A comparative study of treatment of bicondylar tibial plateau fractures using locked plating versus hybrid fixator

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Abstract— *Tibial plateau fractures present a wide spectrum of injuries with a range of fractures patterns involving varying degree of joint surface depression and displacement. This study was conducted to compare the outcomes of locked plating and hybrid fixator in management of tibial plateau fracture. This study observed that in plating group mean interval between surgery and partial weight bearing was 8.45 weeks and in hybrid group it was 11.14 weeks which was with significant difference (p=0.0006). Likewise in plating group mean interval between surgery and full weight bearing was 14.11 weeks whereas 17.82 weeks in hybrid group (p=0.001). In plating group mean time for radiological union was 20.9 weeks whereas it was 24.81 weeks in hybrid group (p=0.023). In this study plating group 14.28% had malunion whereas in hybrid fixator group it was in 31.42% of cases (p=0.087). Nonunion were in 5.71% in plating and 8.57% in hybrid group which was not found significant (p=0.642). In plating group mean Rasmussens score was 23.25 at 24 weeks follow up whereas it was 21.08 weeks in hybrid group which was found with significant (p=0.043) difference. This present study concluded that although distribution of malunion, nonunion cases and duration of hospital stay was without significant difference in plating and hybrid fixator group but partial weight bearing, full weight bearing, radiological union was earlier in plating group than hybrid fixator group. Rasmussens score of knee was higher in plating than hybrid fixator group. So plating is better than hybrid fixator method in treatment of tibial plateau fracture.*

Keywords: Tibial Plateau Fractures, Rasmussens Score, Hybrid Fixator, Locked Plating.

I. INTRODUCTION

With increasing industrialization and road traffic accident there has been a corresponding increase in the case of tibial plateau fractures constitute 1% of all fractures and 8% of fractures in the elderly. No age is exempted from fracture of condyles of tibia.[1] Tibial plateau fractures caused by a varus orvalgus force combined with axial loading.[2]

Tibial plateau fractures present a wide spectrum of injuries with a range of fractures patterns involving varying degree of joint surface depression and displacement.

Fractures of tibial plateau comprise a diverse group of fracture pattern that range in severity from minor injuries that have predictably excellent outcome after simple treatment to fractures at risk for limb threatening complications.

High energy tibial condyle fractures present multifaceted problems of difficulty of achieving accurate joint reconstruction. The management of tibial condyle fractures has remained controversial and

objectives of stable, pain free knee joint with a functional range of motion included most of the treatment modalities.

The goal of treatment is to achieve a stable, aligned congruous joint with painless restoration of motion and function. Non operative modalities like casts, brace or traction are complicated by inherent risks of poor function results and prolong hospital stay. So, operative management is better choice to have better results. Primary repair or reconstruction may prolong operating time thus increase the risk of infection.[3]

Locked plating by MIPO (minimally invasive plate osteosynthesis) is a modality of treatment for tibial plate fractures with minimal exposure of soft tissue. It improves healing rate by minimizing disruption of soft tissue (including periosteum) and preserving vascular supply at fracture site.

Hybrid fixator is a treatment modality for tibial plateau fracture, significant metaphyseal *communition* with or without diahyseal extension, severe metaphyseal and subchondral communution with very small periarticular fragment unsuitable for internal fixation, soft tissue problems like compartment syndrome, open fractures and severe soft tissue injury.

In this study an effort was made to compare locked plating and hybrid fixator in management of Bicondylar tibial plateau fracture.

II. METHODOLOGY

This comparative intervention study was conducted at Department of Orthopaedics, attached to S.M.S. Medical College, Jaipur (Rajasthan) in year 2017 to compare outcome in locked plating and hybrid fixator in management of Bicondylar tibial plateau fracture.

For this study skeletelly mature (age 18 years and above) closed tibial plateau fracture patients with Schatzker type V, VI complete articular fractures involving proximal tibia attended at Orthopaedics department were included. Out of these, patients with polytraumatize/pathological fractures and not fit or consented for surgery were excluded from study. Finally, 35 cases were selected for locked plating and 35 cases were selected for hybrid fixator.

All patients was evaluated clinically at the time of admission to elicit mode of injury, date of injury, previous history and any other associated medical or surgical illness .Vital parameters monitored and fluid and blood transfusion was given if required.

A careful physical examination of the knee and leg of a patient with a tibial plateau fracture was done to assess for associated injuries, indicate surgical versus nonsurgical treatment, to diagnose and avoid severe complications, and to determine optimal timing for surgical intervention.

