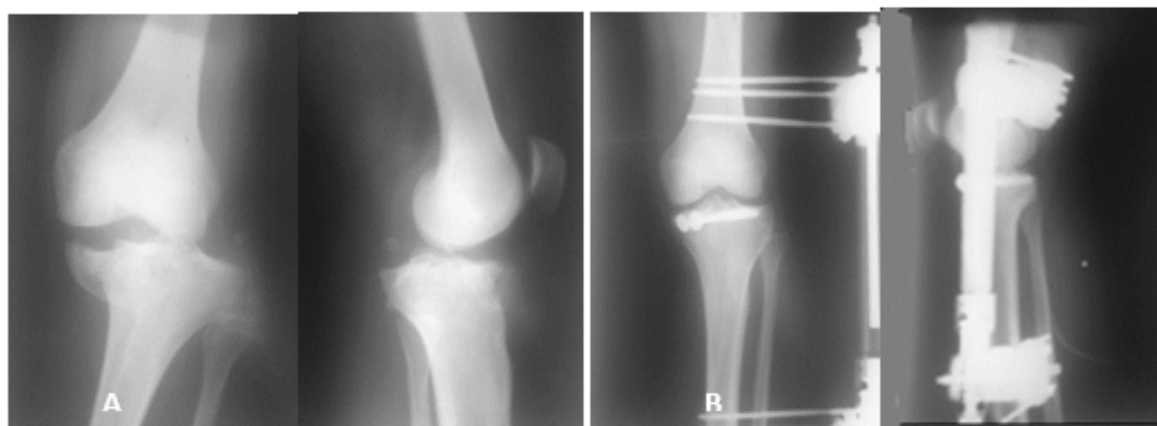


Figure 1: patient aged 35 years having a displaced Schatzker IV tibial plateau fracture resulting in a knee fracture dislocation. He had urgent reduction with percutaneous screw fixation of medial tibial condyle and femorotibial external fixation using Orthofix®.

36,84% of patients had pre-operative articular depression associated or not with condylar widening. The mean pre-operative articular depression was 5,3 mm.

Patients were operated on an average of 4 days. Delayed surgery (> 10 days) was only performed on two occasions: one had poly-trauma and another suffered serious soft tissues injury.

84,2% of patients underwent open reduction while only 3 patients had percutaneous screw fixation under image intensifier control. When open reduction was performed, we used Gernez medial approach to the knee in 93,75% of cases.

The mean operative time was 85 minutes. Different osteosynthesis methods were used in our study (Table 1).

Our study	Percutaneous screw fixation	ORIF with lag screws	Lateral plate fixation	Medial plate fixation
Number of patients	3	8	1	7

Table 1: Fixation methods in our study (ORIF: open reduction internal fixation).

Post-operative complications

21% of patients had post-operative skin damage: three patients developed blisters and one patient suffered skin necrosis. All the above cases underwent open reduction using plate fixation.

Two patients (10,5%) suffered wound infection out of which one was early onset deep wound infection while the other had late superficial infection (detailed information related to patients with infection on table 2).

Patients	Initial skin condition	Operative time (minutes)	Fixation method	Type of infection	Implant removal
1	Closed, no blisters	110	Plate fixation	Deep infection	Yes
2	Open O1	80	Screw fixation	Superficial wound infection	No

Table 2: Clinical data of patients with infection.

Only one patient has shown knee stiffness on the latest follow-up. No thromboembolic events were reported.

Several few complications were seen: one case of algodystrophy syndrome was reported, one patient had delayed union and another had implant failure.

Clinical outcomes

The mean follow-up time in our study was 5 years. Based on a subjective evaluation on the latest follow-up, global patient satisfaction was 68,4%: 7 patients were very satisfied, 6 were moderately satisfied, 3 were indifferent and 3 were unhappy.

The mean Rasmussen clinical assessment score was 25,67 with scores varying between 19 and 29 with 89,5% of patients, accordingly, having satisfactory clinical outcome. 31,6% of patients had excellent, 52,6% had good and 15,8% had medium Rasmussen clinical score.

Knee pain was rather absent or occasional in 78,9% of cases. 63% of patients regained normal walking capacity.

At end of complete follow-up, 84,2% of patients had normal knee stability while three patients suffered impairing lateral laxity of the knee demonstrated by dynamic radiographs. 84,2% of patients had complete extension of the knee joint with on the other hand three patients having a 10-degree lack of extension. Amyotrophy to the quadriceps muscle was seen in 26,3% of cases. 79% of patients had a good-looking scar.

Radiological outcomes

The average fracture union time in our study was 87 days. The mean modified Rasmussen radiological assessment score was 9,46. Scores were excellent in 79% and good in 21% of cases.

10,5% of patients had loss of articular reduction and condylar widening occurred in 15,8% of cases. The above-mentioned cases had percutaneous screw fixation with 2 patients and open reduction with screw fixation with one patient.

Varus deformity was observed in two cases: one underwent percutaneous screw fixation (Figure 2) and one had lateral tibial “L” plate. 15,7% of patients developed post-traumatic osteoarthritis of knee.

