

Study Of Outcomes Of AO/OTA Type C Proximal Tibia Fractures Operated With Open Reduction And Internal Fixation.

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Abstract: Background: Complex Proximal tibia fractures with complete intra-articular extension and metaphyseal comminution (AO/OTA type C) present a difficult treatment challenge. There are many alternatives in treatment of these fractures. Aim: The primary aim of this study was to evaluate the functional and radiologic long-term results of surgically treated (ORIF) complex intra-articular tibial plateau fractures. Methods: 24 patients (18 males and 6 females) with AO/OTA type C proximal tibial fractures were studied from April 2014 to August 2016. The bony and functional outcome was evaluated according to Knee Society Score. Results: According to Knee Society Score, the results were as follows: - excellent in 20 patients (83%), good in 3 patients (12.5%), fair in 1 patient (4.5%), and poor in no patient (0%). Conclusion: Open Reduction and anatomical reduction is the best, effective and procedure in treatment of complex proximal tibial fractures (AO/OTA Type C). Excellent results can be obtained in trained hand with correct choice of implants. [Bhavik D NJIRM 2017; 8(1): 32-37]

Keywords: Proximal Tibia fractures, Tibia Plateau, AO/OTA Type C, Locked Plating, Open Reduction.

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Introduction: Juxta-articular/intra-articular proximal tibia fractures pose a great therapeutic challenge to an orthopaedic surgeon. The challenges associated with proximal tibia fractures are skin problems (blisters etc.), compartment syndrome, maintenance of joint congruity, maintenance of axial alignment of limb and early mobilization so as to have good range of motion besides achieving union. The optimal treatment of such complex AO/OTA type C tibial plateau fractures is a controversial and challenging. There is no specific and proven treatment protocol yet. Lasanianos et al.¹ in their biomechanical study, comparing intramedullary nailing and compression bolt fixation with single lateral locking plate fixation and dual plating technique in the osteosynthesis of Schatzker type VI fractures showed that the collapse of the medial tibial plateau occurred exclusively in the single lateral locking plate fixation group. Though superior to single lateral plate fixation, the dual plating technique is more damaging to the already compromised soft tissues in these high energy injuries and the wound infection rate with dual plating is as high as 20%²⁻⁵. To meet these requirements, operative treatment is gold standard for management of such fractures. This was done in the past using conventional single buttress plate or double incision dual plating. Though conventional method achieved satisfactory results, still it was associated with shortcomings like large incisions, more blood loss and infection, hardware complications besides having some functional and alignment problems. The primary aim of this study was to evaluate the functional and radiologic long-term results of surgically treated (ORIF) tibial plateau fractures.

Methods: From April 2014 to August 2016, patients with proximal tibia fractures managed with open reduction and internal fixation were included in the study. They were followed up for a minimum of 9 months. Informed consent was taken from all participants in this study according to institutional committee on medical ethics.

Inclusion and Exclusion Criteria: Patients with active or recent infection in the involved leg, extensive comminution, Gustilo and Anderson Type IIC fractures and open fractures with extensive soft tissue damage and/or contamination were excluded. Only adult patients with radiological bony maturity were included in study. The fractures were classified using the AO/OTA Classification and only those with Complete Intra-articular involvement (Type C) were

Included In This Study: Patient and Fracture Characteristics 24 patients between from April 2014 and August 2016 were included in this study. There were 18 males and 6 females. Mean age of patients was 42.6 years. Road traffic accidents were most common mode of injury (74%), followed by fall from height (11%). There were 7 type C1, 13 type C2 and 4 type C3 fractures. According to Gustilo-Anderson classification two patients had Type I injury one and patient had Type II open injury. Patients with type III injuries were excluded from this study. 3 patients had suffered from additional injury (limb fractures, head, chest or abdominal injury). All patients were treated by one stage surgery except 2 patients with poor soft tissue conditions who were treated by two stage

surgery (external fixation and then plate fixation). The patients were stabilized and local soft tissue condition assessed pre-operatively, else the surgery was deferred till the wrinkle sign appeared⁶.