Particular attention was given to compartment syndrome which is very common in such type of injury. Peripheral circulation was checked, attention was also given to any neurological deficit. If massive swelling develops a lower tibial pin was passed and traction was applied on bohler braun splint with continuous attention on peripheral circulation of involved limb.

Initial radiograph was including anterior- posterior and lateral views of involved knee taken. Computed tomography with 3D reconstructions was done to evaluating the degree of displacement.

In plating group, locked plating was done whereas in other group hybrid Fixator operation of knee was done.

Post operative rehabilitations were done in the form of isometric quadriceps exercise and knee mobilization from post op day one. The goal is full extension and 90 degree of flexion of knee joint as soon as possible. And partial weight bearing was done after 6-10 weeks and full weight bearing 10-20 weeks.

Results were assessed as per Rasmussens criteria[4]

Statistical analysis: Categorical data was expressed as proportion and difference in proportion was analyzed using Chi square test. Quantitative data was expressed as mean and standard deviation and the difference in mean between two groups was inferred using unpaired 't' test. Statistical significance was kept at $p<0.05$. All statistical analysis was done using Epi info version 7.2.1.0 software.

III. RESULTS

In each of group i.e. plating and Hybrid Fixator group 35 cases were included in the study. The youngest patient in this study was of 18 years and oldest patient was 62 of year. The mean age in the plating group was 37.57 year and in hybrid group was 38.62 year. In the plating group 33 male and 2 female and male-female ratio was 16.5:1. In hybrid group 32 male and 3 female and male-female ratio being 10.6: 1. In this series plating group right knee was involved in 19 paients (54.28%) and left knee was in 16 patients (45.71%) and in hybrid group right knee was involved 18 patients (51.42%) and left knee was in 17 patients (48.57%). In plating group frequency of type of fracture was Schatzkar type VI (57.14%) more common than type V (42.85%) and in hybrid group frequency was Schtzkar type VI (51.42%) is more common than type V (48.57%). Patients in plating group, was operated at a mean interval of 6.08 days and in hybrid group were operated at a mean interval of 6.31 days. The delay in operating time was due to impending compartment syndrome require settlement of soft tissue injuries, poor skin condition such as abrasion, blisters. On analysis it was observed that both groups were comparable ($p>0.05$) as per age, sex, side of knee, type of fracture and time lag in surgery. (Table 1)

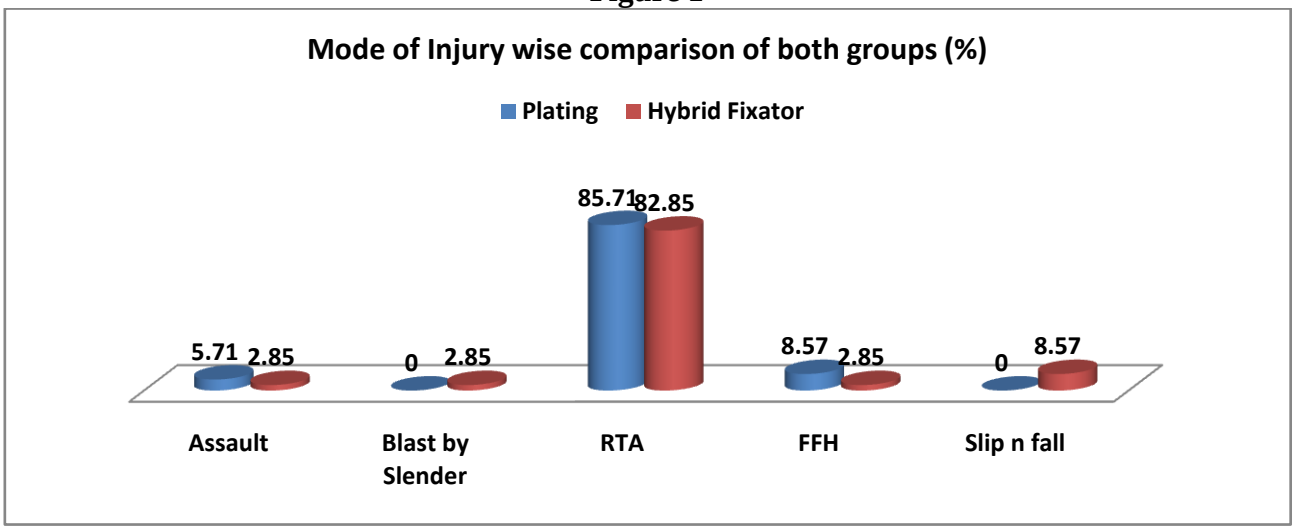
Table 1
Age and sex wise comparison of both groups

