



“A STUDY OF FUNCTIONAL OUTCOME OF TIBIAL PLATEAU FRACTURE OPERATED BY PLATE OSTEOSYNTHESIS”

Orthopaedics

Dr Rahul Rathod* Post Graduate. *Corresponding Author

Dr Anand Garampalli Professor, Dept. of orthopaedics, Mahadevappa rampure medical college, kalaburagi.

Dr Vikrant Kulkarni Assistant Professor, Dept of orthopaedics, Mahadevappa rampure medical college, kalaburagi.

ABSTRACT

Background: Tremendous advance in mechanization and fastness of travel have been accompanied by steep increase in number and severity of fractures and those of tibial plateau are no exception. Knee being one of the major weight bearing joints of the body, fractures around it will be of paramount importance.

Objective:

1. This study is to analyze the functional outcome of ORIF with plating with or without bone grafting in tibial plateau fractures in adults.
2. To study complication of operative management

Methods: Confirmed cases of Tibial plateau fractures admitted in Department of Orthopaedics in Basaweshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College, Kalaburagi. The purpose of the study is to include with tibial plateau fractures diagnosed with history taking, Examination and investigations: knee X ray-AP and Lateral view. The need of operative intervention is assessed based on the Shatzker's classification and intervention done by techniques like anterolateral plating bicondylar plating, posteromedial plating. Patients will be reviewed at 6 weeks, 3 months and 6 months interval and their assessment done by Rasmussens functional and radiological scoring. **Results:** In our series, majority of the patients were males, middle aged, with road traffic accident being the commonest mode of injury. Most of the cases were Type I fractures i.e., split fracture of lateral condyle according to Schatzker's classification, Surgery was performed with in 6.48 average days, Union was noted clinically and radiologically and functional evaluation was done by Rasmussen functional and radiological score. Excellent results were present in 23 patients (76%), 4(20%) good and 1(4%) poor results. **Interpretation /Conclusion:** Achieving and maintaining anatomical reduction with plates with less soft tissue dissection helps in early mobilization and hence obtaining good functional and radiological outcomes of tibial plateau fractures early physiotherapy for rehabilitation

KEYWORDS

Tibial Plateau, Buttress Plate, Internal Fixation, Proximal tibia

INTRODUCTION

Knee joint is an important joint as it is involved in varied functions Like load bearing, walking, running, sitting etc. Knee joint is comprised of distal femur, proximal tibia & patella. Injuries of the knee must be treated properly to maintain a good knee function¹.

Fractures of the tibial plateau represent 1% of all fractures and approximately 8% of fractures occurring in the elderly^{2,3}. These are serious injuries resulting frequently in functional impairment⁴.

Despite many advances in the care of intra-articular fractures, tibial plateau fractures continue to be a difficult surgical problem. A survey of the literature indicates that many authors report only slightly better than 50% satisfactory results with either closed or operative methods of treatment. The failures of treatment are usually due to residual pain, stiffness, deformity, recurrent effusions, and instability. Review of over 140 of these fractures treated by both closed and operative methods has shed considerable light on the reason for the failures (Schatzker et al. 1979)⁵.

For over three decades various modality of treatment starting from traction, knee spanning external fixator to total knee arthroplasty were used for tibial plateau fractures. Traction and closed reduction followed by POP application will not restore the articular surface and lead on to articular surface collapse and knee stiffness. Open reduction and fixation with plating will lead to good reduction of articular surface. ORIF with dual plating has been an attractive treatment method for complex types of injuries⁶. The successful management of these fractures demands familiarity into the character of fracture, technical aspect of fracture fixation, knowledge of implant profile and art of the post operative management⁷.

Classification

There are numerous classification systems that have been proposed to describe tibial plateau fractures. The majority of these systems are very similar, and each one recognizes wedge, compression, and bi-condylar types.

