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Functional and radiological outcome of ORIF with locking plates for tibial plateau fractures

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Abstract
Background: Tibial plateau is one of the most important weight bearing surface. Fractures of the tibial plateau are most commonly a result of high energy trauma. They principally affect young adults. It involves a diverse group of fractures. Surgery is warranted in most of the cases. Limb alignment and articular surface restoration, allowing early knee motion, are the main goals of surgical treatment. Open reduction and internal fixation (ORIF) is the gold standard treatment.
Method and Materials: We prospectively analyzed the functional and radiological outcomes of 25 surgically treated tibial plateau fractures. Fractures were classified with Schatzker's classification. Preoperative radiographs and CT were taken. ORIF with LCPs fixation was done. All the patients were followed for 18 months. Functional outcome was evaluated with modified Rasmussen's criteria.
Results: After treating with ORIF and locking plates, All patients were started with non-weight bearing walking on POD 1 along with QSE and knee range of movement exercises, partial weight bearing by 3 weeks and Full weight bearing by 4 months. Majority of the patients gained full functional outcome (knee flexion of 130 deg) by 6 months. 24 cases had full radiological reduction, 1 case went for nonunion and required bone grafting. None of the patients had neurovascular complications. Modified Rasmussen's criteria showed excellent functional outcome in 22, good in 2 and fair in 1 case.

Keywords: Tibial plateau fracture, locking compression plates, Schatzkers classification

Introduction
Fractures of the tibial plateau represent 1% of all fractures [1]. An axial loading type of force to the proximal tibia causes a fracture in the tibial plateau region. A direct interdependence exists between the mechanisms of injury, energy required to cause the fracture and age of the patient. Tibial Plateau Fractures can be caused by a wide array of traumatic injuries, ranging from high energy to low energy trauma. Due to the osteoporotic nature of the bone, even a low energy trauma can cause a complex fracture pattern. Surrounding soft tissue injury cannot be ruled out even in a low – energy fractures. Similarly a high energy trauma is expected to cause a complex fracture pattern. Because of the above said reasons, it is mandatory to do a complete evaluation in order to understand the exact fracture pattern, size, shape and location of different fragments. Restoration of joint congruity, ensuring joint stability, alignment and to achieve a full range of movement are the primary goals in the treatment of these kinds of fractures.[2] In the course of treatment of the fracture it is noteworthy to mention that enough attention has to be given to manage the soft tissue damage. The edema and inflammation associated with the trauma can easily lead to local venous compromise, dermal hypoxia, and additional soft-tissue injury [3]. One of the most devastating complication of proximal tibial fracture is Compartment syndrome, its incidence can rise to 17% of closed and 18.7% of open complex pattern proximal tibia fractures [4]. A great deal of controversy exists in the management of these types of injuries. The spectrum of treatment ranges from simple casting and bracing to skeletal traction and early motion to open reduction and internal fixation [5, 6]. One of the commonly applied types of plates in ORIF is the locking compression plate, The use of LCPs not only ensures a robust connection between the articular components but also provides greater stability which is a huge benefit in these unstable fractures [7]. Stabilizing the joint surface by this method, not only seems to cause a significant decrease in side effects but also reduces the length of hospital stay and hospital costs [8, 9]. With this aim in mind, this study

was conducted to determine the outcome of ORIF with locking plates for tibial plateau fractures.

