Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(3), 962-968 | ISSN:2251-6727

Functional Outcome of Fractures of the Tibial Condyle Treated with Open Reduction and Internal Fixation

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(Received: 07 January 2024 Revised: 12 February 2024 Accepted: 06 March 2024)

KEYWORDS
tibial condyle fractures, open reduction and internal fixation, functional outcome.

ABSTRACT

Background: Tibial condyle fractures are intra articular fractures and hence displaced fractures can give poor functional outcome if not treated properly. This is a prospective Observational study to assess the functional outcome of tibial condyle fractures following Open reduction and internal fixation.

Methods: 24 patients who underwent Open Reduction and Internal Fixation of Tibial condyle fractures were followed up during immediate post op period and at 6 weeks, 3 months and 6 months. Functional outcome was assessed using American Knee Society Score and results were analysed statistically.

Results: Majority of patients in this study group were from 40-50 years with mean age 46. 20.8 cases were Schatzker type 2, 12.55 were type 3, 8.3% were type 4, 16.7% were type 5, 41.7% were type 6. Knee Society Score of patients were excellent in 41.7%, good in 50% and fair in 8.3% cases. Patients with higher grade of injury had lesser knee society score. Patients with persistent osseous depression and higher grade of valgus deformity had poor outcome. Patients who were started on knee mobilization earlier achieved good ROM earlier.

Conclusion: Open reduction and internal fixation with plates and screws is a good method for treating tibial condyle fractures even in high velocity injuries. Bicondylar fractures can be effectively fixed with single plate. Post-operative wound infection is a major problem in tibial condyle fractures following surgery.

Introduction:

Tibial plateau is one of the most critical load bearing areas in the human body. With the ever-increasing number of road traffic accidents, fractures of the tibial condyle have become very common. Non displaced and stable fractures are best treated non operatively.[1,2]Treatment methods proposed for fractures of the tibial condyle include extensile exposure and reconstruction of the joint surface with plate and screw fixation, arthroscopy or limited arthrotomy and percutaneous screw fixation or external fixation with pin or wire fixators, closed manipulation and casting with early motion.[3] Newer plating techniques are capable of fixation with less iatrogenic soft tissue dissection and employ minimally invasive approaches. Depressed articular segments cannot be reduced by ligamentotaxis alone.[4] These require elevation through a cortical window, bone grafting and fixation with a buttress plate.

The most severe complication that occurs with operative treatment of tibial plateau is infection either superficial or deep. Pin tract infection can occur in cases treated initially by external fixators. Spread of infection into the joint is also possible. Skin sloughing can occur due to poor surgical timing and improper soft tissue techniques with extensive osseous devitalization and the use of implants over both condyles.[5,6] Thromboembolic phenomenon can occur following operative treatment of tibial condyle fractures. Late

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(3), 962-968 | ISSN:2251-6727

complications include painful hardware, loss of fixation, posttraumatic arthritis and malunion.[7]
In this study we did serial follow up of the patients undergoing open reduction and internal fixation of fractures of the tibial condyle for a period 6 months at 6 weeks, 3 months and 6 months. Patients were looked for development of any complications and Knee Society Score was assessed at each visit.