Schatzker Classification:

Nowadays it is the most commonly used classification, because of its

usefulness in decision making for tibial condyle fracture

Type I : Lateral condyle split fracture

Type II : Split and depression of the lateral condyle

Type III : Intact rim with pure central depression of lateral condyle

Type IV : Medial condyle fracture

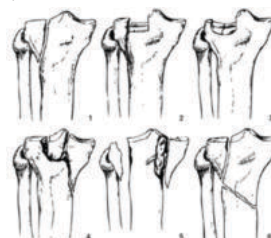
Type A : Split fracture

Type B : Depression fracture. Both are may associated with tibial spine fracture

Type V : Fracture of the both condyle

Type VI : Both tibial condyle fracture with metaphysio diaphysial dissociation

Honkonen and Jarvinen have recently modified Schatzker's classification to take residual limb alignment into account. They divide Type VI fractures into two types; those that are medially and laterally tilted to take into account functional results in treated fractures with residual angulation.



Schatzker classification

Three Column Concept In Proximal Tibia

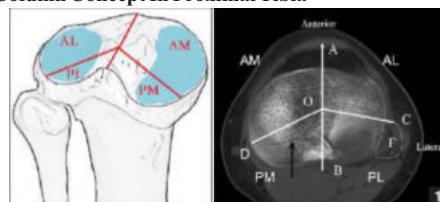


Fig 5 - Three column classification

Each column is an independent articular depression in the proximal tibia. There are three columns described in proximal tibia, anteromedial, anterolateral and posterior column which again is divided into posteromedial and posterolateral columns. Pure articular depression defined as zero column fracture.

Mechanism of Injury

Tibial condyles fractures caused by high velocity injuries and fall from height. Most common mechanism is axial compression with valgus thrust, and the shear forces by indirect violence. Antermost part of femoral condyle which was wedge shaped produce axial impaction on the tibial plateau. The magnitude direction, and the force, along with the position of the knee joint, determine the location, fracture pattern, and amount of displacement⁸.

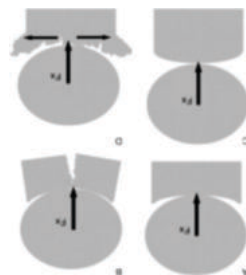


FIG - 6 Mechanism of injury

METHODOLOGY

The present study consists of 30 cases of tibial plateau fracture treated by open reduction and internal fixation with bicondylar plating or anterolateral plating or posteromedial plating at the Basaveshwar Teaching and General Hospital attached to Mahadevappa Rampure Medical College, Kalaburagi from March 2021 to August 2022.

Study was conducted with due emphasis for functional outcome and analysis of results after surgical management of fractures of tibial plateau with bicondylar plating or anterolateral plating or posteromedial plating

Inclusion Criteria:

1. Patient who has been diagnosed as closed tibial plateau fracture.
2. Patient who has been diagnosed as open Gustillo Anderson type I and type II fracture
3. Age group of 18 – 60 years of all gender.

Exclusion Criteria:

1. Patients with open Gustillo Anderson type III tibial plateau fracture.
2. Fracture associated with neurovascular compromise.
3. Age less than 18yrs of all gender.
4. Pathological fracture.
5. Medically unfit.

Study Method:

This is a study of 30 cases of clinically and radiologically diagnosed patient with tibial plateau fracture and treated with open reduction and internal fixation by plating. Patient was evaluated clinically and radiologically at 6 weeks, 3 months, 6 months intervals using appropriate tools. Functional outcome was graded by Rasmussen's 30-point clinical grading system and Rasmussen radiological evaluation of knee.

Evaluation Of Results:

Although there are many methods of evaluation of results given by many authors, the treated tibial plateau fractures by anterolateral plating or posteromedial plating or bicondylar plating were evaluated in our study with Rasmussen scoring for functional outcome and Standard radiographs for radiological outcome.