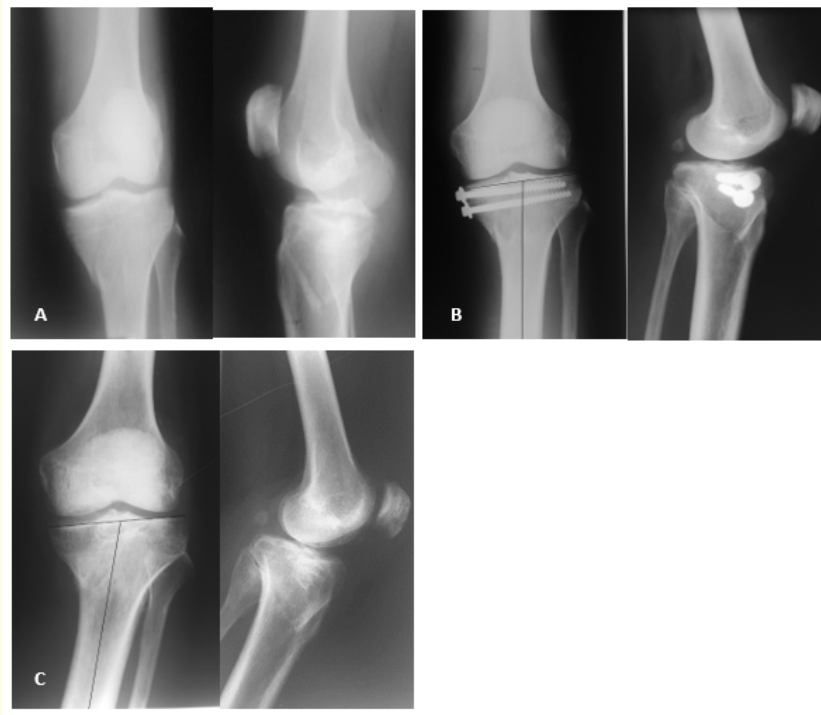


Figure 2: Schatzker IV tibial plateau fracture in a 61-year-old diabetic patient following a domestic fall accident (A). He had surgery with percutaneous fixation using 2 cancellous lag screws. The post-operative tibial plateau angle was 85 degrees (B). Implant removal was done 6 months after surgery following implant failure. On the latest follow-up, 4 years after surgery, radiographs have shown condylar widening and varus deformity with a tibial plateau angle equal to 75 degrees (C). Physical examination revealed varus deformity to the operated knee. The Rasmussen clinical assessment score was 24 and the modified Rasmussen radiological

Discussion

Tibial plateau fractures are frequent in adult trauma and account for 1% of all fractures. Lateral tibial plateau fractures are most common and represent 50 to 70% of tibial plateau fractures according to many studies. Medial tibial plateau fractures on the other hand are rare. Dasaraiah, *et al.* [3] reported in a study an incidence of 4,2% for medial tibial plateau fractures. Manidakis, *et al.* [4] have found in a 125-patient study an incidence of 7,2%. Out of 239 patients, 11,7% had medial tibial plateau fractures according to another study carried by Albuquerque, *et al* [5].

Medial tibial plateau fractures are often associated with injuries to nearby ligaments and menisci. Condylar widening is frequently observed in this type of fracture. Antero medial approach is most commonly used for reduction and fixation. The main risk with antero-medial approach is skin necrosis which may lead to implant exposure. Given this complication, it may be wise to differ surgery few days until soft tissue injuries and blisters are healed.

Fractures with posteromedial fragment having a major displacement or articular depression require a posteromedial approach to the knee. Skin incision is performed running 1 cm posteriorly to the medial epicondyle towards the posteromedial edge of the tibia. After

opening of the fascia, pes anserinus is identified and retracted anteriorly and the medial gastrocnemius is retracted posteriorly and distally to expose the medial edge of the tibial plateau.

Morin., *et al.* [6] carried out an interesting study involving 15 patients with the mean age of 39 years who had medial tibial plateau fracture with posteromedial fragment following sport accident. Tibial spine fractures were found in 80% of cases. All patients included underwent surgery using posteromedial approach to the knee with open reduction and fixation using 2 or 3 cancellous lag screws. The mean follow-up time was 16 months. 93% of patients were satisfied and 87% regained sporting activity on the latest follow-up. No cases of deformity or non-union were reported.

Two studies have biomechanically compared fixation methods for medial tibial plateau fractures.

H Cift., *et al.* [7] compared two groups of 10 units each using synthetic bone samples with Schatzker IV tibial plateau fracture. The first group using 3 cancellous lag screws fixation showed lesser resistance and stability compared to the second group using T-plate fixation.

In the same topic, Huang., *et al.* [8] carried out an experimentation using a 3D reconstruction system and it showed that T-plate fixation had biomechanically better outcomes than cancellous lag screws fixation.

Not many studies have described medial tibial plateau fractures.

Haider., *et al.* [9], have found associated injuries to ligaments and menisci in 29% of cases in a 27-patients study with the mean age of 50 years treated for Schatzker IV type tibial plateau fractures. 66% of patients were males. The mean preoperative articular depression was 4,5 mm between 0 to 23. Surgery was performed in 78% of cases. As for complications, 1 case of infection was reported, one patient had loss of articular reduction and another suffered persistent knee instability.

Acklin., *et al.* [10], carried out a study involving 26 patients with the mean age of 51 years diagnosed with Schatzker IV type tibial plateau fracture. Surgery was performed using an extended anteromedial approach to the proximal tibia and locking plate fixation. Good and excellent clinical outcomes were reported in all cases.

In our study, 19 patients with the mean age of 39,7 years underwent surgery for medial tibial plateau fractures (Schatzker IV type). 84% of patients were males. Associated tibial spine fractures were seen in 63% of cases. Various fixation methods were used (percutaneous screw fixation, open reduction with screw fixation, plate fixation). 89,5% of patients had good and excellent clinical outcomes using the knee Rasmussen clinical assessment score.

Conclusion

Medial tibial plateau fractures are not frequently seen in adult trauma. They are highly accompanied by ligamentous injury that may compromise functional prognosis of the knee if not diagnosed and treated. Surgery is always required. The post-operative complications are dominated by skin damage.

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