Method and Materials

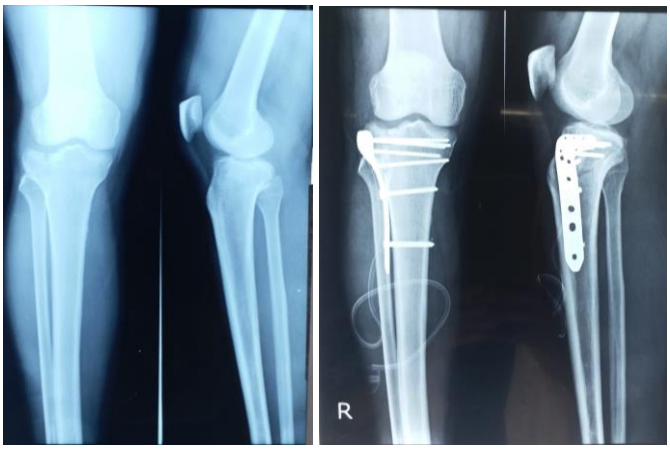
This is a prospective study done in the Department of Orthopaedics at Aarupadai Veedu Medical College and Hospital from November 2017 to April 2019. The total number of cases included in the study was 25.

- Inclusion criteria - Inclusion criteria was age above 18 years, closed tibial plateau fractures.
- Exclusion criteria - Exclusion criteria was age less than 18 years or more than 60 years, patients compound tibial plateau fractures.

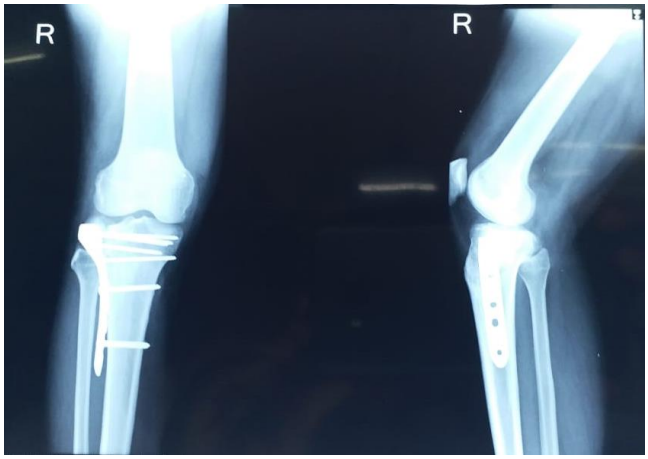
After a detailed and complete clinical history and evaluation including routine blood investigations and proper radiographic evidence with both X – Ray of the leg with knee and ankle (AP and Lateral views) and CT Scans the fracture was classified according to Schatzker classification. The soft tissue status and the fracture patterns dictated the plan of surgery. In all the cases, One hour before the skin incision, a prophylactic preoperative intravenous antibiotic was administered. In a modular operating theater, under strict aseptic precautions, under spinal anesthesia and tourniquet control the operative procedures were performed. Based on the fracture configuration, either the anterolateral or the posteromedial approach or both was used to expose the fracture. Various types of LCPs were used to fix the fracture which included the following types, T shape LCP having a vertical and horizontal limb, L shape LCP having a right or left offset and includes a double bed to fit into the plateau. The reduction of the fracture was done and confirmed under fluoroscopic guidance. Post operatively, for a period of 3 to 5 days, the patients were administered with intravenous antibiotics. Static quadriceps strengthening exercises started from post op day 1. Once the pain subsided, intermittent knee range of movements was started if the fixation was deemed stable. Partial weight bearing was deferred for a period of 3 weeks, and until evidence of union was seen on X ray the patient was restricted from full weight bearing. Modified Rasmussen Criteria for Clinical Assessment was used to evaluate the results of the treatment.