Materials and methods
It was a prospective observational study in which data was collected from patients who underwent open reduction and internal fixation of fractures of the tibial condyle. Sample size was calculated as 24. Study duration was from 1st January 2021 to 31st December 2023 (24 months). All cases of tibial condyle fractures, closed and Gustilo Anderson Type 1 and 2 open fractures, in adults aged above 20 years, both males and females, treated by open reduction and internal fixation with plate and screws are included in this study. Tibial condyle fractures treated conservatively, treated by screw fixation, ilizarov fixators and other methods are excluded from this study. Type 3 open fractures, those associated with other fractures of lower limb, pelvis or spine and cases without sufficient post-operative information and those lost to follow up are excluded from this study.
All cases in this series were done through an anterolateral approach in most of the cases. In medial condyle fractures and two of the type 5 fractures, posteromedial approach was done. All the cases were done under tourniquets control. All fractures in this series were fixed with a single implant. Reduction of fractures were attained by direct method. Segments of the articular surface that remained depressed following attempted indirect reduction or in a pure depression fracture, a cortical window was made in the metaphysis, the site of which depends on the depression's location. Post operative protocols were different in different units. All patients with closed fractures were given three doses of antibiotics, one dose one hour before surgery and two doses post operatively. In open fractures, i.v. antibiotics were given for 5 days. Deep venous thrombosis prophylaxis was given to all patients. Patients were allowed to sit up in bed on the first post operative day and static quadriceps exercises were started. Non weight bearing ambulation with walker or crutches was started on the first or second post operative day. Some patients were started on active knee mobilization from the first day itself while in some patients it was started after suture removal. Sutures were removed after 12-14 days. Patients were advised active ROM exercises and quadriceps strengthening exercises. Weight bearing was started after 12 weeks.
All the patients were followed up at 6 weeks, 3 months and 6 months. Functional outcome was assessed based on different criterias which included pain, presence of gross swelling, status of ambulation, any post-operative complications and Knee Society Score.

Statistical Analysis-
The statistical analysis was performed using SPSS for windows version 22.0 software (Mac, and Linux). The findings were present in number and percentage analyzed by frequency, percent. Wilcoxon signed rank test was used to find the association among variables. The critical value of P indicating the probability of significant difference was taken as <0.05 for comparison.

Results-

Table 1- Gender and Age wise distribution of study participants

Gender	Frequency	Percentage
Female	6	25.0
Male	18	75.0
Total	24	100.0

As per table 1 the study was male preponderance and comprises 75% of study participant. Females were 25%. The most common age group was 41-50 years shows 29%. Sidewise distribution of Tibial condyle fractures shows left side was most common 58.3% were as right side was 41.7%. Most of the fractures are closed (91.7%) and most common mode of injury is RTA (83.3%).

Table 2- Distribution of Surgical Approach and Start of knee mobilization

SurgicalApproach	Frequency	Percent
Anterolateral	20	83.3
Posteromedial	4	16.7
Total	24	100.0

As per table 2 the most common surgical approach is anterolateral done in 83.3% of study participants and start of knee mobilization after surgery is mostly seen in 2 weeks for about 58% of cases.

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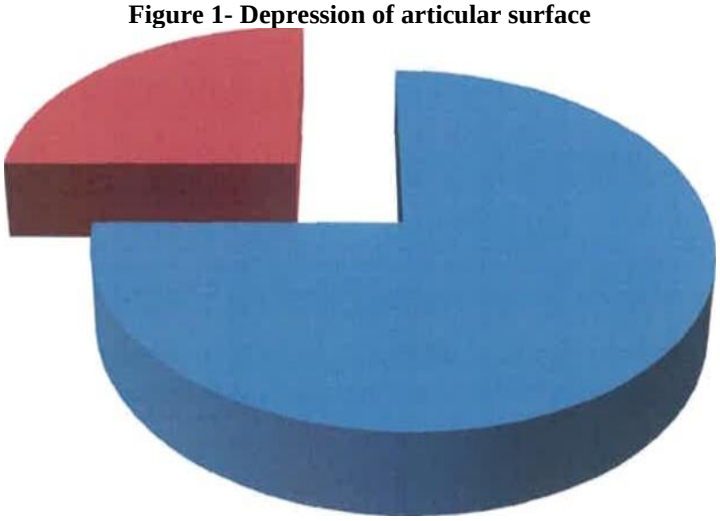
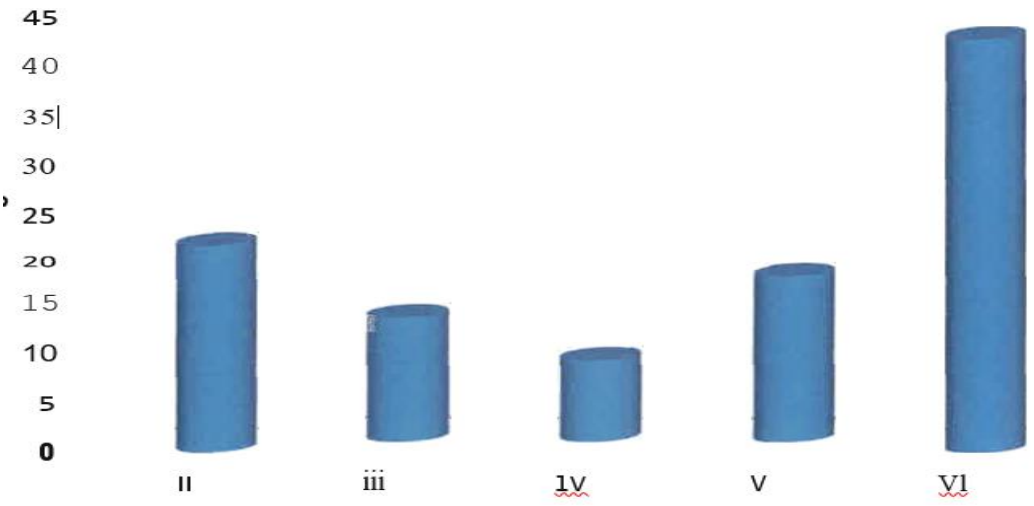
Figure 1- Depression of articular surface



