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Comparison of Functional and Radiological Outcome in Tibial Plateau Fractures Treated with Locking vs Nonlocking Plate

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ABSTRACT

Background: The tibial condyle fractures are one of the commonest intraarticular fractures. The majority of tibial condyle fractures are secondary to high speed velocity accidents and fall from height[1] where fractures results from direct axial compression, usually with a valgus (more common) or varus moment an indirect shear forces. This study is to compare the functional outcome in tibial plateau fractures treated with Locking and Non-locking Plate.

Methods: The study included 40 patients having age between 18-70 years who receive operative treatment of a closed fracture for Tibial Plateau Fractures. The patients were then followed up at 6 weeks, 3 months and 6 months, during which time the anatomic and functional evaluation was done using the Modified Rasmussen clinical and radiological grading system.

Results: In our study, the majority of the fractures were found to be of Type 2(35 %) and equal no of Type 1 and Type 3 fractures (17.5%) of Schatzker Classification. Tibial plateau fractures are more commonly seen in the active productive age group (31-50 years). In our series majority of patients were males. The ratio being males: females - 4:1. Mode of Injury is by Road Traffic Accidents (85 %) and fall (15%). Overall Rasmussen score in group 1 is 25.05 and in group 2 is 24.85 at 6 months follow up.

Conclusion: Both locking and non locking plates provided high union rates, acceptable complications rates as well as satisfactory clinical outcome. The functional and radiological outcome of locking and non locking plates were comparable and no statistical difference was found between the groups ($p > 0.05$).

KEYWORDS- LCP -Locking Compression Plate, LISS -Less Invasive Stabilizing System, POP - Plaster of Paris, ROM-Range of motion, MIPO-Minimally Invasive Plate Osteosynthesis, ORIF-Open Reduction and Internal Fixation.

I. INTRODUCTION

The luxuries of our life in the present time is at the cost of rapidly increasing industrialization, urbanization and mechanisation which directly or indirectly have become responsible for increase in high energy trauma. The crowed cities, irregular traffic arrangement, fast moving vehicles are the most important contributory factors causing bony injuries, particularly polytrauma, comminuted fractures and the soft tissue injury. Tibial plateau fracture is one of them.

Fractures of tibial condyles were brought into prominence in **1929** by the papers of **cotton F.J. Berg R. in Boston, and cubbins W.R., Seiffert G. and coneley A.H., from chicago – mone** calling them as **fender fracture** and other as **bumper fracture** because they were often caused by **"automobile in contact with the jay walking citizens."**

The tibial condyle fractures are one of the commonest intraarticular fractures. The majority of tibial condyle fractures are secondary to high speed velocity accidents and fall from height[1] where fractures results from direct axial compression, usually with a valgus (more common) or varus moment an indirect shear forces.[2] Older patients with osteopenic bone are more likely to sustain depression type fracture because their subchondral bone is less likely to resist axial directed loads.[3]

The emphasis in treating displaced fractures is an anatomical restoration of articular surface, repair of soft tissue injuries and rigid internal fixation to obtain a stable painless knee joint with normal range of motion controlled by well functioning muscles.[4]

Initially, minimally invasive plate osteosynthesis was performed with standard plates. But this was difficult as conventional plates needed to be accurately contoured to achieve good fixation, osteoporosis also posed the same problem of poor fixation with conventional plates.[5]

As more and more concepts about biological fixation become clearer the innovation

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of plates progressed lead to development of less invasive stabilizing system (LISS).
Research to combine these two methods has led to the development of the AO locking compression plate (LCP).[6]
This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven to worth in complex fracture situations and in osteoporosis.
This study is to compare the Functional Outcome in Tibial Plateau Fractures treated with Locking and Non locking Plate.

II. AIM

To compare the Functional Outcome in Tibial Plateau Fractures treated with Locking vs Non Locking Plates.

III. MATERIAL AND METHODS

This study was carried out in a tertiary care hospital. The study included 40 patients having age between 18-70 years who receive operative treatment of a closed fracture for Tibial Plateau Fractures.