Results

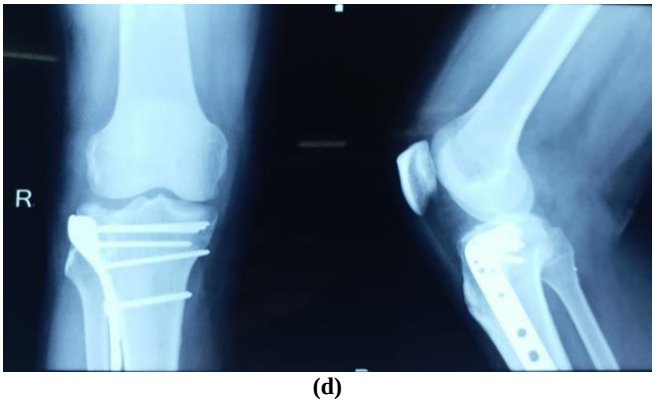
A total 25 cases were included in this study. The average duration of hospitalization was 10 days (range 7 - 14 days). The age group varied from 18 to 55 years with a mean age of 40 years. The incidence of fracture was observed maximum between 30 to 45 years of age. Majority of patients were male (19 cases - 76%), the most common mode of injury was road traffic accident (22 cases - 88%). The average duration between the date of injury and date of surgery was 4 days. 17 cases were operated within 2 to 3 days of injury, 6 cases operated within 7 days and 2 cases were operated beyond 1 week of presentation. Those patients who had swelling around the proximal leg were operated as soon as local tissue condition was optimized for surgery. 16 cases were operated with unicondylar plating (Schatzkers Type I, Type II, Type III and Type IV) and 9 cases needed dual plating (Schatzkers type V and Type VI). The cases were reviewed at 3 weeks, 6 weeks, 12 weeks, and at monthly intervals thereafter till radiological union and maximal functional recovery. Average time gap between operation and partial weight bearing was around 4 weeks (3 to 5 weeks). The mean period of radiological union was 14 weeks (12 to 16 weeks). Most of the patients (20 cases - 80%) had 130º knee flexion after 12 weeks. Fracture pattern and type of fracture significantly affected the fracture healing. The use LCPs not only ensured that anatomical reduction could be achieved to the best possible extent but also provided a relatively stable fixation which facilitated early rehabilitation and reduced the occurrences of complications. A total of 4 patients (16%) had residual pain at the end of follow up period which was not significant and the patients had normal walking capacity with full knee range of motion. One patient had non union (4%) at the end of the follow up period due to noncompliance of post op instructions and unadvised early weight bearing. The case was further managed with a bone graft and restricted weight bearing for 6 weeks and adequate physiotherapy to avoid any stiffness. Final result as per Rasmussen's criteria was excellent in 22, good in 2 and fair in 1 patient.



(a) **(b)**

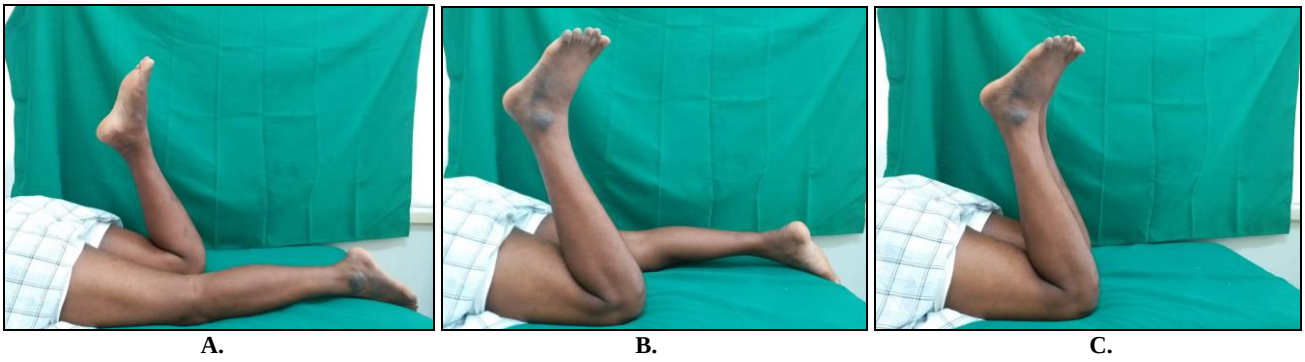


(c)



(d)

