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Corresponding Author
C.Y.G Keerthi,
Department of Orthopaedics, Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore, Karnataka, India

Author Designation
[1]Senior Resident
[2]Assistant Professor
[3]MBBS, D. Ortho
[4]Consultant Orthopedician

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The Functional Outcome of Open Reduction and Internal Fixation with Plate Versus closed Reduction and Fixation with Hybrid Ilizarov in the Treatment of Tibial Plateau Fractures

[1]Rahul Gawalkar, [2]C.Y.G Keerthi, [3]R. Kishore kumar and [4]Vittobha Gawalkar

[1,2]Department of Orthopaedics, Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore, Karnataka, India
[3]DNB Orthopedics. Registrar, SS Sparsh Hospital, Rajarajeshwari Nagar, Bangalore, Karnataka, India
[4]Harikrishna Hospital, Shahpur, District Yadgir, Karnataka, India

ABSTRACT
The prognosis of tibial plateau fractures directly depends on four factors: degree of joint depression, extension and separation of the fracture line of the tibial condyles, degree of comminution and metaphyseal-diaphyseal dissociation, and integrity of the soft tissue envelope. All patients attending to Emergency and Orthopaedics Outpatients Clinic of a tertiary care hospital with tibial plateau fractures were screened for eligibility by clinico-radiological evaluation and informed consent was taken from eligible candidates and were randomized by Excel random number generation into two groups. Group A- Plate and screw and Group B- Hybrid ilizarov. In this study, functional outcome was assessed by WOMAC score questionnaire in the end of 6 months. P-value was found to be 0.612 which is >0.05, so there was no significant difference between the functional outcome in two groups. Similarly, in sub-category like pain, stiffness and physical function, there was no significant difference between two groups.

INTRODUCTION

The two most common methods for the classification of tibial plateau fractures are those of Schatzker and the AO Group. The Schatzker classification divides tibial plateau fractures into six distinct groups, distinguishing between pure shearing, pure depression and combinations of these two standards. The first three groups (I, II and III) are pure tibial plateau fractures that are usually associated with a low-energy mechanism[1]. Groups IV, V and VI are fracture-dislocations of the knee and are therefore more severe and associated with significant soft tissue damage. About 50% of tibial plateau fractures are associated with meniscal injuries, while ligament injuries can be found in up to 25% of cases. High energy injuries may also be associated with neurovascular injuries, compartment syndromes and communicating open wounds. The prognosis of tibial plateau fractures directly depends on four factors: degree of joint depression, extension and separation of the fracture line of the tibial condyles, degree of comminution and metaphyseal-diaphyseal dissociation and integrity of the soft tissue envelope. Bicondylartibial plateau fracture is due to high energy injures and often associated with soft tissue injury, a high risk of wound complications, difficulty in reduction and further sufficient fixation for stabilization is challenging[2]. There is no specific and proven treatment protocol yet. Most patients have significant residual dysfunction even after the completion of treatment. Treatment options include screws, an external fixator, hybrid external fixation limited internal fixation combined with a tensioned wire, classic dual buttress plates, a unilateral periarticular locking plate and hybrid dual plates (combination of locking plate and buttress plate)[3]. External fixators, combined with minimal ORIF offer high mechanical properties., however, pin tract problems are not to be underestimated, since the device has to remain in situ until fracture union[4]. Dual plate fixation of severe bicondylartibial plateau fractures is an excellent treatment option as it provides rigid fixation and allows early knee mobilization. Careful soft tissue handling and employing minimal invasive techniques minimize soft tissue complications. However, this procedure involves significant soft tissue stripping leading to unacceptably high incidence of infection, wound dehiscence and nonunion[5]. There is no definite protocol for treatment of tibial plateau fractures. Comparative study regarding different modalities especially fixation with plate and screws versus fixation with hybrid external fixator is needed. To our knowledge, no study in the literature directly compares the outcome of patients with tibial plateau fractures treated in the same institution with plate and screws and with hybrid external fixator. So we have done study on fixation with plate and screws versus fixation with external fixator (hybrid ilizarov) in treatment of tibial plateau fractures[6].

MATERIALS AND METHODS

Setting: Department of Orthopaedics.

Study Type: Prospective randomized controlled trial.

Research Hypothesis: There is no significant difference in functional outcome between the two techniques of fixation for tibial plateau fractures namely open reduction and internal fixation with plate and closed reduction and external fixation with hybrid ilizarov.

Sample Size: Based on a literature reported by Canadian Orthopedics Trauma Society, M±SD of flexion (range of motion) in between group open reduction and internalfixation and circular fixator were reported as (113±32) and (123±15) respectively.9 Considering the difference in mean σ=23.5 and pooled standard deviation δ=10, significance level α=5%, power β=80%, Zα=1.96 and Zβ =0.84

n= 2 (Z α + Zβ) 2 σ2/ δ2

= 2(1.96 + 0.84)2 (23.5)2 / (10)2

=86.5

=87(33)

Sample size is calculated to be 87 in each group with total sample size of 174. But based on previous medical record total number of eligible patients coming to OPD is 40. So in account that population growth rate of 10% and 10% patient not able to follow up, total sample size= 44+10%x 44=48.4 (approximately 48) i.e. 24 in each group.