As per figure 1 red pie zone shows depression of articular surface greater than 3mm (25%) and blue zone upto 3mm (75%).

Figure 2- Distribution of Schatzker types of fracture



As per figure 2 the most common type is VI (41.7%) followed by type II (20.3%).

Table 3- VAS scoring of pain at 6 weeks, 3 months and 6 months

					Wilcoxonsignedranktest (comparisonwith6weeksscore)			
	N	Painscore(VAS)		Median	Inter quartilerange			
					Q1	Q3	Z	P
		Mean	SD					
At 6weeks	24	3.4	0.7	3.0	3.0	4.0		

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JCHR (2024) 14(3), 962-968 | ISSN:2251-6727

At 3months	24	2.4	0.9	2.5	2.0	3.0	3.619	<0.001
At6	24	1.1	0.7	1.0	1.0	1.8	4.463	<0.001

As per table 6 VAS scoring of pain at 6 weeks, 3 months and 6 months was compared which was found to be statistically significant ($p<0.05$).

Table 4- Presence of gross knee swelling at 6 weeks, 3 months and 6 months

	6 weeks	3 months	6 months	p-value
Swelling				
Present	18 (75%)	6 (25%)	4 (17%)	**0.001**
Absent	6 (25%)	18 (75%)	20 (83%)	**0.001**

Table 4 shows the comparison of gross knee swelling of 6weeks with 3 months and 6 months which shows significant improvement in 3 months and 6 months ($p<0.05$).

Table 5- Presence of gross knee swelling at 3 months in patients with low velocity injury group and high velocity injury group

Type	Swellingat3 months				Total	
	Present		Absent			
	N	%	N	%	N	%
II-III	2	33.3	6	33.3	8	33.3
IV—VI	4	66.7	12	66.7	16	66.7
Total	6	100.0	18	100.0	24	100.0

As per table 5 gross knee swelling was absent in type IV-VI in 3 months as compared to type II-III and it was significant.

Table 6-Range of motion at 6 weeks, 3 months and 6 months

	N	ROM		Median	Interquartilerange		Wicoxonsignedrank test(comparisonwith6weeks score)	
		Mean	sd		Q1	Q3	Z	
At 6weeks	24	105.0	13.5	100.0	92.5	110.0		
At 3months	24	118.3	10.1	120.0	110.0	130.0	4.298	<0.001
At 6months	24	126.7	6.4	130.0	122.5	130.0	4.292	<0.001

As per table 6 range of motion increases as the time period increases and it was statistically significant.