Inclusion Criteria:

- Patients with Tibial Plateau Fractures of age 18-70yrs, both male & female
- Patients willing for treatment and given informed written consent.
- Closed Proximal Tibial Fractures.
- Patients even with co morbid diseases like diabetes mellitus, hypertension, asthma, epilepsy and other medical conditions having closed Proximal Tibial Fractures.
- Osteoporotic fractures.

Exclusion Criteria:

- Patients with pathological fractures of proximal tibial fractures other than osteoporosis.
- Patients below 18 years of age.
- Patients not willing for treatment.
- Patients managed conservatively for other medical reasons.
- Tibial Plateau fractures with neurovascular deficit.
- Non union and Delayed union
- Compound fractures of proximal tibia.
- Pregnancy.
- Peri-prosthetic fractures.

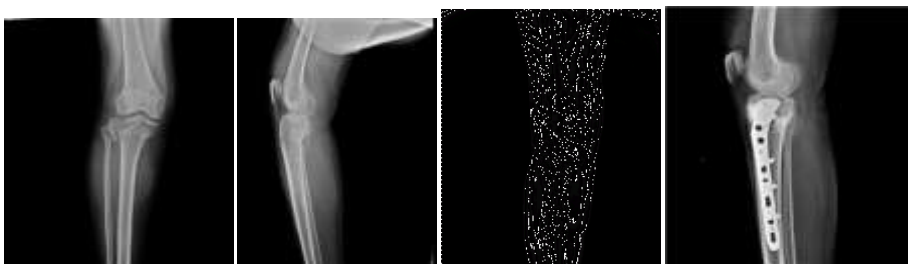
Methodology:

After Institutional Ethical committee approval and written informed consent from patients and their relatives for the procedure, the study was conducted in all the adult patients (18-70years) who were to receive operative treatment of a closed fracture for Tibial Plateau Fractures at our hospital in the period of 1 year. All the cases were diagnosed, treated and followed according to prescribed proforma.

Once the patient was admitted, x-rays were taken (AP and lateral), posterior splint/POP slab given for support and analgesics and anti-inflammatory drugs were given. All the associated injuries were treated accordingly. Type of fracture was decided according to SCHATZKER CLASSIFICATION.

The orthopaedic surgeons performed the operation based on their expertise or their preference with regard to fixation (Locking Vs Non locking Plates) and two groups will be assigned.
1. Group one (twenty patients) is treated with Locking Plate(Figure 1) while
2. Group two (twenty patients) is treated with Non Locking Plate(Figure 2).
FOLLOW UP:
6 weeks, 3 months, 6 months.

Based on the clinical and radiological signs of union patients were allowed partial weight bearing and gradually progressed to full weight bearing. The patients were then followed up at 6 months, during which time the anatomic and functional evaluation was done using the **Modified Rasmussen clinical and radiological grading system.**



(b)

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(d) (e) (f)

Figure 1: Locking Plate fixation and Outcome

(b) (c) (d)

Figure 2: Non-Locking plate fixation and outcome

Statistical Method:

All the data will be selected, and then analyzed with appropriate statistical tools.

Data will be presented as mean with standard deviation or proportions as appropriate.

Mean, standard deviation, would be calculated and following statistical significance tests would be applied.

Mean ± standard among the demographic data age, etc were analyzed by using

" test of significance for single mean "or |t|- TEST .

Incidence of complications were analyzed by "chi – square test" and " | t| – test "

Analysis of variance (ANOVA) was used for comparing pain score , walking capacity , extension lag , range of motion , stability , etc .

p- value was found by obtaining the "chi-square " value and degree of freedom (d.f.) from the standard statistical table .

Finally the calculated value was compared with the tabulated value at particular degree of freedom and finds the level of significance.

A "p-value" <0.05 was taken as significant.