Inclusion Criteria: All adult (>18 yrs) with Tibial Plateau Fractures Schatzker TYPE I to TYPE VI attending Department of Orthopaedics.

Exclusion Criteria:

- A pathologic fracture.
- A preexisting joint disease which interferes with rehabilitation.
- Open growth plates (age <18 yrs)., age >65 yrs.
- vascular injury requiring repair (gustilo grade-iiic fracture).
- Patient not fit for surgery not willing to provide consent.

Allocation: All patients attending to Emergency and Orthopaedics Outpatients Clinic of a tertiary care hospital with tibial plateau fractures were screened for eligibility by clinico- radiological evaluation and informed consent was taken from eligible candidates and were randomized by Excel random number generation into two groups.

Group A-Plate and screw

Group B-Hybrid ilizarov

Intervention:

- Patients with final diagnosis of Tibial Plateau Fracture presented to a tertiary care hospital Orthopaedics out Patients Clinic and Emergency were signed informed consent enrolled in the study.
- A detailed history regarding demographic profile, modes of injury, associated injuries and comorbidities were recorded in preset proforma.
- A through general physical and systemic examination was carried out to look for underlying exclusion criteria.
- X-ray knee in standard AP and Lateral view was taken.
- A prior informed and written consent were taken from each patient after explaining about the modes of plating, complications and possible outcomes.
- Preoperative and Post-operative Hb% were recorded.
- Prophylactic IV antibiotic as 2nd generation Cephalosporin with Aminoglycoside (Inj. Cefuroxime + Inj. Amikacin) were administered to both the groups.
- Surgery was performed under general or spinal anesthesia. Patient was set up in the supine position on the operating table, with traction applied.
- A tourniquet was used to diminish blood loss and deflated after no more than two hours.

Group A:

- In plating group anterolateral/anteromedial incision was made after painting and draping. Meticulous soft tissue dissection was done.
- One condyle was fixed with plate and other condyle with percutaneous CC screws or plate as per requirement.
- During the operation, the fracture reduction was visualized via an image intensifier.
- Intra-operative blood loss and operative time were noted.
- Post-operative check X-ray was taken on next day.
- Dressing opened after 48 hrs and physiotherapy was started soon as per feasibility. Post-operative fever and post-operative pain noted and looked for superficial infection.
- Patient discharged in few days depending upon the condition of the patient.

Group B:

- In hybrid ilizarov group patient will be treated in similar set up and criteria. After adequate traction and initial reduction, painting and draping was done.
- During the procedure, at least two ilizarov/olive wires will be applied into the proximal metaphyseal area of the tibia with more than 30'of angulation.
- Additional drop wires or oblique wires were used to reduce the fracture fragments.
- These wires were connected with 5/8 ilizarov ring of appropriate size and adequate amount of tensioning of wires were done and at least two schanz pins were applied distally and connected by connecting tubes.
- Stability of construct was confirmed and reduction confirmed in image intensifier.
- Post-operative check X-ray was taken on next day.
- Dressing was opened after 48 hrs and physiotherapy was started soon as per feasibility. Post-operative fever and post-operative pain were noted and observed for superficial infection.
- Patient was discharged after few days depending upon the condition of the patient.
- In both groups, patients were followed up on 14th post-operative day and suture was removed. Wound infection, knee ROM, pain, intra-articular step- off if any were also noted. Similarly, during 6 weeks, 3 and 6 months follow-up, wound infection, knee ROM, intra-articular stepping and varus/valgus tilt and hardware impingement if any noted.
- Non-weight bearing was continued till 6 weeks. Patients were followed every 6 weeks to assess status of union by X-ray and were allowed wt. bearing depending upon bony union.
- Knee ROM, union, malunion, hardware impingement and implant failure were observed and functional outcome was evaluated using WOMAC SCORE.
- Outcome was recorded on the basis of the following variables.
- Operation time-recorded from time of incision to time of closure.
- Blood loss-recorded by counting numbers of wet sponge and gauge piece and converted into milliliter.
- Hospitalisation period-from the date of admission of patient to date of discharge.
- Pain-assessed by using VAS scale.
- Physical function, stiffness and functional outcome-assessed by using WOMAC SCORE (The Western Ontario and McMaster Universities Osteoarthritis Index)
- Quality of Reduction-assessed by postoperative check x-ray taken in standard AP and Lateral view. According to previous clinical articles, Barei DP *et al*. malunion with malreduction or malalignment is defined as change of alignment.
- Intra-articular step-off over 2 mm.
- Angulation over 5° in AP or lateral view radiographs 3.
- Post-operative infection-observed during hospital stay and during regular follow up
- Union-Two criteria would be used to be sure about union on plain films: bridging callus

between fragments and obliteration of previous fracture gap.