RASMUSSEN'S 30-POINT CLINICAL GRADING SYSTEM

A) SUBJECTIVE COMPLAINS

a) Pain

No pain	6
Occasional pain	5
Constant pain after activity	4
Significant rest pain	0

b) Walking Capacity

Normal walking capacity (in relation to age)	6
Walking outdoor for at least 1 hr	4
Short walk outdoor for 15 mins	2
Walking indoors only	1
Wheelchair or bed ridden	0

B) CLINICAL SIGNS

b) Extension

Normal	6
Lack of extension (0-10°)	4
Lack of extension (>10°)	2

b) Total Range Of Motion

≥140°	6
≥120°	5
≥90°	4
≥60°	2
≥30°	0

c) Stability

Normal stability in extension and 20° of flexion	6
Abnormal instability 20° of flexion	5
Instability of extension <10°	4
Instability of extension >10°	2

Maximum scoring – 30

Excellent -27-30

Good -20-26

Fair -10-19

Poor-<10

RASMUSSEN RADIOLOGIC ASSESSMENT:

Articular depression	
Not present	6
< 5 mm	4
6-10mm	2
>10mm	0
Condylar widening	
Not present	6
< 5 mm	4
6-10mm	2
>10mm	0
Angulation	
Not present	6
<10°	4
10-20°	2
>20°	0

Maximum 18

Excellent – 18

Good -12-17

Fair -6-11

Poor -<6

Immediate Management:

Immediately on arrival of the patient, if he/she was in shock, the level of shock was noted and managed accordingly. X-ray of the part was taken and the knee was immobilized in above knee POP posterior slab. The affected limb was kept elevated. Analgesics and antibiotics were given if necessary. Patient was then prepared for surgery and anesthesia after the pre-anesthetic checkup.

Radiographic Examination:

Standard radiographs were taken in two planes i.e. anteroposterior and lateral views were taken for confirmation of the diagnosis and to classify the fracture. CT scan was done for diagnosis in few patients who had complex fractures. The fracture fragments were analyzed and joint positions were assessed and classified according to the Schatzker's classification.

Anesthesia

All cases were operated under spinal anesthesia with or without epidural catheter

Position And Tourniquet:

Under the action of spinal anesthesia, the patient was placed supine on the operating table with the injured limb over tibia stand. The limb was

elevated for 2-3 minutes and exsanguinated and a thigh pneumatic tourniquet was applied. The leg and foot were scrubbed thoroughly with betadine 10 % scrub, painted with betadine 10% solution and draped under aseptic precaution.

Operative Technique

Under spinal or general anaesthesia, patient was placed in supine position. The operating limb was cleaned and draped. Limb should be free for reduction techniques during the surgery. Fracture reduction was done under C-arm guidance by closed methods using ligamentotaxis. Combined traction with Valgus or varus strain was done in flexion or extension of knee as per the need of the individual case depending upon the reduction. Compression bony clamp was used in cases to bring the fracture fragments together. After confirming the reduction under C-arm guidance fixation of the fracture was done with locking plate.

In case of Schatzker type III fracture depression was elevated with bent Steinmann pin introduced from the opposite condyle with or without bone grafting. After proper wound wash, wound was closed in layers with drain insitu. Postoperatively standard anteroposterior and lateral radiographs were taken.



Fig 1 - CARM Picture Showing Elevation Of Depression



Fig 2 - Reduction Of Fracture By Reduction Clamp



Fig 3 - Fixation Of Anterolateral Raft Plate With K Wire



Fig 4- Pre Op X Ray

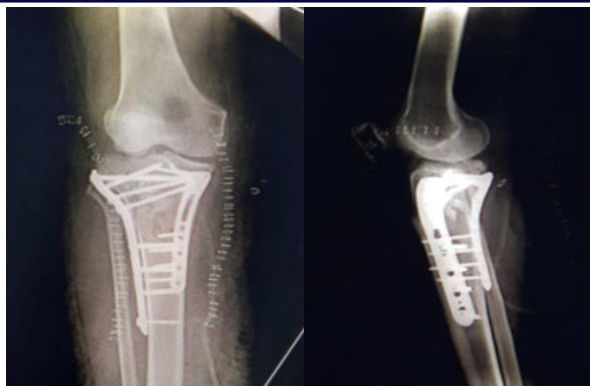


Fig 5 Post Op XRAY



Fig 6 Pre Op X Ray Of Medial Condyle Fracture



Fig 7 - Fixation Of Posteromedial Plate For Medial Condyle Fracture



Fig 8 Post Op Xray

POSTOPERATIVE MANAGEMENT:

- a) All the patients were treated with Inj. Cefaperazone + Sulbatum 1.5 gm twice daily for 5 days followed by Tab Cefuroxime + clavulenic acid 500mg daily for 7 days. Some cases were treated with Inj. Amikacin 500mg daily for 3 days.
- b) Anti-inflammatory analgesics, Inj. Diclofenac 75mg for 3 days followed by Tab Diclofenac 50mg twice daily. In some cases, Inj. Tramadol and Inj. Paracetamol were also added.
- c) Calcium and vitamin supplements were given.
- d) Affected limb was immobilized in above knee POP posterior slab with knee in 10° flexion for 2 weeks and kept elevated. Patient was asked to perform finger movements on day 1. Passive assisted knee movements was advised from 1st postoperative day.

FOLLOW UP:

Patient was discharged with continuing oral antibiotics and adequate analgesics along with calcium supplements. In our study, discharged patients were advised to report for follow up after 2 weeks for suture removal, at 6 weeks, 12 weeks and thereafter at 6 months post-operatively. The result is assessed at 6 months after the procedure. At follow up, a detailed radiological and clinical examination was done. Radiologically patient was assessed for signs of union and stability of the fixation. On clinical examination pain, swelling of the joint, range of motion of the knee joint, hardware prominence, nutrition, function and power of the muscles acting on the joint were noted.

At 2 weeks follow up, patients were instructed to carry out physiotherapy in the form of active flexion-extension of knee joint without loading and with partial loading was initiated at 6 weeks.

Check x-ray were taken and when final x-ray showed union, implant was removed. In all patients, duration after which they returned to job was noted.

RESULTS

The present study consists of 30 cases of tibial plateau fracture treated by open reduction and internal fixation with bicondylar plating or anterolateral plating or posteromedial plating at the Basaweshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College, Kalaburagi. From March 2021 to August 2022. The following are the observations made and the available data are analysed as follows.

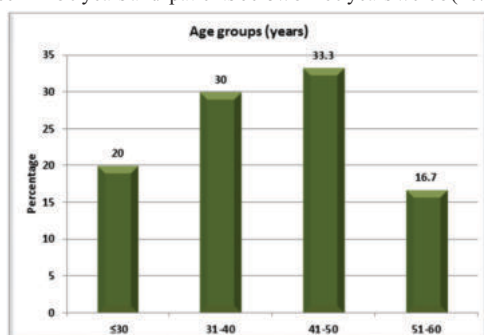
Statistical Analysis

Data were entered into Microsoft Excel and statistical analysis was carried out in SPSS software version 17.0. Age and time interval was categorised and reported as percentages. Other categorical variables like gender, side involved, classification, associated injuries, complications and final results were presented as frequency and proportions. Type of surgical procedure was expressed as numbers and percentages. Bar diagrams and pie charts were used for graphical representation of data.

1) AGE INCIDENCE:**Table-1 : Showing The Age Incidence**

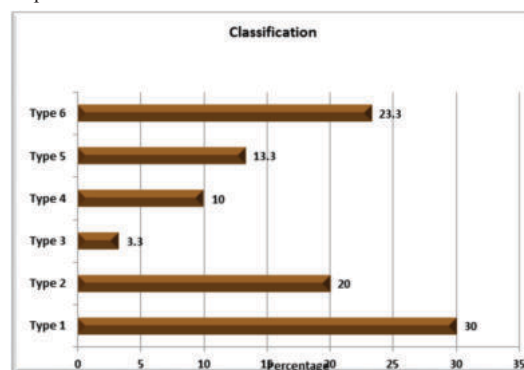
Age in years	21-30	31-40	41-50	51-60
No. of cases	6	9	10	5
Percentage	20%	30%	33.3%	16.7%

The age of this patients ranged from 21-60 years, with fracture association being most common in 4th decade i.e. 10 cases (33.3%) and mean age of 40.5 years. In this series, 6(20%) patients between 21-30 years, 9 (30%) patients between 31-40 years, 10 (33.3%) patients between 41-50 years and patients below 51-60 years were 5(16.7%).

