

Assessment of Clinical and Radiological Outcome of Type 5 and Type 6 Proximal Tibia Fractures

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Abstract

Introduction: Proximal tibia fractures account for around 1% of fractures in adults. Proximal tibial fractures are intricate wounds created by high-or low-velocity injury, the ideal treatment of high energy tibial plateau fracture remains contentious. Open Reduction and Internal Fixation (O.R.I.F.) with a rigid implant achieves the goal of anatomic, articular congruency, and mechanical alignment restoration while allowing early remobilization.

Materials and methods: Ours was a prospective-retrospective study conducted with a sample size of 28 patients who were diagnosed with proximal tibia (Schatzker's type 5 and 6) fracture between June 2018 and June 2020. Clinical outcomes were recorded using The American Knee Society (KS) Score for post-operative knee range of motion, The Knee Society Function (KSF).

Results: The immediate post-operative and the one year follow up outcomes did not show any significant difference in the alignment of the tibia, which indicated that there was no secondary loss of reduction.

We observed no Malunion complications in coronal or sagittal or both planes, in any of the patients. However, post-operative Varus alignment was observed in two patients.

Conclusion: In the Intra articular fractures of proximal tibia, namely Schatzker's type 5 and 6, treatment outcomes were dependent upon the fracture type, correct and precise reduction along with appropriate fixation techniques.

The outcomes were excellent when the fracture was accurately aligned, the joints were stabilized and the articular surfaces were well reduced.

Keywords

Proximal Tibia• Schatzker's• Dual plating• Lateral plating

Introduction

Proximal tibia fractures account for around 1% of fractures in adults. Proximal tibial fractures are intricate wounds created by high-or low-velocity injury, the ideal treatment of high energy tibial plateau fracture remains contentious. Open reduction and internal fixation with a rigid implant achieves the goal of anatomic, articular congruency, and mechanical alignment restoration while allowing early remobilization, but open reduction internal fixation compromises the soft tissue structures and has been associated with major wound

complications. Alternate methods that have been described each have its own advantages and disadvantages [1].

Schatzker's type I-IV can be considered as a low velocity post traumatic fracture. Schatzker's type V and VI breaks are high-velocity fractures, often accompanied by other injuries and complications. These usually have prognosis depending on the surgeon and the type of surgery [2].

Various choices available for the open reduction and internal fixation of these fractures are external fixators, less invasive stabilization system, lateral locking plating, dual plating with single incision, and double plating with dual incision technique [2]. With advancement in the current research techniques with respect to implants and the expectation of early mobilization in patients, the treatment of these fractures has improved in light of the fact that the

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above implants above implants take into consideration better comprehension of fracture geometry [3].

Overall, the management of proximal tibia fractures is a challenge in view of their design, related soft tissue and tendon injuries [4].

We evaluated the functional outcome and complications of Schatzker's 5 and 6 tibial plateau fractures treated with a lateral plate through an antero-lateral approach or dual plating also incorporating a postero-medial approach.

Materials and Methods

This was a prospective-retrospective study conducted with a sample size of 28 who were diagnosed with proximal tibia fracture between June 2017 and June 2020.

They were operated with bi-columnar plating with dual incisions for the patients falling under type 5 and 6 according to Schatzker's classification of Proximal tibia fractures.

The Follow up of these patients was done for a minimum period of one year.

Clinical outcomes were recorded using the American knee society scoring system for evaluating pain relief, satisfaction and fulfilling of the expectations.

Inclusion criteria

1. Type 5 and Type 6 Schatzker's classification system for proximal tibia fractures.

Exclusion criteria

1. Type 1,2,3,4 Schatzker's classification system for proximal tibia fractures.
2. Pathological fractures.
3. Open fractures
4. Polytrauma patients

Surgical technique

The patients were operated in either of the three positions, namely Supine, Prone and Supine, and with both limbs draped in supine position with the use of the tourniquet.

The medial and postero-medial condyle fractures were fixed via the postero-medial approach wherein the incision was taken just posterior and parallel to the posteromedial tibial border [5].

After the superficial incision and dividing the subcutaneous tissue, we mobilized the inferior border of pes anserinus tendons and then created an interval with the medial head of the gastrocnemius muscle. After reducing the fracture fragment, we fixed it with 3.5 mm T shaped proximal tibia plate centered over the apex of the distal fracture extension [5].