Variables		Plating Group (N=35)	Hybrid Fixator (N=35)	P Value LS
Age (Mean± SD in years)		37.42±9.17	38.62±12.06	0.641 NS
Sex	**Male:Female**	33:2	32:3	0.642 NS
Side	**Left:Right**	16:19	17:18	0.810 NS
Type of Fracture	**Schatzker type V:VI**	15:20	17:18	0.631 NS
Injury to Surgery Interval (in hrs)		6.085±4.01	6.31±4.17	0.816 NS

The most common mode of injury in both groups was road traffic accident in 85.71 in plating and 82.85% in hybrid fixator group. In plating it was followed with fall from height 8.57% and assault

5.71% cases. In hybrid group it was followed by slip n fall 8.57%, fall from height, blast injury and assault 2.85%. (Figure 1)

Figure 1



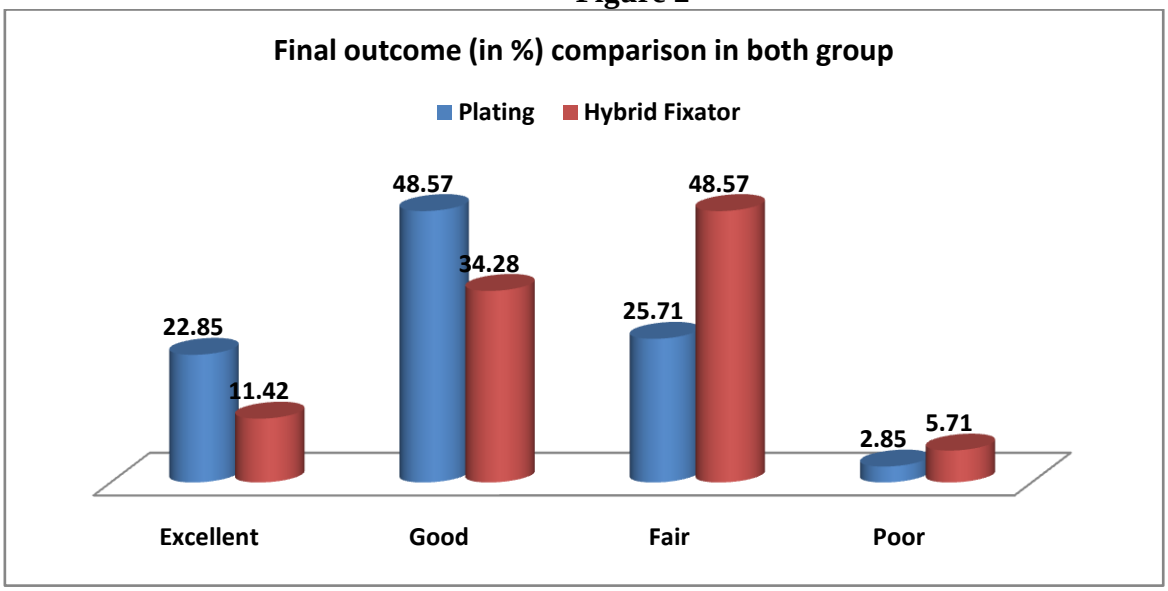
On comparison of both the groups, in plating group mean interval between surgery and partial weight bearing was 8.45 weeks and in hybrid group it was 11.14 weeks which was with significant difference (p=0.0006). Likewise in plating group mean interval between surgery and full weight bearing was 14.11 weeks whereas 17.82 weeks in hybrid group (p=0.001). In plating group mean time for radiological union was 20.9 weeks whereas it was 24.81 weeks in hybrid group (p=0.023). In this study plating group 14.28% had malunion whereas in hybrid fixator group it was in 31.42% of cases (p=0.087). Nonunion were in 5.71% in plating and 8.57% in hybrid group which was not found significant (p=0.642). In plating group mean Rasmussens score was 23.25 at 24 weeks follow up whereas it was 21.08 weeks in hybrid group which was found with significant (p=0.043) difference. In the plating group mean time of duration of hospital stay was 10.6 days whereas in hybrid group it was 13.34. In plating group mean range of motion was 117.42^0(range 90^0 to 140^0) at 24 week. Normal extension of knee was observed in 34 patients and extension lag of 5^0 was noted in one patient. In hybrid group, mean range of motion was 110.71^0 (90^0 to 140^0) at 24 week. Normal extension of knee was observed in 33 patients and extension lag was noted in 2 patients. (Table 2)