Scoring System

Modified Rasmussen Criteria for Clinical Assessment Score[07]

1) Pain:

a. No pain – 6
b. Occasional pain – 5
c. Stabbing pain in certain position, moderate pain – 4
d. Severe pain, constant pain around knee after activity – 2
e. Rest Pain – 0

2) Walking capacity

a. Normal walking capacity in relation to age – 6
b. Walking capacity out doors for atleast one hour – 4
c. Walking capacity out door > 15 minutes – 2
d. Walking capacity – walking indoor only – 1
e. Wheel chair bound / bed ridden – 0

3) Extension of leg (extensor lag)

a. Normal extension – 6
b. Lack of extension (0-100) – 4
c. Lack of extension (> 100) – 2

4) Range of motion

a. At least 1400– 6
b. At least 1200 – 5
c. At least 900 – 4
d. At least 600 – 2
e. At least 300 – 1
f. 00 – 0

5) Stability

a. Normal in extension and 200 flexion – 6
b. Abnormal in 200 flexion – 5
c. Unstable in extension (> 100) – 4
d. Unstable in extension (> 100) – 2

Maximum Score - 30
Excellent 28-30
Good 24-27
Fair 20-23
Poor <20

Modified Rasmussen criteria for radiological assessment

1. Articular depressions :

None 3
< 5 mm 2
6-10 mm 1

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>10 mm 0

2. Condylar widening

None 3
<5 mm 2
6-10 mm 1
>10 mm 0

3. Valgus varus angulation

None 3
<10° 2
10°-20° 1
>20° 0

4. Osteoarthrosis

None/No progress 1
Progression by 1 grade 0
Progression by >1 grade -1

Excellent 9-10
Good 7-8
Fair 5-6
Poor <5.

IV. RESULTS AND DISCUSSION:

Table no. :- 01

Overall results of functional outcome among the patients

Results	Locking			Non locking		
	6 w	3 m	6 m	6 w	3 m	6 m
Excellent (28 – 30)	**0**	**0**	**9**	**0**	**0**	**9**
Good (24 – 27)	**2**	**4**	**5**	**0**	**5**	**3**
Fair (20 – 23)	**6**	**10**	**3**	**11**	**10**	**4**
Poor (< 20)	**12**	**6**	**3**	**9**	**5**	**4**

For Test of Significance , Here we use "Analysis of Variance (ANOVA) Or F - Test " Here , at 95% confidence limit ,with degree of freedom 1 d.f. across (→) and 38 d.f. vertically (↓) at 5% level of significance , when the computed F – ratio is less than the tabulated F – ratio = 4.05 } Then, their were Statistically no significant difference among the groups according to given pain score , with p - value { p > 0.05 } .

Duration	F_{cal}	F_{tab}	P- value	Remark
After 6week	**0.046**	**4.05**	**p>0.05**	**Not significant**
After 3 month	**0.140**	**4.05**	**p>0.05**	**Not significant**
After 6 month	**0.016**	**4.05**	**p>0.05**	**Not significant**

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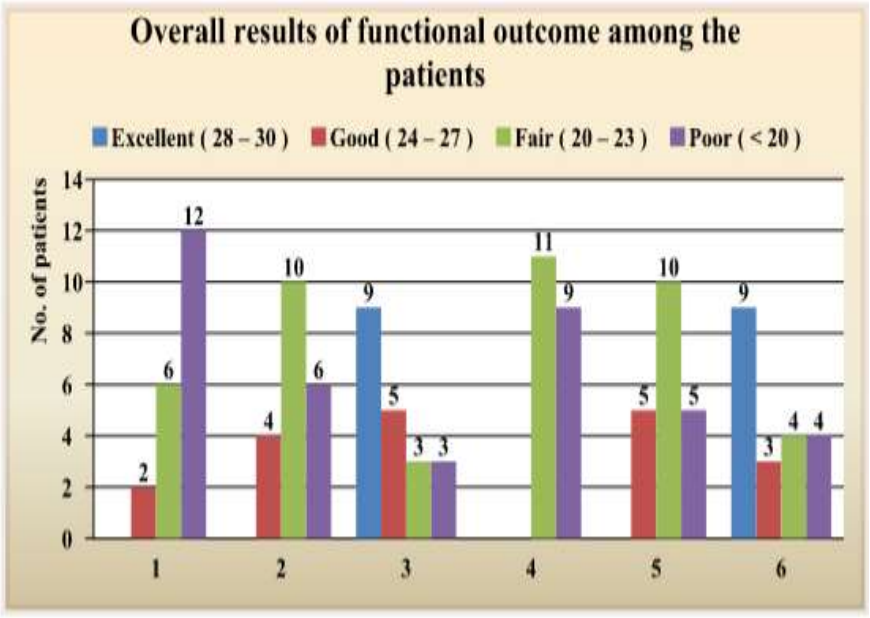