This approach was used in conjunction with lateral condylar fixation through an antero-lateral approach, which was taken via a sub-meniscal approach and the fracture was split open which was followed by the elevation of the fragment in the antero-posterior plane

using a Cobb's elevator/periosteal elevator [5]. Axial traction was maintained throughout the reduction manoeuvre and an image intensifier was used to verify the reduction, the alignment and the rotation. Use of bone graft or bone graft substitute was planned according to the fracture fragment and this was followed by fixation of the raft plate. Acceptable positioning of the plate was confirmed with a C-arm. The plate was fixed to the proximal and distal fragment with cortical screws on either side of the fracture site. All screws were preferably placed bi-cortically [6].

The wound was irrigated, and closed in layers over a suction drain in a standard fashion [6].

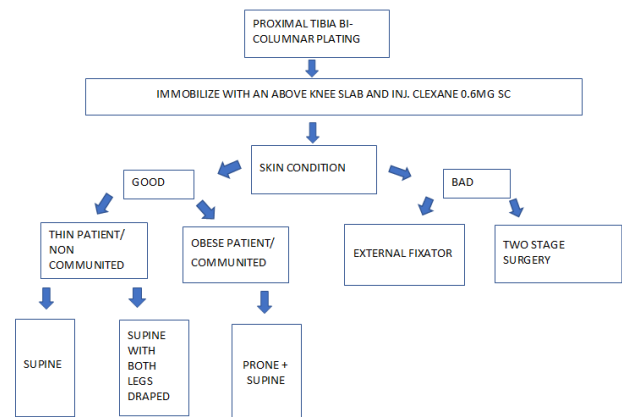


Figure 1. The following protocol was used to decide the surgical incision.

Post-operative rehabilitation

Post-operative slab was given for 3 weeks. Clexane 0.6 mg S/C was started on day 1 to day 3 post op followed by tab. Xarelto 10 mg which was continued for 21 days.

Injectable Teriperatide (8U) was started in osteoporotic patients. All patients at 6 weeks post operatively were started with toe touch weight bearing ambulation with crutches. Full weight bearing was initiated after evidence of bony union was observed clinically and radiologically.

Active assisted range of motion was started at three weeks and full range of motion was obtained by six weeks. The patients were followed up at six weeks, three months, six months and one year post operatively.

Follow up and outcome measures:

- We analysed the radiological, clinical, and functional outcomes in addition to the wound complications associated with the surgery.
- Antero-posterior and lateral radiographs were obtained during the post-operative period and follow up visits.
- Fracture alignment was assessed using an ortho view and Syngo-XS imaging system by independent observers who were not directly involved in the patient care.
- Clinical outcomes were evaluated using the American Knee society for functional score.



Figure 2. Pre-operative X rays of proximal tibia fracture Schatzker type 6.



Figure 4. 3 months post operative ROM.



Figure 3. Post-operative x rays after bicolumnar plating of the fracture.



Figure 5. 3 months postoperative ROM.

Result

The study incorporated fourteen cases of each, type 5 and type 6 Schatzker's classification.

At the final follow-up:

	Type 5	Type 6
6 weeks	50	49.3
3 months	69.3	69.3
6 months	84.1	84.3
12 months	117.2	119

Table 1. Mean of KS score for assessing the range of motion.

	Type 5	Type 6
6 weeks	0	0
3months	45.6	46.3

6 months	58.8	57.7
12 months	86.7	86.9

Table 2. Mean of the KSF score for evaluating knee functionality.

Post op, one case of type 5 and one case of type 6 reported to have a superficial suture abscess on day 5 and day 10 of the post-operative sutures. Rest all had a clean suture line till they were removed on day 14. The immediate post-operative and the one year follow up outcomes did not show any significant difference in the alignment of the tibia, which indicated that there was no secondary loss of reduction. We observed no Malunion complications in coronal or sagittal or both planes, in any of the patients.

However, post-operative Varus alignment was observed in two patients. No patients reported to have procurvatum or recurvatum deformities. Clinical examination revealed no rotational malunion, however an average shortening of one cm was noted in two patients who had severe comminution of the tibial metaphyses.

Discussion

In modern world of development there seems to be a steep increase in complex injuries. High energy proximal tibia fractures remain a challenge to the Orthopaedic surgeon. The classification and treatment of tibial plateau fractures has always been a subject of debate and controversy because of their varied complexities [7]. The primary aims of surgical treatment of bicondylar tibial plateau fractures are to reconstruct articular surface congruity, restore normal alignment of the lower extremity, and to provide stable fixation to allow for a prompt initiation of Range of Motion (ROM) of the knee joint [8].

Achieving a good reduction and stable fixation remains a challenging task.