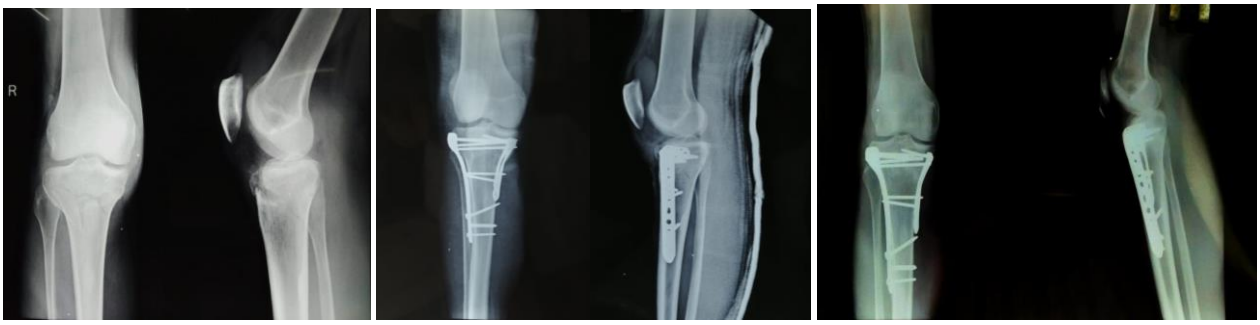
Fig 1: Pre op X Ray (a), immediate Post op X Ray (b), Follow up X Ray 6 weeks (c) and 12 weeks (d).



A. B. C.

E. F.

Fig 2: Knee Range of Movement at 12 weeks right leg (a,d), left leg (b,e) and bilateral legs (c).



A. B. C.

Fig 3: Pre op X Ray(a), Immediate post op X Ray(b) and follow up X Ray(c).

A. B. C.

E. F.

Fig 4: Range of movement at 24 weeks – crossed leg sitting(a), Squatting(b), flexion in bilateral leg(c), Flexion in left leg(d) and right leg(e).

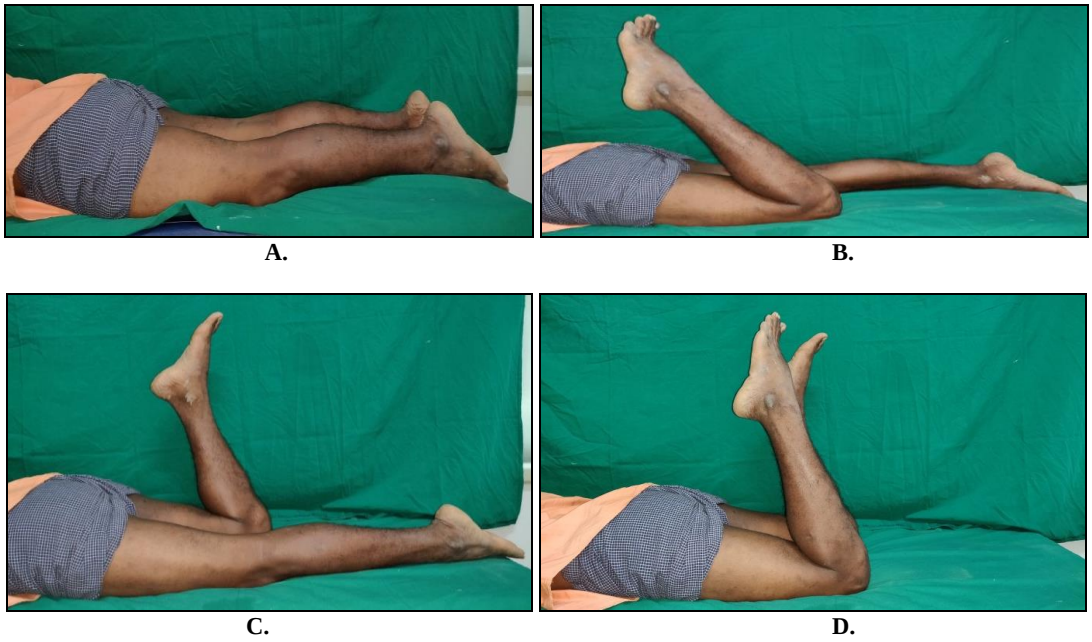


Fig 5: Range of movement at 24 weeks - Bilateral limb in complete extension (a), left leg flexion (b), right leg flexion(c) and bilateral leg flexion(d).

