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Open Reduction and Internal Fixation with Plate Versus Closed Reduction and Fixation with Hybrid Ilizarov in the Treatment of Tibial Plateau Fractures: Complications

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ABSTRACT

Treatment of tibial plateau fractures is difficult due to associated injuries, hence pre-operative planning is essential. Basic goal is to reconstruct the articular surface followed by achievement of full function of knee. Conservative treatment by traction, bracing and cast application rarely permits accurate reconstruction and reduction of fractures and not practical in presence of soft tissue compromise. Unilateral plating, screws, dual plating and external fixators are being used in treatment of bicondylar tibial plateau fractures with their own benefit and pitfall. Patients with final diagnosis of Tibial Plateau Fracture presented to 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 thorough general physical and systemic examination was carried out to look for underlying exclusion criteria. In this study, there were four cases (16.66%) of malunion in plate and screw group and 7 cases (29.1%) of malunion in hybrid ilizarov group as evident by intra-articular step off greater than 2 mm. In this study, there was single (4.1%) case of nonunion in plate and screw group whereas all the fractures were united in hybrid ilizarov group.

INTRODUCTION

Tibial plateau fractures have complicated intra-articular fracture pattern representing 1.2% of all fracture. In 1979, Schatzker *et al.*, introduced a classification of tibial plateau fracture that distinguished low energy split depression fractures from high energy bicondylar tibial plateau fractures (Schatzker type V and VI)^[1]. Radiographs, CT scan and MRI are the imaging modalities in diagnosis of tibial plateau fractures. CT scan is shown to be sensitive and specific in identifying ligament injuries and bony avulsion but MRI is necessary to detect meniscal injuries^[2]. Acceptability criteria of depression and widening is matter of controversy. Waddell *et al.* found that plateau depression or widening of >10 mm was usually tolerated. Honkonen found that 5 mm of widening and 3 mm of step off were well tolerated but medial side displacement or tilt should be avoided. Assessing and managing other intra-articular meniscal and ligament injuries that are frequently present is controversial. Many severe tibial plateau fractures have excellent outcomes after being treated surgically with techniques that do not routinely evaluate or repair meniscal injuries^[3]. Treatment of tibial plateau fractures is difficult due to associated injuries, hence pre-operative planning is essential. Basic goal is to reconstruct the articular surface followed by achievement of full function of knee. Conservative treatment by traction, bracing and cast application rarely permits accurate reconstruction and reduction of fractures and not practical in presence of soft tissue compromise. Unilateral plating, screws, dual plating and external fixators are being used in treatment of bicondylar tibial plateau fractures with their own benefit and pitfall^[4]. Mechanical strength of fixation of bicondylar tibial plateau fractures using internal and external fixation techniques showed weight-bearing mobilization of the patient may be undertaken earlier with more confidence by using the double plating or two-ring hybrid fixator rather than other less strong techniques but the choice on which of these two methods to use may depend on tissue viability and surgeon preference^[5,6].

MATERIALS AND METHODS

Study Type: Prospective randomized controlled trial.

Sample Size: Based on a literature reported by Canadian Orthopedics Trauma Society, $M \pm SD$ of flexion (range of motion) in between group open reduction and internal fixation and circular fixator were reported as (113 ± 32) and (123 ± 15) respectively. Considering the difference in mean $\sigma = 23.5$ and pooled standard deviation $\delta = 10$, significance level $\alpha = 5\%$, power $\beta = 80\%$, $Z\alpha = 1.96$ and $Z\beta = 0.84$.

$$n = 2 (Z\alpha + Z\beta)^2 \sigma^2 / \delta^2$$

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

$$= 86.5$$

$$= 87(33)$$

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 = $44 + 10\% \times 44 = 48.4$ (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.
- A vascular injury requiring repair (Gustilo Grade-III C 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 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 thorough 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.

RESULTS AND DISCUSSIONS

Table 1: Different Immediate Complications in Two Groups

Immediate complication	Plate and screw Plating n (%)	Hybrid ilizarov n (%)	Total	P-value
No	23(95.83)	23(95.83)	46	N.A.
CPN palsy	1(4.16)	1(4.16)	2	
Total	24	24	48	

There was single case of CPN palsy in plate and screw and hybrid ilizarov group which recovered spontaneously in subsequent follow up.

Table 2: Post-Operative Pain in Two Group

Post-operative pain	Plate and screw n (%)	Hybrid ilizarov n (%)	Total	P-value
Mild	0	0	0	0.556
Moderate	8(33.33)	11(45.83)	19	
Severe	16(66.66)	13(54.16)	29	

In this study, there is no significant difference in post-operative pain in two group (p-value=0.273) but severe pain was perceived by many patients in hybrid ilizarov group.