Good articular reduction with the help of rigid fixation is an important goal of surgery to get a good knee function. This is achieved by open reduction and internal fixation. Dual plating is favoured as compared to fixed-angle implants in a significantly displaced medial articular surface fracture [9].

There have been mixed reviews in terms of advantages and disadvantages of using all the surgical positions we have used in this study, namely, supine, both; supine and prone and both limbs draped in supine position technique.

Many different studies inferred that using a midline longitudinal incision for dual-plate fixation, with the patient in supine position, in selected circumstances lead to inflammation and infection, firstly due to the damage caused to the surrounding soft tissues over the anterior tibial plateau, secondly due to the large size of the incision [2].

A study done by Barei and associates studied the likely complications after operative treatment of complex tibial plateau fractures using dual plating via two incisions. They observed that 8.4% of the subject had deep infections. Although the complication rate was significant, the investigators noted a substantial

improvement with this technique as compared to use of a single, midline anterior incision [10].

We found that the results were operative technique-dependent and the results weren't reproducible in our study.

However, some authors like Gosling T, Schandelmaier P, Marti A, et al have proposed that with the emergence of locking plates, stable fixation of the postero-medial fragment is literally achievable via the lateral side with the patient in supine position. It seems, however, that this technique is a challenge when a postero-medial shear fragment is present, because the lateral screws are drilled in the coronal plane and are more often than not parallel to the fracture lines observed in these fracture patterns and thereby, may fail to capture the posteromedial fragment all-together [11].

To counter this problem of excessive soft tissue damage in a single midline longitudinal approach, inappropriate postero-medial fixation and subsequent subsidence of the fracture fragments in a lateral approach, a study by Yoram A. Weil et found that performing an antiglide plating with a postero-medial approach with the patient in a supine position, that can concomitantly be used with a lateral approach (if required), produced acceptable clinical results, as this approach is sufficient for buttressing the posteromedial spike, and also kept the deep dissection and soft-tissue stripping to a minimum [11].

However the limitation of this study was that all the fracture lines of posteromedial component instead of completely lying in the coronal plane had components of obliquity as well [11].

In our study we operated fourteen patients in supine position with dual incisions (postero-medial with lateral) with bi-condylar plating with a satisfactory post-operative clinical and radiological result with an average Knee Society score at 12 months being 117.2 for type 5 and 119 for type 6 fractures.

The Knee society function score was 86.7 and 86.9 for type 5 and type 6 respectively.

Interestingly, we observed that, several accounts of single and dual approaches to the proximal tibia published in the past 10 years, are in supine position. We observed that these papers had great disadvantages in treating complex proximal tibia fractures associated with postero-lateral corner injury [12].

We positioned the five patients with both lower limbs draped, a technique suggested by Shi- Min Chang et al. One scrubbed assistant holding the contralateral limb with the hip flexed and adducted with the pelvis turned towards the injured leg along with the ipsilateral hip externally rotated and knee slightly flexed and the surgeon standing opposite to the injured leg to start with the postero-medial approach to attend the fractures of the postero-medial fragments.

The key advantages of this method were that that there was no need of re draping and skin preparation of the affected limb if and when position of the patient was changed from prone to supine (in

supine plus prone positioning of the patient) and thus saving ample amount of time intra-operatively, as well as it gave us an option of adjusting technically through the first incision, if needed. The main disadvantage is that an additional scrubbed assistant is required to keep the healthy leg in a favourable position. The indications of this position are bicondylar tibial plateau fracture associated with a posterior coronal fragment that is going to require a separate plate fixation. It is possible to correct three (anteromedial and posteromedial) or three (plus posterolateral) quadrants of bicondylar tibial plateau fractures via the posteromedial gastrocnemius approach while the patient is still in the supine position. However, this manoeuvre is not feasible for patients with associated contralateral leg fractures, spinal fractures, and pelvic fractures, severe comminution obese patients or patients who have poor bone quality [13].

Also, provisional reduction is difficult due to visibility being affected due the limitations of the position.

Hence, Yih-Wen Turng et. al suggested another triple columnar fixation patient positioning which is Supine + Prone position. This was advantageous because the initial posterior approach makes it easier to visualise, access and reduce the postero-lateral or postero-medial fragment in complex proximal tibia fractures, if i.e. there is a postero-lateral or postero-medial segment in the coronal plane.

Also according to the biomechanical principles, it is advisable to put the posterior anti-glide buttress plate which they concluded was cumbersome when the patient is supine [14].

In our study, it was difficult to put the buttress plate in obese patient and hence posterior fracture fragment is done in prone position. According to our observations, the advantages of operating obese/osteoporotic patients in prone position were; good exposure and visualization of the fracture fragment, comfortable surgical position for the incision and the surgeon. The C-arm can also be visualised in the Antero-Posterior and lateral views without moving the limb around.