Table 7- Comparison of range of motion at 6 weeks in patients started on knee mobilization on post op day 1 and two weeks

StartofKnee mobilization	ROMat6weeks				Total	
	Upto100degree		>100degree			
	N	%	N	%	N	0q
2weeks	10	71.4	4	28.6	14	100.0
PODl	4	40.0	6	60.0	10	100.0
Total	14	58.3	10	41.7	24	100.0

As per table 7 ROM on knee mobilization was not significant**.**

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(3), 962-968 | ISSN:2251-6727

Table 8- Table 24 - Post operative complications at 6 weeks, 3 months and 6 months

	At6weeks		At3months		At6months	
Postopcomplications	N	%	N	%	N	%
Nil	21	87.5	24	100.0	23	95.8
SurgicalSiteInfection	3	12.5	0	0	1	4.2
Total	24	100.0	0	0	24	100.0

As per table 8 surgical site infection was seen 12.5% at 6 weeks and 4.2% at 6 months which was significant.

Table 9- Knee Society score at 6 weeks, 3 months and 6 months

KneeSociety Score	At 6weeks		At3months		At6months	
	N	%	N	%	N	%
Excellent	0	0	0	0	10	41.7
Good	0	0	10	41.7	12	50.0
Fair	0	0	10	41.7	2	8.3
Poor	24	100.0	4	16.7	0	0.0
Total	24	100.0	24	100.0	24	100.0

As per table 9 as the time progresses the knee society score was poor at 6 weeks (100%), it was 16.7% poor at 3 months and not seen at 6 months. The score was excellent only at 6 months for 41.7%.

Discussion-

Age of the patients ranged from 27 to 68, most number of patients being in the age group 41-50. In our study, average age is 46 years. In a study done by Honkonen[8] the mean age was 39.8 years and in Stevens[9] it was 40 years.Males form the majority of this study group with male:female ratio is 3:1 which corresponds to most of the series. This is due to more outdoor activities of males compared to females. As per Moore[10] it was 62% males and 38% females.83.3% cases were following road traffic accidents, 12.5% following fall and one case (4.2%) was following assault. Ravi Kant jain[11] study shows RTA as the 70% main cause.

14 (58.3%) cases of fractures were on the left side and 10 (41.7%) cases were on the right side. Open or closed fracture: 22 cases were closed and two cases were Type 2 open (Gustilo Anderson Type2).The fractures were classified as per Schatzker classification. Most of the cases in this series are high velocity injuries. Type 2 fractures constituted 5 cases (20.8%). 3 cases were Type 3 (12.5%). Type 4 cases were 2 in number (8.3%). Type 5 constituted 4 (16.7%) cases and Type 6 formed the majority in this series with 10 cases (41.7%).

Pain was assessed with visual analogue scale (out of 10). At 6 weeks after surgery, the mean VAS score was 3.4. At the end of 3 months it was 2.4 and at the end of 6 months it was 1.1. The pain score decreased with time and the reduction in VAS score showed statistical significance. Pain was separately assessed in patients with low velocity injuries (Shatzker type 2 and 3) and high velocity injuries (Schatzker type 4,5,6). It was observed that pain was more in high velocity injury patients but there was no significance found statistically.

Post operatively swelling was noted in many of the patients. This was not joint effusion or haemarthrosis but synovitis or oedema. Swelling was noticed in 18 patients (75%) at 6 weeks, 6 patients (25%) at 3 months and 4 patients (16.7%) at 6 months. The presence of swelling was more noted in high velocity injury patients but no statistical significance was found out. All the patients who were started on knee mobilization on first post-operative day had swelling at 6 weeks. In the patients who were started on knee mobilization at 2 weeks, only 57% had swelling at 6 weeks. This showed statistical significance.