Table 3: Different Complications in Two Groups

Complication	Plate and screw n (%)	Hybrid ilizarov n (%)	Total	P-value
Malunion	4(16.66)	7(29.1)	11	22
Nonunion	1(4.1)	0	1	N.A
Hardware impingement	4(16.6)	6(25)	9	0.52

In this study, there were four cases (16.66%) of malunion in plate and screw group and 7 cases (29.1%) of malunion in hybrid ilizarov group as evident by intra-articular step off greater than 2 mm. In this study, there was single (4.1%) case of nonunion in plate and screw group whereas all the fractures were united in hybrid ilizarov group. In this study, 4 cases (16.6%) and 6 case (25%) had hardware impingement in plate and screw group and hybrid ilizarov group respectively.

Table 4: Infection Rate in Two Groups

Superficial infection	Plate and screw n (%)	Hybrid ilizarov n (%)	Total	P-value
Immediate postoperative	6(25)	3(12.5)	9	0.267
At 2 wks	6(25)	4(16.66)	10	0.477
At 6 wks	2(8.33)	10(41.6)	12	0.01
Deep Infection (At 6 wks)	1(12.5)	0	1	N.A

In this study, 6 case (25%) of superficial infection was seen in plate and screw group during immediate post-operative period and during 2 (25%) weeks follow up and 2 (8.33%) case of superficial infection was seen during 6 weeks follow up. 3 (12.5%) cases of superficial infection was seen in hybrid ilizarov group in immediate postoperative period and 4 (16.66) cases in 2 weeks follow up and 10 case (41.6%) in 6 weeks follow up. In this study, 1 case (12.5%) of deep infection was seen in plate and screw group at 6 weeks follow up.

Time duration of admission to operation was found to be 2-3 days in this study. No significant difference in hospital stay and operative time was noted (p=0.225, 0.063) and blood loss was significantly high in plate and screw group (p=0.001). Canadian orthopedics trauma society also found the similar result with nearly equal hospital stay, less blood loss and nearly equal operative time (p- Value: 0.024, 0.006, 0.229 respectively) between open reduction and internal fixation technique and ilizarov circular fixator application^[7]. In this study, superficial infection ranged from 21% and 8% in plate and screws group and from 12.5 and 41.6% in hybrid ilizarov group with pin tract infection being more common in hybrid ilizarov group. 1 case of deep infection was found in plate and screw group requiring serial debridement. In the study of Canadian Orthopedics trauma society deep infection was found in 18% in open reduction and internal fixation group and the number of unplanned repeated surgical intervention and their severity was greater in open reduction and internal fixation group compared with the circular fixator group (p=0.001)^[7]. Young and Barrack found 31.0% infection rate in Discussion Thesis 2016 Page 40 unilateral plating while the infection rate in dual plating was found to be 87.5%^[8]. But Cole *et al* and Barei *et al.*, found lower infection rate (4%, 8.4%) respectively^[9,10]. The incidence of wound infection appears to correlate with soft tissue compromise, amount of metal implant used, nutritional status of the patient and presence of chronic illness. In this study, malalignment was 17% and 29% in plate and screw group and hybrid ilizarov group respectively which is not statistically significant (p=0.22). Which is similar to finding of Canadian Orthopaedics trauma society (p=0.847)^[7]. Higgins *et al.*, found that dual plating allows less subsidence in bicondylar tibial plateau fractures. Literature suggests failure in restoring and maintaining alignment in about 8-10% of bicondylar tibial plateau fractures^[5]. Barei *et al.*, reported 10% incidence of immediate malalignment after dual plating and Jiang *et al.*, found significantly higher rate of malalignment and symptomatic hardware with unilateral plating^[11,12]. We assumed that malreduction may result from difficulties in gross evaluation of alignment and articular surface under intraoperative fluoroscopy.

CONCLUSION

- Tibial plateau fracture being high energy intra articular injury of knee joint is associated with higher rates of complication resulting from the trauma itself and also secondary to surgery.
- In this study, 6 case (25%) of superficial infection was seen in plate and screw group during immediate post-operative period and during 2 (25%) weeks follow up and 2 (8.33%) case of superficial infection was seen during 6 weeks follow up. 3 (12.5%) cases of superficial infection was seen in hybrid ilizarov group in immediate postoperative period and 4 (16.66) cases in 2

weeks follow up and 10 case (41.6%) in 6 weeks follow up.
Hybrid ilizarov fixation decreases soft tissue stripping, blood loss and infection rate.

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