Table 2
Outcome variables wise comparison of both groups

Variables	Plating Group (N=35)	Hybrid Fixator (N=35)	P Value LS
Partial weight bearing (Mean±SD in Weeks)	8.45±2.52	11.14±3.67	<0.001 **S**
Complete weight bearing (Mean±SD in Weeks)	14.11±3.87	17.82±5.40	<0.001 **S**
Hospital Stay (Mean±SD in hrs)	10.6±5.11	13.34±9.23	0.128 NS
Radiological Union (Mean±SD in Weeks)	20.90±6.14	24.81±7.41	0.023 **S**
Malunion (Present:Absent)	5:30	11:24	0.087 NS
Nonunion (Present:Absent)	2:33	3:32	0.642 NS
Range of motion in degree at 24 week	117.42±15.50	110.71±17.07	0.089 NS
Rassmusen knee score	23.25±4.39	21.08±4.44	0.043 **S**

Patients were evaluated using Rasmussens criteria. In plating group 8 (22.85%) cases had excellent, 17 (48.57%) cases had good, 9 (25.71%) cases had fair and one (2.85%) case had poor outcome. The mean Rasmussens score was 23.25 at 24 weeks follow up. In hybrid group out of 35 cases 14 (11.42%) pateints had excellent, 34.28% patients had good, 48.57% patients had fair and 5.71% patients had poor follow up at 24 weeks. The mean score was 21.08 at 24 weeks follow up. (Figure 2)

Figure 2



IV. DISCUSSION

Ever since the earliest documentable description of tibial plateau fractures various treatment methods have evolved ranging from splinting, traction, cast bracing to open reduction and internal fixation with each methods having its merit and demerits. The ideal out come after a tibial plateau fracture is a stable, pain free, non osteoarthritis knee with a functional range of motion. There is a universal agreement that accurate restoration of joint surface, stable fixation and early knee motion are equally important. To overcome the demerits of both the operative and non operative philoshophies and to combine the beneficial attributes of these, minimally invasive techniques are being developed and utilized.

In this study, in plating group mean interval between surgery and partial weight bearing 8.45 weeks and hybrid fixator mean interval between surgery and partial weight bearing was 9.92 weeks. Early weight bearing stimulates fracture healing by axial micro motion without shear and allows retention of muscular strength. Causes of delayed partial weight bearing were mainly due to other associated bony injuries which require prolonged non weight bearing. In Sangwan SS et al[5] series (2002) average time gap between operation and partial weight bearing was 8.92 weeks . In Zahid et al[6] series (2010) partial weight bearing was started at 12 weeks.

In plating group mean interval between surgery and full weight bearing was 14.11 weeks and in hybrid group mean interval between surgery and full weight bearing was 17.82 weeks. In Dendrinos GK et al[7] series (1996) patients were allowed complete weight bearing at a mean of 14.4 weeks. In Sangwan SS et al[5] series (2002) patients were allowed complete weight bearing with an average of 13.12 weeks. In Kataria H et al[8] series (2007) the mean interval between surgery and full weight bearing was 3.7 months or approximate 16 weeks. In Zahid M et al[6] series (2010) the mean interval between the surgery and full weight bearing was 16 weeks.

The average duration of hospital stay was in plating group was 10.6 days and in hybrid group 13.34 days. In Sangwan SS et al[5] series (2002) the average duration of hospitalization was 6 days. In Kataria et al[8]. In Kataria et al[8] series (2007) the mean hospital stay was 9 days. In Zahid et al[6] series (2010) the mean hospital stay was 13 days.