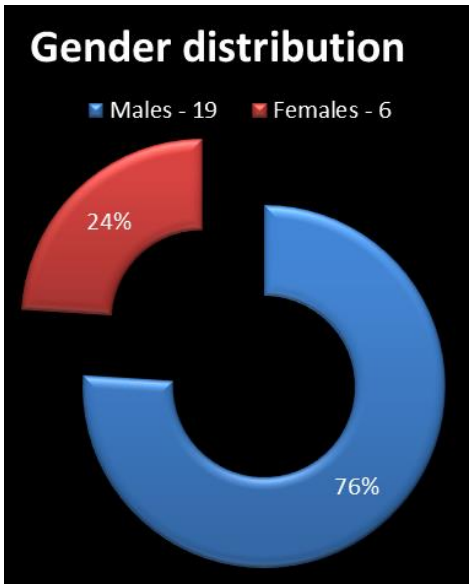


Fig 6: Chart showing the gender distribution of the cases included in the study.

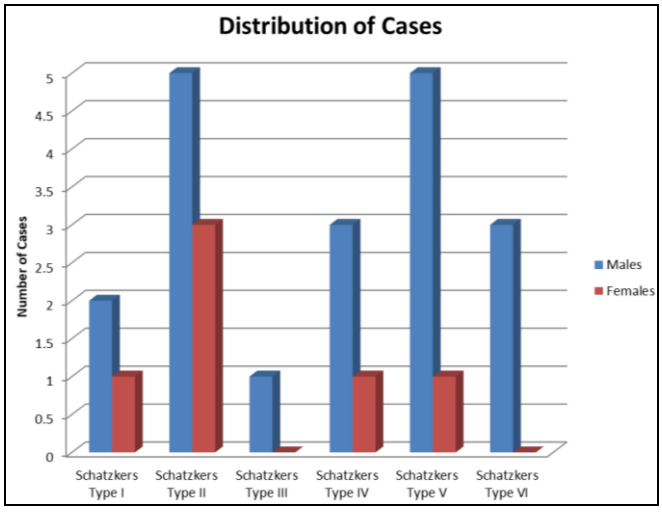


Fig 7: Graph showing the gender distribution and number of cases as per each type of Schatzker's classification