At 6 weeks following surgery, surgical site infection was noted in 3 patients (12.5%). These patients were given wound washout and the infection got settled. One patient developed deep infection at 6 months and he underwent implant removal. His fracture was united and had good functional outcome after implant removal. Other common complications like wound dehiscence, implant prominence, neurovascular complications, compartment syndrome, malunion or nonunion were not seen in any of the patients in this series.

When comparing with other series, infection rate is slightly higher. It may be due to the associated comorbid conditions of the patient. Two of the patients who had infection were having diabetes mellitus, one patient had chronic liver disease, one patient was a post renal transplant patient and was on immunosuppressants. As Hohl M[13] per infection rate is 7.8% and Palmer[14] 0% as compared to our study which was 12.5%.

Knee society score was assessed at 6 weeks, 3 months and 6 months follow up. At 6 weeks, no patients were allowed to weight bear. All of them were adviced no weight bearing ambulation with crutches or walker

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(3), 962-968 | ISSN:2251-6727

support. So the knee society score was poor in all these patients as they are losing the points of pain assessment during walking and climbing stairs. At 3 months follow up 10 patients (41.5%) had good score, 10 (41.5%) had fair outcome and 4 patients (16.7%) had poor outcome. There were no patients with excellent score at 3 months. At 6 months 10 (41.7%) patients showed excellent score, 12 patients (50%) had good outcome and 2 patients.

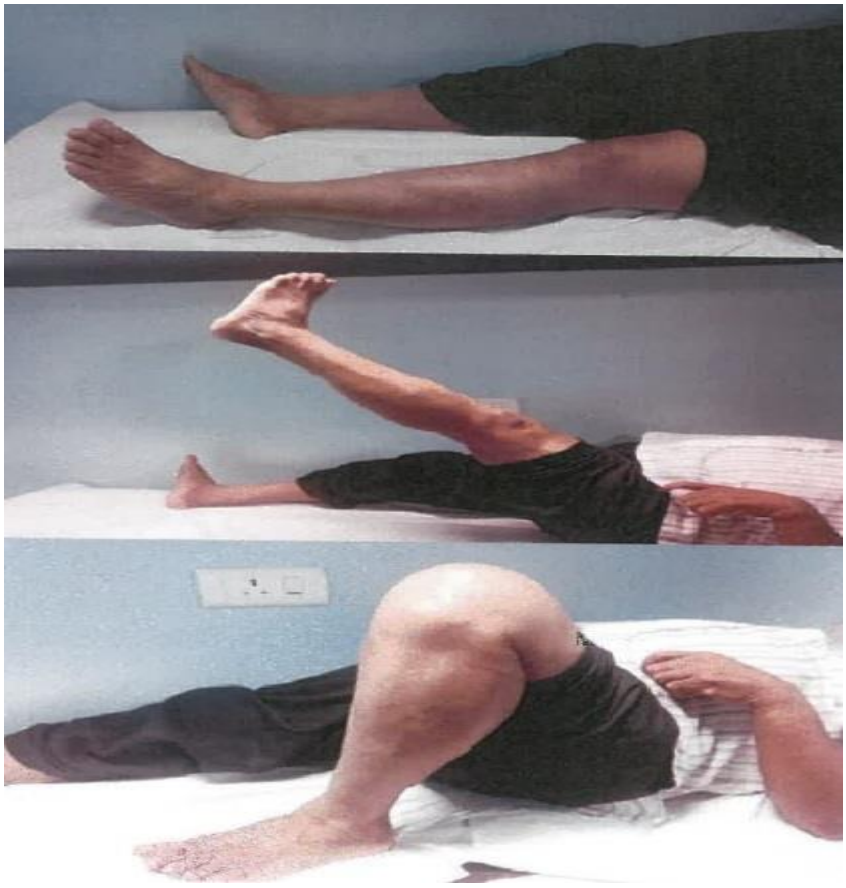

Fig : Full Knee ROM achieved in a Schatzker type 6

Considering the different parameters in Knee Society Score, mild extension lag was present in 14 patients (58%) at 6 weeks, 8 patients (33.3%) at 3 months and 4 (16.7%) patients at 6 months. 7 patients (29%) continued to have mild pain at rest at 6 months follow up.Lachiewicz[15] Percentage of cases with satisfactory results 93% also Rademakers[12] shows 84%.