In this study the complication noted was superficial infection in 3 cases in plating group (8.57%) and 5 cases in hybrid group(14.28%). These infection were superficial or limited to the soft tissue and did not extend to the bone. None of the patients required hospital admission. There were treated with oral antibiotic and local pin care dressing. All pin track infections healed without requiring wire or half pin removal that could compromise frames stability. Less incidence of infection was due to aseptic techniques, minimum soft tissue handling , small incision and minimum duration of surgery. In Kataria et al[8] (2007) series pin track and superficial infection was noted in 13.15% cases. In Zahid et al[6] series pin track and superficial infection was noted in 23.80% of cases which was higher to our series. Although superficial pin track infection was noted in our series cause of which can be explained because of low education level and rural background leads to improper care of pins. No case of deep vein thrombosis or pulmonary embolism was observed as the patients were mobilized early, in contrast to treatment by traction method. In Dendrinos GK et al[7] series (1994) eight patients had a deep vein thrombosis and four of these developed pulmonary embolism. There was no case of Peroneal nerve palsy was observed in our series as care was taken during surgery for placement of k-wires. All proximal tibial hold K-wires was placed anterior to fibula bone to prevent injury to peroneal nerve. In Kataria et al[8] series (2007) four case of post op peroneal nerve palsy was observed. There was no case of Osteomyelitis, myositis ossifications. None had symptoms relevant to instability or meniscal abnormality. In Sangwan SS et al[5] series (2002) two cases show instability of knee, but none had symptoms relevant to instability or meniscal abnormality. In Kataria et al[8] series (2007) although varus or valgus instability was noted in 10 patients, none of them complained of functional instability. In George C Babis, Dimitrios S Evangelopoulos (2011)[9] noted deep vein thrombosis was one patient (3%) and were 3 pin track infections(9.1%). In Zahid et al[6] series (2010) varus or valgus instability was noted in 5 patients, none of them complained of functional instability. This may be related to the fact that the patient's bone has absorbed most of the energy that would have been directed at these soft tissue elements. Furthermore, periarticular fibrosis after soft tissue injuries around the knee may be responsible for the absence of symptoms relevant to instability.

In this series patients were evaluated using Rasmussens criteria. In plating group 8 cases had excellent, 17 cases had good, 9 cases had fair and one case had poor follow up. The mean score was 23.25 at 24 weeks follow up.

In hybrid group out of 35 cases, 4 had excellent and 12 patients had good and 17 patients had fair and 2 patients had poor follow up at 24 weeks. The mean score was 21.08 at 24 weeks follow up. In Sangwan SS et al[5] series (2002) final results as per Rasmmusens criteria were excellent in 12, good 11, fair 2 and no poor result. Final end result was satisfactory in 23 (92%) cases. In Kataria et al[8] series (2007) the mean Rasmussens functional score was 26(range 17-30); excellent in 19; good in 17; and fair in 2. And the mean Rasmmusens radiological score was 14(range 10-18): excellent in 6, good in 26, fair in 6 patients. 36 out or 38 could walk normally outdoors for at least one hour. The remaining two described decreased walking capacity (about half an hour), one of them needed to change his occupation. In Zahid et al[6] series (2010) 19 of the 21 patients were able to carry out the task which were associated with their

pre-injury occupation. The remaining 2 had to change their occupation. In George etall (2011),[9] excellent in 18 patients (55%), good in 10 patients (30%), fair in 4 patients(12%) and poor in 1(3%).

In plating group, mean range of motion was117.42^0 (range 90^0 to 140^0) at 24 week. Normal extension of knee was observed in 34 patients and extension lag of 5^0 was noted in one patient. In hybrid group mean range of motion 110.71^0 (90^0 to 140^0) at 24 week. Normal extension of knee was observed in 33 patients and extension lag was noted in 2 patients. In Dendron's GK et al[7] series (1997) 13 patients achieved full extension and 11 had an extension lag of less than 6^0. 3 had extension lag of 6-10^0 and 4 more than 10^0. 17 patients achieved flexion of more than 110^0 and 5 of these were able to flex the knee to more than 130^0. In Sangwan SS et al[5] series (2002) most of the patients (60%) had 120^0 or more range of motion and one patient had less than 90^0 range of motion. Average range of motion was 107.8^0. Normal extension of knee was observed in 21 patients and lack of extension (5-10^0) was there in 4 patients. In Kataria et al[8] series (2007) the mean range of knee movement was 2^0 of extension to 134^0 of flexion. In Zahid et al[6] series (2010) the mean range of knee flexion was 130^0(range 100-140^0). The normal extension of knee was observed in 16 patients, and extensor lag of 5-10^0 was noted in 5 patients. Full range of motion is essential in an Indian to allow him to squatting. Early mobilization encourages recovery of knee movement and restoration of muscle strength. The injured limb is therefore rehabilitated to its former physiological state soon after fracture. In George et al (2011) [9] at the one year follow up range of motion averaged 115^0 of flexion (range 75^0 to 125^0) and 5^0 lack of extension (range 0^0-8^0).

V. CONCLUSION

This present study concluded that although distribution of malunion, nonunion cases and duration of hospital stay was without significant difference in plating and hybrid fixator group but partial weight bearing, full weight bearing, radiological union was earlier in plating group that hybrid fixator group. Rasmussens score of knee was higher in plating than hybrid fixator group. So plating is better than hybrid fixator method in treatment of tibial fracture.

CONFLICT OF INTEREST

None declared till now.

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