Graph-01: Functional outcome

Table no. :- 02
Overall results of radiological outcome among the patients

Results	Locking			Non locking		
	6 w	3 m	6 m	6 w	3 m	6 m
Excellent (9 – 10)	17	17	17	15	15	15
Good (7 – 8)	1	1	1	2	2	2
Fair (5 – 6)	2	2	2	2	2	2
Poor (< 5)	0	0	0	1	1	1

For Test of Significance , Here we use "Analysis of Variance (ANOVA) Or F - Test " Here , at 95% confidence limit ,with degree of freedom 1 d.f. across (→) and 38 d.f. vertically (↓) at 5% level of significance , when the computed F – ratio is less than the tabulated F – ratio = 4.05 } Then, their were Statistically no significant difference among the groups according to given pain score , with p - value { p > 0.05 } .

Duration	F_{cal}	F_{tab}	P- value	Remark
After 6 week	0.351	4.05	p>0.05	Not significant
After 3 month	0.637	4.05	p>0.05	Not significant
After 6 month	0.816	4.05	p>0.05	Not significant

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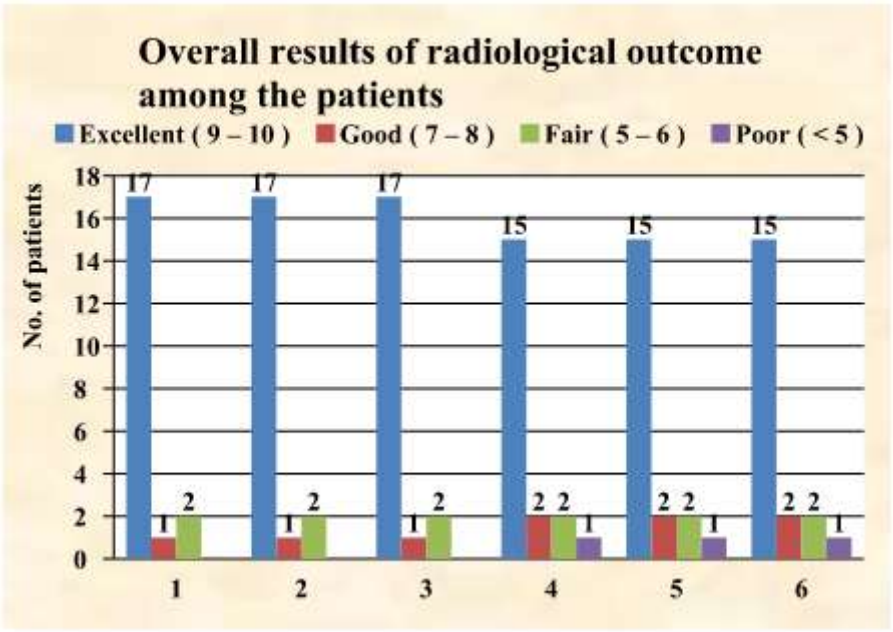

Graph-02: Radiological Outcome

Overall **Functional Outcome** based on **Rasmussen Clinical Score** in

Table no :03

	Group 1	**Group 2**
Excellent	9 patients (45%)	9 patients (45%)
Good	5 patients (25%)	3 patients (15%)
Fair	3 patients (15%)	4 patients (20%)
Poor	3 patients (15%)	4 patients (20%)

Overall **Radiological** Outcome based on **Rasmussen Radiological Score**

Table no : 04

	Group 1	**Group 2**
Excellent	17 patients (85%)	15 patients (75%)
Good	1 patient (5%)	2 patients (10%)
Fair	2 patients (10%)	2 patients (10%)
Poor	Nil	1 patient (5%)

	Group 1	Group 2
Overall Rasmussen score	25.05	24.85

Tibial plateau fractures, one of the commonest intra articular fractures, occurring as a result of RTA, fall from height, violence, etc.