Age (year)	Male	Female	Total	Percentage (%)
21-30	4	1	5	20.8
31-40	8	3	11	45.8
41-50	3	2	5	20.8
≥ 51	3	0	3	12.5
Total	18	6	24	100

Mode of trauma	No of cases	Percentage (%)
Struck by vehicle	7	29
Fall from vehicle	9	38
Fall from Height	4	17
Minor fall	3	12.5
Other	1	4.1
Total	24	100

Fracture Characteristic	Number Of Patients
Closed	18
Open	
Gustilo – Anderson I	2
Gustilo-Anderson Ii	1
Gustillo-Anderson Iii	0
Distal Fracture Extension	
Proximal Third Shaft	21
Middle Thrd Shaft	3

AO/OTA Type	21-30	31-40	41-50	>50	No of patient
C1	3	2	1	1	7
C2	1	7	3	2	13
C3	1	2	1	0	4
Total	5	11	5	3	24

AO/OTA Type	Males	Females	Total	Percentage
C1	5	2	7	29.2
C2	12	3	13	54.1
C3	3	1	4	16.7

Radiography: Standard antero-posterior and lateral radiographs of the thigh and leg including the knee joint were taken to determine the fracture pattern, classifying the fractures according to the AO/OTA classification and for preoperative planning⁷. Computed tomography (CT) scan was done in cases where more detailed⁸ fracture configuration was required⁹.

Implants: Proximal tibia condylar plates were used in 17 patients. Proximal Tibia peri-articular (rafting) locking plates were used in 8 patients. Additional support was given by contoured 3.5mm simple plates whenever required. Minimally invasive plate osteosynthesis (MIPO) was used wherever the fracture configuration and soft tissue condition permitted. Pre-contouring of plates was done wherever necessary to achieve optimal seating of the plate. 6.5 cannulated screws were used in 5 patients. 5 patients were operated on traction table and all others on simple table using padded support to keep knee flexed. All surgeries were done using tourniquets with mean time of 57.5 minutes. C-Arm image intensification was used in all surgeries.

Approach: Antero-medial Approach: A curvilinear incision is made over the proximal lateral tibia¹⁰. The skin incision is approximately 6 cm in length for extra-articular fractures and is extended as needed to provide exposure of the articular surface for intra-articular fractures¹¹. The fascia of the iliotibial band is divided longitudinally parallel to its fibres starting at the gerdy tubercle and extended proximally. Dissection is extended distally through the fascia of the tibialis anterior muscle, and a small portion of the muscle is elevated off the proximal lateral tibia¹². A sub-meniscal arthrotomy is made for intra-articular fractures¹³.

Postero-medial Approach: With the knee in slight flexion straight or slightly curved incision running from the medial epicondyle towards the postero-medial edge of the tibia is made¹⁰. Fascia is opened and pes anserinus exposed and retracted posteriorly along with gastrocnemius. Medial edge of tibial plateau and medial meniscus identified. Capsule is incised and joint accessed.

Post-Operative Care: Immediate active assisted range of motion of the knee (intra-articular fractures) or active and active assisted range of motion of the knee (extra-articular fractures) is begun on the first postoperative day. Patients with intra-articular fractures are kept toe-touch weight bearing for 8 to 12 weeks, and patients with extra-articular fractures were kept toe-touch weight bearing for 6 to 8 weeks. Thereafter, weight bearing is advanced based on tolerance and radiographic evidence of fracture healing.

Follow-Up: All patients were reviewed weekly for 4 weeks then monthly for 6 weeks. Standard radiographs were taken and 1, 3 and 6 months.

Results: The mean time between the operation and bone union was 15.4 weeks (range, 12-26 weeks), and the mean interval between the operation and full weight-bearing was 18 weeks (range, 14-26 weeks). At the final clinical follow-up, no patients showed knee instability, and the mean range of motion was 112.3° (85°-130°) None of the patients developed joint infection. 2 patients had superficial infection, which was suppressed with daily care and antibiotics. None of the patients developed a varus or valgus deformity and leg-length discrepancy. None of the patients underwent a second operative procedure. 18 patients achieved ability to perform previous activities of daily living (ADL) and returned to their previous work, 5 patients got ability to perform previous activities of daily living (ADL) and previous work with minimal difficulty, and 1 patients had significantly limited activities of daily living (ADL) and required a change from previous work. According to Knee Society Score, the results were as follows: excellent in 20 patients (83.3%), good in 3 patients (11%), fair in 1 patient (6%), and poor in no patient (0%).



Patient 2: 34/male with 22 weeks follow-up having normal ROM and excellent knee score of 87.