RESULTS AND DISCUSSIONS

Table 1: Gustilo Anderson Grading of Fractures in Two Group

Grades of Fractures	Plate and screw n(%)	Hybrid ilizarovn(%)	Total	P-value
Close	17(66.66)	20(83.33)	37	N.A.
GG I	6(29.1)	3(12.5)	9	
GG II	1(4.1)	1(4.1)	2	
Total	24	24	48	

In this study, 66.66% and 83.33% patients had close fractures in plate and screw group and hybrid ilizarov group respectively whereas 29.1% and 12.5% patients had GG I fractures plate and screw group and hybrid ilizarov group. 4.1% patients had GG II fracture in plate and screw group and in hybrid ilizarov group. Above data shows most of the patients in both group had close fractures.

Table 2: Different Immediate Modalities of Treatment

Immediate treatment	Plate and screw n (%)	Hybrid ilizarov n (%)	Total	P-value
Slab	8(33.33)	11(45.83)	19	N.A.
BB splint	11(45.83)	8(33.33)	19	
Wound care	5(20.83)	5(20.83)	10	
Total	24	24	48	

In this study, 33.33% patients in in plate and screw group and 45.83% patient in hybrid ilizarov were treated with slab immediately, whereas 45.83% and 33.3% patients in plate and screw and hybrid ilizarov group respectively were splinted on BB splint because of gross swelling whereas 20.83% patients with wound in both groups managed with wound debridement in both groups.

Table 3: Range of Motion in Two Groups

Range of Motion	Group Plate and screw Mean±SD	Hybrid ilizarov Mean±SD
ROM -2 Wks	84.58°±6.58	87.92°±8.33
ROM-6 Wks	103.33°±8.68	105.00°±8.34
ROM-12 Wks	109.05°±6.24	111.36°±6.39
ROM- 6 months	111.43°±5.73	113°±5.67

In this study, p-value for range of motion at 2 weeks found to be 0.131 which is>0.05 which is statically not significant and on subsequent follow up, there was no significant difference in p-value. Range of motion in the end (6 months) in both group were comparable and there was no stiffness in any patient.

Table 4: Functional Outcome in Two Groups

Functional Outcome	Group Plate and Screw Mean±S.D (Range)	Hybrid Ilizarov Mean±S.D (Range)	P-value
WOMAC Score (WS) 0-96	44.21 ± 3.47 (38-55)	43.87 ± 2.90 (41-52)	0.612
Pain (WSP) 0-20	5.83 ± 1.55 (4-10)	5.88 ± 1.54 (4-8)	0.926
Stiffness (WSS) 0-8	4.71 ± 0.75 (4-6)	4.54 ± 0.72 (4-6)	0.437
Physical Function (WSSP)0-68	34.29± 2.75 (30-40)	33.79± 2.58 (32-40)	0.52

In this study, functional outcome was assessed by WOMAC score questionnaire in the end of 6 months. P-value was found to be 0.612 which is >0.05, so there was no significant difference between the functional outcome in two groups. Similarly, in sub-category like pain, stiffness and physical function, there was no significant difference between two groups. In this study, the final range of motion of 0-111° and 0-114° was found respectively in two groups with no statistical significance (p value-0.320). Stable fixation of complex tibial plateau fractures allows early range of motion exercise with favourable clinical results. Canadian orthopaedics trauma society reported similar range of motion among open reduction and internal fixation group and circular external fixator group (range 0-113° and 0-123° respectively)[7]. In this study one patient had nonunion (4.1%), which can be explained bymetaphyseal comminution and severe soft tissue compromise, no cases of refracture and Implant failure were observed whereas 4(16.6%) and 6 (25%) cases of hardware impingement in pate and screw group and hybrid ilizarov group respectively. Comparing the functional result in recent literature is complicated by different outcome measures and treatment techniques. WOMAC score was used as a measure for functional outcome and was no significant difference (p value-0.612) was found between two groups regarding total and sub group scores. Similar finding was found by Canadian Orthopaedics trauma society[7]. Naeem *et al.* did descriptive case series of hybrid ilizarov fixation for tibial plateau fractures and found good outcome with regards to outcome, infection, knee range of motion and union[8]. To achieve the most satisfactory outcome, a well-designed pre-operative surgical planning is required with minimal soft tissue injury complimented by proper physiotherapy.

CONCLUSION

There is no significant difference in short term functional outcome of high energy tibial plateau fractures fixed with open reduction and internal fixation with plate and screw and closed reduction and external fixation with hybrid Ilizarov.

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