**2) TYPE OF FRACTURES: Schatzker classification****Table-2: Type Of Fractures**

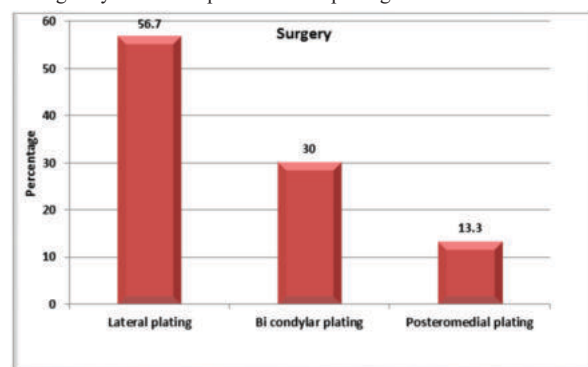
Classification	Number	Percentage
Type 1	9	30.0
Type 2	6	20.0
Type 3	1	3.3
Type 4	3	10.0
Type 5	4	13.3
Type 6	7	23.3
Total	30	100.0

In our case series 9 patients were Schatzker type 1 which was majority of the case and Schatzker type 6 were next majority of the cases which were operated

**3) Methods Of Surgery****Table-3 Surgery Done**

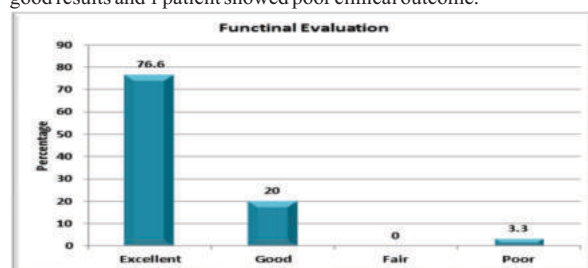
METHOD OF SURGERY	No. of cases	Percentage
LATERAL PLATING	17	56.7
BICONDYLAR PLATING	9	30.0
POSTEROMEDIAL PLATING	4	13.3
TOTAL	30	100.0

In this series 17 patients were managed by lateral plating, 9 patients were managed by ORIF with bicondylar plating and 4 patients were managed by ORIF with posteromedial plating

**4) Clinical Evaluation****Table 4-Functional Results**

FUNCTINAL OUTCOME	No. of cases	Percentage
EXCELLENT	23	76.6
GOOD	6	20.0
FAIR	0	0
POOR	1	3.3

In our study 23 patients showed excellent results 6 patients showed good results and 1 patient showed poor clinical outcome.

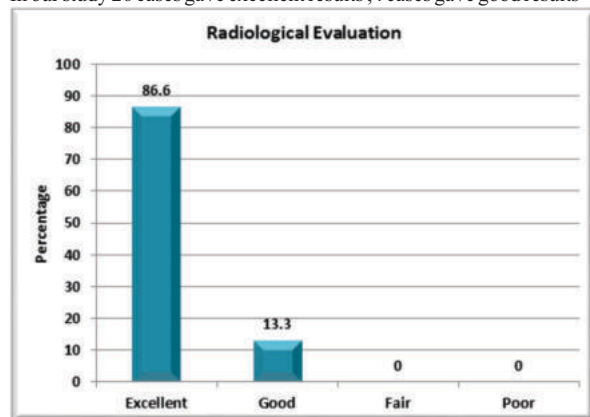


5) Radiological Evaluation

Table 5-Radiological Results

RADIOLOGICAL OUTCOME	No. of cases	Percentage
EXCELLENT	26	86.6
GOOD	4	13.3
FAIR	0	0
POOR	0	0