There were also some disadvantages of the dual position of the patient, like; patients with any lung complications or chest trauma cannot be given the prone position. The limitations being that it leaves no room for secondary adjustment or revision of the first procedure after the skin is closed and the patient position is shifted. The overall preparation time of this position takes a long time [2].

In our study we operated nine patients who were obese and had comminuted (which included a postero-lateral fragment) fractures in supine + prone position, and achieved satisfactory reduction although it did take a longer time to prepare the patient as was discussed by Yuh Weng Turng et al.

Chang-Weng Oh et al reported his study on outcome of double plating. In a series of twenty-three unstable proximal tibia fractures, all fractures healed at an average of nineteen weeks. Twenty-one patients had excellent or good clinical and radiographic results [15].

There was one case of shortening of around 1 cm, 2 cases of more than 10 degrees varus malalignment and one case of superficial infection which healed after hardware removal. No deep infections were noted [16].

In our study, we observed that there was one centimetre of limb shortening in one patient who had a compound fracture with a significant bone loss in the metaphyseal region and two cases who had a varus mal-alignment.

Our clinical study included total of 28 patients. The analysis of the results was made in terms of- analysis of the types, various operative patient's positions and incisions, complications and the subjective, clinical, and functional outcome based on American knee society.

The outcomes were also analysed radiologically.

A study by Nagendra et al included a prevalence of 59% of type 5 and 41% of type 6 respectively. In the study conducted by G Thiruvengita Prasad et al, forty out of the forty-six patients completed the follow up, out of which twenty were type 5 and twenty were type 6 Schatzker's classified patients.17 In our study, 14 patients had Schatzker's type V fracture and 14 patients had Schatzker's type VI fracture and thus totally a sample size of 28 patients.

A study conducted by David et al observed a significant negative effect on functional outcomes of tibial plateau fractures that were associated with articular comminution. The condition of the soft tissue was considered important before every surgery. Majority of patients had good range of movements at knee with mean flexion of 120.67 degrees. Extension lag was present in 4 cases which was 5 degrees in 2 cases and 10 degrees in other 2 cases. Malunion was the cause in 1 case and in other 3 cases lack of physiotherapy was the cause. We observed a Good range of movement in our study was due to early mobilization and use of Continuous Passive Motion (CPM) machine [18].

Another study by Kulwinder et al stated that the mean time taken for fracture union in their study was 16.93 weeks (12 to 22 weeks). The mean time of follow up of the study was 36.67 weeks (24- 48 weeks) [19].

Our patients showed the fracture union time of approximately 12-18 weeks.

In our study the average knee moment (flexion) was 121.2 degrees for Schatzker's type 5 and 124 degrees in Schatzker's type 6 fracture at one-year post-operative in relevance to the studies by Kataria et al. where average Knee moment 132 degrees in 48 patients for Schatzker's type 5 and 6. Marsh et al. reported 138 degrees.

The decrease in the average knee motion in our study was due to longer immobilization period postoperatively and poor patient compliance for post-operative rehabilitation with a follow up period of only one year.

Staged open reduction and internal fixation of high-energy tibial plateau fractures often resulted in non-union and deep infections. High rates of infections were observed when open fractures and open fasciotomy wounds were corrected with internal fixation [20].

Michael R Ruffolo et al concluded in his study that the total major complication rates were 27.9%, out of which 23.6% were deep infections and 10.0% of non-union rates were noted. A higher rate of infections of approximately 43.8% were associated with open fractures whereas about 21.0% were observed in closed injuries.20 In this study of 28 patients, only 2 of them developed suture site infection: superficial suture abscess, probably because of the skin

stretching at the ends of the extended initial small incision. To counter this, we would take an initial long incision as supported by appropriate literature. We had zero cases of mal union or non-union.

Thus, we conclude that the treatment outcomes were dependent upon the fracture type, correct and precise reduction along with appropriate fixation techniques.

Conclusion

In Intraarticular fracture of proximal tibia, Schatzker type 5 and 6, treatment outcome depends on the type of fracture as well as correct reduction and the use of appropriate fixation.

When accurate alignment, joint stability and well reduced articular surfaces are achieved, outcomes are significant.

A congruent and anatomical reduction is an essential key for better outcome in treated proximal tibia fracture, as it helps in nourishment of articular cartilage; facilitate early mobilization and decrease chances of delayed degeneration and post-operative complications. Early mobilization is the key to achieve good outcome in these fracture series.

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