Discussion: The most common difficulties are faced by the surgeon while dealing with intra-articular proximal tibia fractures are the compromised skin and soft tissue envelope, which invites a high rate of complications following attempted open reduction and internal fixation, and poor bone quality and comminuted fracture patterns creating difficulty in achieving stable fixation^{14, 15, 16-19.}

Table :1

Type	Number Of Patients With Knee Rom (In Degrees)	
	>120	<120
C1	5	2
C2	11	3
C3	2	2



Patient 1: Pre-operative and post-operative images of 31/male with C2 fracture. Patient had near normal ROM and excellent knee society score of 91.

Treatment options include non-operative treatment using traction, casts or braces, hybrid, ring, or uniplanar external fixation; fixed angle implants utilizing percutaneous exposure and reduction; dual plating with one or two incision, arthroscopically assisted fixation and minimal percutaneous pinning, lateral plating and medial fixator, and minimally invasive techniques(LISS)^{20,21,22,18,23-27} Regardless of treatment technique the reported complications include: wound breakdown, deep infection, deep vein thrombosis, compartment syndrome, non-union, myositis-

ossificans, common peroneal palsies, hardware failure, and arthrofibrosis^{15, 28, 29}.

Table-2

Type	Number Of Patients With Extension Lag (More Than 5 Degrees)
C1	2
C2	2
C3	2

Table-3

Complications	Number Of Patients
Infection	2
Shortening	0
Limp	0
Non-Union	0
Delayed Union	2
Implant Loosening	0

Table-4

Grade (According To Knee Society Score)	Number Of Patients	Percentage
Excellent (80-100)	20	83.3%
Good (70-79)	3	12.5%
Fair (60-69)	1	4.1%
Poor (Below 60)	0	0%

Non-operative treatment using traction, casts or braces has been reported to produce poor functional results, have prolonged hospital stays and complicated by the loss of reduction¹⁹. Arthroscopy assisted fixation and minimal percutaneous pinning have also been reported to give good results but these modalities are suitable for simple split depression and local compression fractures^{27,20}. Open double plate fixation has been reported to be associated with the complication of wound dehiscence and infection^{17, 31, 32}. Hybrid fixation systems have not good functional and bony results, and give increased risk of pin tract infection and prolonged courses of treatment^{32, 33}. There are studies which have reported that open lateral plating and medial fixator in complex bicondylar fractures of the tibia give good functional results minimizing soft tissue complications²³. Currently, minimally invasive techniques (LISS system) are used commonly by orthopaedic surgeons, and there have been reports of good results in tibia plateau fractures being treated exclusively by this technique. This system minimizes the surgical complications by decreasing the soft-tissue stripping, to provide a rigid fracture reduction and to respect the post-traumatic soft- tissue injury^{25, 34, 35}. To

minimize the surgical complication especially infection, staged treatment is necessary in open complex proximal tibia fractures^[36]. In this study 2 patients with poor soft tissue condition were treated by two stage surgery (External Fixation and then plate fixation). Anatomical knee joint reduction, the relative stability and alignment of the proximal tibia allowing the earliest knee mobilization, while keeping complications to a minimum rate, are the major goals in the treatment of complex proximal tibia fractures^{37, 38}. In order to obtain stability of bi-condylar and complex proximal tibia fractures, reduction and fixation of both medial and lateral columns is necessary. Dual plating successfully gives a good stability by buttressing both columns but high rate of complications associated with this open technique are reported^{17,18}. Steven N., et al. reported wound dehiscence and infection in proximal tibia fractures treated with double plate fixation³⁹. In our study superficial infection was observed in 2 cases and no soft tissue breakdown was noted. Which was managed with antibiotic coverage for extended period. In this study, our results demonstrate a lower risk for deep infection and soft tissue complications, good functional and bony results in complex proximal tibia fractures when compared to earlier reports about other techniques.

Conclusion: Treatment of complex proximal tibia fractures is a challenge to even most experienced orthopaedicians. Good skin condition is prime necessity for open reduction and internal fixation. Timing of surgery can be delayed or staged surgery in form of temporary external fixation can be performed till skin is incision-ready. Dual-Plate fixation in bicondylar fractures and fractures with extensive metaphyseal comminution is superior to single-plate fixation as it provides better alignment and prevent varus stresses. To conclude, best results can be achieved with anatomical reduction, sound surgical knowledge and proper choice of fixation implants for complex intraarticular fractures of proximal tibia.

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