The mean Rasmussen functional outcome score was 9.6 (Range 0-9) . In our study 26 cases gave excellent results ,4 cases gave good results

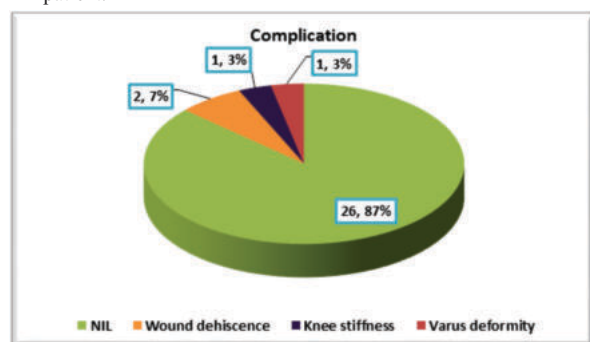


6) Complications Or Demerits Of This Procedure:

Table - 6

Complications	Number	Percentage
Wound dehiscence	2	6.7
Knee stiffness	1	3.3
Varus deformity	1	3.3
Nil	26	86.7
Total	30	100.0

The complications of the present study, wound dehiscence was in 2 patients, which was treated with wound debridement and secondary suturing. 1 patient had knee stiffness and varus deformity was noticed in 1 patient.



DISCUSSION

Intraarticular tibial plateau fractures are complex fractures accounting for about 1.2% of all fractures⁹. They affect knee function and stability which results in considerable morbidity. These fractures are caused by high velocity injuries and often associated with severe comminution and soft-tissue damage. The goals of treatment are to restore joint congruity, limb alignment and early mobilisation of joint¹⁰. Stable internal plate fixation without damaging the soft-tissue envelope is very difficult to achieve only fair results are seen in 20% to 50% in these fractures¹¹.

Open reduction and internal fixation (ORIF) with plates and screws enables direct fracture visualisation, reduction, and fixation, but there is high risk of soft tissue injury, stiffness and deep infection¹². The hybrid external fixator avoids soft tissue problems, but risks malalignment, pin tract infections and poor patient compliance.

The concept of preserving the blood supply and atraumatic surgical technique led to the development of biological fixation techniques. Using this technique, soft tissue damage is reduced and shows higher union rate¹⁴.

The development of locking implants has allowed the use of minimally

invasive technique for unilateral plating¹⁵ with improvement in handling the soft tissue.

Laterally placed locking plates provide better stability in the presence of complex proximal 1/3rd tibia fracture with metaphyseal comminution and serves as an alternative to medial plate or external fixator for additional support of the medial column when a non-locking plate is used for bicondylar fractures¹⁶. This plate allows fixation through single incision which avoids wound dehiscence, infection and prolonged immobilisation associated with extensile approaches.¹⁷

The aim of our study is to evaluate the functional out of tibial plateau fracture treated with plate osteosynthesis.

As there is no universal scoring for assessing the functional outcome for these fractures. In our study we have considered Rasmussen system of scoring as functional and radiological system of scoring.

All the fractures were treated by a single plate either anterolateral or posteromedial or by bicondylar plating with or without bone grafting at the fracture site. Bone graft was extracted from iliac crest.

Mechanism of injury was road traffic accident for all these patients. The fractures were classified by Schatzker's classification. 7 patients belonged to type VI, 4 patients belonged to type V, 3 patients belonged to type IV, 1 patient belonged to type III and 6 patients belonged to type II. According to literature type II fractures were the most common, type I was most common in our study. Type VI fracture was found to be second most common.

Type I fracture and type II fracture were treated with anterolateral plating, only 1 patient of type III fractures was operated in our study type IV and were operated with posteromedial plating type V and VI patients were operated with bicondylar plating and fracture with metaphyseal extension were operated with bone grafting. 11 patients were operated with bone grafting majorly involving type VI and type II.