The management of tibial plateau fracture has always been a subject of debate because of their variety and complexity. Any fracture around the joint (especially weight bearing knee joint in the lower limb) is of paramount importance as it would result in significant morbidity and quality of life may be affected. High energy intraarticular fractures of the tibial plateau causes on going management problems and remains challenging for orthopedic surgeons even today.

Aim of our study is to compare the Functional Outcome in Tibial Plateau fractures treated with locking and nonlocking plates. This series we had studied 40 cases of tibial plateau fractures treated with Locking and Non Locking Plate. In our study, the majority of the fractures were found to be of **Type 2(35 %)** and equal no of **Type 1** and **Type 3 fractures (17.5%)** of **Schatzker Classification**.

The analysis of the results were made in terms of age of the patient, sex distribution, occupation, mode of injury, side of fracture, analysis of the types, modalities of treatment, complications associated injuries, Functional Outcome and Radiological Outcome. Tibial plateau fractures are more commonly seen in the active productive age group (31-50 years).

In our series majority of patient were males. The ratio being males: females - 4:1, which corresponds to most of the series. This can be attributed to more activities.

In our study, there was right sided predominance, **Rt : Lt = 3:2(24:16).**

Occupationally tibial plateau fractures were seen in people with high level of activity, movement and travel.

Mode of Injury is by Road Traffic Accidents (85 %) and Fall (15%) in our study.

Overall Rasmussen score in group 1 is 25.05 and in group 2 is 24.85 at 6 months follow up.

Based on our study in 40 patients with 20 patients in each group when clinical parameters like Pain Relief, Stability of Knee Joint, Walking Capacity, Extensor lag, Range of Motion and Radiological Parameters like Articular Depression, Condylar Widening, Varus Valgus Angulation, Osteoarthrosis were compared at 6 weeks, 3 months and 6 months, the results were statistically comparable ($p > 0.05$).

However in one patient in Nonlocking Plate Group developed pain, had decreased ROM, decreased walking Capacity and radiologically articular depression and Condylar widening was seen at the end of 6 months. But on this finding, no particular recommendation about superiority of any modality of treatment can be made in the absence of Statistical Significance.

Studies having the similar outcome that the results in two groups locking and non locking plate are comparable are done by

R. Jiang et al. [08] conducted a prospective study in Eighty-four patients with bicondylar tibial plateau fractures were treated with plate fixation by either locked plate (Less Invasive Stabilization System, LISS) or classic double plates (DP). In conclusion, LISS provides an alternative treatment for bicondylar tibial plateau fractures, but it may not replace the conventional two-incision double plating technique as the standard of care.

MH lee et al [09] conducted a retrospective study in 76 patients compared post-operative results and functional outcomes of tibial plateau fractures treated with non-locking and locking plate fixation. The locking plate cohort had some operative advantage and showed less ongoing subsidence for malaligned cases. There was no significant difference in functional outcomes.

Littlechild et al.[10] also noticed that there was no definite advantage associated with the use of locked plating for high-energy tibial plateau fractures.

However there are few studies having better results with the use of locking plates like **Stannard and colleagues[11]** who collected data from a series of 39 tibial plateau fractures, all of which healed without further intervention and with only two superficial wound infections as complications.

Krupp et al.[12] reported the results of 42 consecutive tibial plateau fractures with91% union, 9% malalignment, and 4% infection rate.

Biggi [13] discovered that internal fixation with locking plates, following the principles of minimally invasive percutaneous osteosynthesis, could provide satisfactory fracture reduction with good results regarding the midterm clinical outcome.

V. CONCLUSION:

- Both locking and non locking plates provided high union rates, acceptable complications rates as well as satisfactory clinical outcome.
- The functional and radiological outcome of locking and non locking plates were comparable
- No statistical difference was found between the groups ($p > 0.05$).

Data Availability:

The data used to support the findings of this study are included within this article.

Conflicts of Interest:

The authors declare that they have no conflicts of interest.

Funding Statement:

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