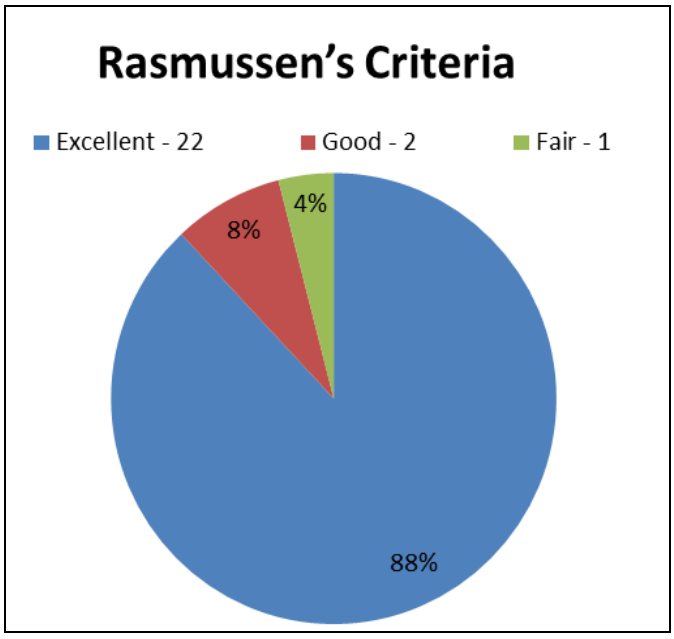


Fig 8: Chart showing functional outcome of the cases as per Rasmussen's criteria

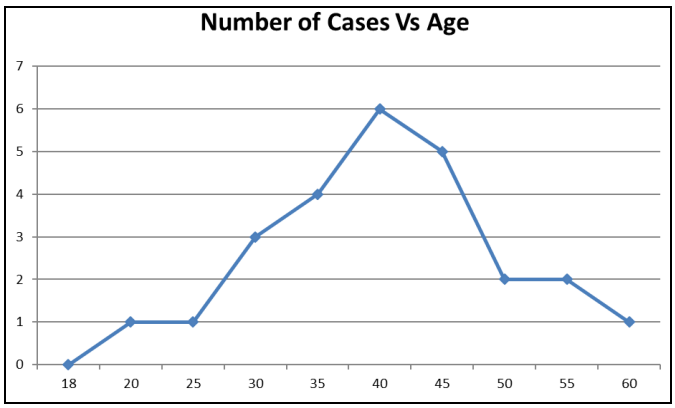


Fig 9: Graph showing the distribution of age vs number of cases.

Discussion

Tibial plateau fractures, one of the commonest intra articular

fractures, are major traumatic injury occurring due to road traffic accidents, fall from height, violence etc. It is sometimes associated with other bony or soft tissue injuries. Any fracture around the joint (especially weight bearing joint in the lower limb) is of paramount importance as it would result in significant morbidity and quality of life. Hence the treatment of upper tibial fractures with intra articular extension has become a challenge for orthopaedic surgeons. Majority of the literature available for the assessment of operatively treated tibial plateau fracture is surgeon based assessment system which includes criteria like radiographic articular reduction, knee range of motion and knee instability. The current trend is to use patient-specific tools to measure functional outcomes [10]. Open reduction and internal fixation with plating is considered one of the acceptable methods of treatment in tibial plateau fractures. Excellent results in 81% of the cases have been reported in one of the series by Lachiewicz and Funcik [11]. Oh *et al*. [12] have also reported excellent results in 91% of the cases treated with open reduction and internal fixation of proximal tibial plateau fractures. Touliatos *et al*. [13] have reported excellent result in 57% of their cases while in our series 88% had excellent and 8% had good functional outcome. Since adequate articular alignment was achieved with minimal soft tissue damage during surgery, it facilitated early and aggressive physiotherapy which led to excellent functional outcomes. It is not uncommon to encounter various complications while treating tibial plateau fractures with respect to fracture fixation methods or soft tissue envelope.

As the surgeon has numerous options of management available at his/her disposal, the optimal treatment for high energy tibial plateau fracture still remains a topic of controversy.

Finally, we acknowledge that this study has certain limitations including lack of control group, follow-up period of less than two years, being not able to trace large number of patients. Despite such limitations we believe this study provides reliable and valid information through the use of Rasmussen's criteria. In conclusion, open reduction and internal fixation is an excellent method of treatment of tibial plateau fractures in judiciously selected cases. The high Rasmussen's criteria in these cases support the fact that operative intervention can alter the lifestyle of the patients markedly.

Conclusion

In summary, the surgical management of tibial plateau fractures is an orthopaedic challenge and needs a comprehensive understanding of fracture, soft tissue, time interval from injury to surgery and post-operative rehabilitation. Anatomical reduction and stable fixation are very important. Knee stability is one of the most important factor for good prognosis including factors like avoidance of soft tissue necrosis, direct and accurate fracture reduction. The advantages of locking condylar plating are: Early mobilization, stable fixation and better functional outcome. It is noteworthy to mention that the functional outcome is inversely proportional to the severity of the fracture.

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