Hasnain raza¹⁸ et al, in their study of assessing the functional outcome of tibial condyle fractures of 41 patients by minimally invasive plate osteosynthesis by Rasmussen functional score found excellent results in 18 patients, good in 19 patients and 4 patients had unacceptable results. The mean Rasmussen score was found to be 25.3 and range of knee flexion was 118 degrees.

In our study mean Rasmussen score was found to be 28.7 and average range of knee flexion was found to be 120.9 degrees. Of which 23 patients had excellent and 6 patients had good results. Only 1 patients had poor results.

Mohammad Ali Tahririan, Seyyed Hamid Mousavitadi, and Mohsen Derakhshan¹⁹ in their clinical study comparing the functional outcomes of tibial plateau fractures treated with nonlocking and locking plate fixation by knee society score, found a score of 80.2 for locking plate and 72.5 for non locking plate. Average range of knee flexion was found to be 122.3 degrees for locking plate and 115.7 degrees for non locking plate. In our study, locking plate was used for all the cases. Average knee society score was found to be 92.5 and average knee flexion was found to be 120.9 degrees. So, functional outcome in our study was marginally better than the locking plate group in that study and significantly better than the non locking group. This shows the superiority of the locking plate in view of stable fixation and early range of motion when compared to non locking plate.

Chang-Wug Oh²⁰ et al in their study on double plating of (twenty three) type V and type VI proximal tibial fractures using minimally invasive percutaneous osteosynthesis found Eighteen patients with excellent, three patients with good and two patients with fair results. Average Rasmussen score was found to be 26 and average knee range of motion was found to be 123 degrees.

In our study, 7 patients belonged to type VI and 4 patients belonged to type V fractures. Average Rasmussen score of these type V and type VI fractures were found to be 28.09. Average range of flexion achieved by type V and type VI was found to be 118.5 degrees. which was comparable to their studies

Radiological union and results are also compared with other

studies. Weil Ya, Gardner MJ, Boraiah S conducted similar study with 28 patients and had 55% excellent, 41% good and 4% fair results. In another study conducted by Lobenhoffer P, Gerich T, Bertram T they had 21 patients and the results were 57% patients had excellent results, 42% with good results. Study of Berber R, Lewis CP, Copas D revealed 54% excellent results, 36% good and 9% fair results. In our study 76.6% patients had excellent results, 20% good and 3.3% poor results and hence it showed significantly good compared to results of other published studies.

Dual plate gives better biomechanical strength and rigid construct thereby better control of both columns thus avoiding late collapse. There were no major wound problems in any of these studies. Weight bearing was started only at 8-12 weeks which was similar to our study.

In their study of ten patients Kye-Youl Cho²¹ et al, used a single midline longitudinal incision and dual plating for the treatment of type V and type VI Schatzker fractures. Their mean knee society score for the study group was 85 and the mean range of motion was 125 degrees. They had only one case with delayed wound healing as postoperative complication. In our study, average knee society score was found to be 87.25. One patient had 10 degrees of valgus malalignment in type VI fracture and one patient had flexion contracture of 5-10 degrees. But the functional outcome was not significantly altered when compared with others.

In our study, there was no late complications like loss of reduction and malalignment with unilateral plating for type V and type VI fractures. Functional outcome at midterm follow up is similar to those two studies with dual plating. Since our study group is small we were not able to statistically conclude which procedure is better.

Choice of the procedure/implant should be based on the fracture pattern, bone quality and intraoperative reduction.

CONCLUSION

The treatment of this type of fracture is a challenging prospect. Successful treatment of this fracture may be achieved by identification of the fracture configuration using 3D CT scan, proper timing of the operation, appropriate methods of internal fixation, and intraoperative restoration of the normal morphological characteristics of the knee joint.

Achieving and maintaining anatomical reduction with plates with less soft tissue dissection helps in early mobilization and hence obtaining good functional and radiological outcomes of tibial plateau fractures.

Further, early protected passive motion exercise should be strongly recommended in such cases to avoid subsequent joint stiffness or posttraumatic arthritis.

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