Our study has few limitations as follows:

(1) Study population is small (24 patients).
(2) Period of study was only ten months with follow up of only 6 months.
(3) The surgeries were done by 3 different surgeons.
(4) There was a wide range of patients ages.
(5) Individual fracture patterns could not be studied in detail as there were only limited number of cases in each type of fractures.
(6) Tibial condyle fractures consist of a spectrum of cases ranging from low velocity injuries to high velocity injuries and each type may differ in outcome from others.

Strengths of the study:

(1) Various functional and radiological parameters were assessed in detail
(2) Patients were closely followed up

Conclusions-

Majority of the patients come in the age group of 40-50 with mean age of 46 years.Males are affected more.Road traffic accident forms the major mode of injury.Left side is affected in 58.3% cases and right side in 41.7% cases.At 6 months 41.7% patients showed excellent score, 50% patients had good outcome and 8.3% patients had fair outcome.Patients with higher grade of injury were observed to have poor outcomes in various parameters like pain, swelling, range of motion and Knee society score.Patients with persistent osseous depression and higher grade of valgus deformity had poor outcome.Patients who were started on knee mobilisation earlier achieved good ROM earlier.Post-operative wound infection is a major problem in tibial condyle fractures following surgery.The post-operative outcomes of this study

Journal of Chemical Health Risks
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indicate that Open Reduction and Internal Fixation is a good option in the management of tibial condyle fractures even in high velocity injuries.

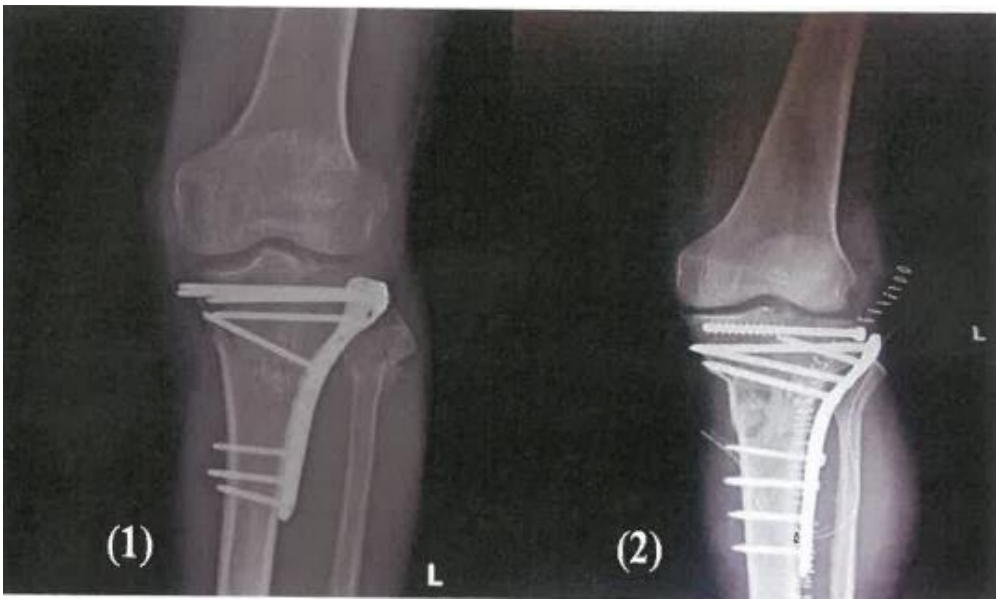

Fig : Two cases of Schatzker Type 6 tibial condyle fractures fixed with single lateral plate, first one with a 3.5 system raft plate and second one with a 4.5 system LCP

Conflict of Interest- None declared

Source of Funding- None

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