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A prospective study of operative results of intra-articular fractures of proximal tibia

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Abstract
Introduction: Proximal tibial fracture is a common injury, with some of these fractures being caused by a strong impact such as a traffic accident and others being caused by the relatively weak impact of a fall in elderly people. Such fractures are frequently intraarticular and comminuted and it is likely that secondary osteoarthritis will occur due to residual malalignment of the lower extremity or irregularity of the articular surface, especially in patients with comminuted intraarticular fractures. To preserve normal knee function, surgeon must strive to maintain joint congruity, preserve normal mechanical axis, ensure joint stability and restore a full range of motion.
Methods: We have studied 50 cases of fractures of upper end tibia with intraarticular extension, treated at our tertiary care institute with different modalities of fixation during the period of Jan 2017 to May 2017. We used Schatzker type I – VI classification. Surgical techniques used were external fixation, open reduction and internal fixation, ligament injury repair with condylar fracture and arthroscopically assisted reduction and fixation of tibial plateau.
Results: We used knee society scores (max. 350) used for final follow up at 1 year. Functional was Excellent in 82% (41), good in 6% (3), Fair in 12% (6) patients. In type I fracture 3 patients had excellent result, 1 patient had fair result. In type II/III/IV fracture all patients having excellent result. In type V fracture patients treated with double plate (2) had excellent result and single plate (15), 12 had excellent, 2 patients had good and 1 had fair result. 1 patient with preexisting osteoarthritis treated with hybrid fixator complicated by infection had fair result. 1 patient treated with C.C. (Cannulated Cancellous) screw had fair result. In type VI fracture, 6 patients treated with plate had excellent result. Out of 4 patients treated with hybrid fixator 3 had excellent result and 1 had good result. One patient had excellent and one had fair result treated with external fixator.
Conclusion: Open reduction and internal fixation (ORIF) is the gold standard treatment for these fractures. Complex articular fractures can be treated by ring external fixators and minimally-invasive osteosynthesis (EFMO) or by ORIF. EFMO can be related to suboptimal articular reduction; however, outcome analysis shows results that are equal to, or even superior to, ORIF. The ORIF strategy should also include the optimal reduction of the articular surface.

Keywords: Proximal tibia fracture, external fixation, open reduction internal fixation

Introduction
Reporting of first three conservatively treated cases of tibial condyle fracture was done by Sever (1916). First study and classification of these fractures was done by Barr in 1940.According to him fractures were caused by (1) direct impact, (2) Varus/ valgus strain. He devised method of internal fixation for depressed/displaced fractures lateral condyle. History of these fractures can be classified into (1) Era of closed treatment (2) Era of operative treatment.

Era of Conservative Treatment [1]
Bradfort *et al* (1950) (JBJS-32A) have shown good results with manipulation and plaster reduction. Mason *et al* (1956) JBJS 38(A-B) have shown better results by conservative trial. Perkins (1940), Fariback (1959) and Appley (1956) JBJS 38(A-B) showed good results with use of skeletal traction and early mobilization.

Era of Surgical Treatment [2]

AO devised techniques and method of open reduction and internal fixation by buttress plates, tibial bolts and cancellous screws. External fixation for open Grade fractures is being used. In 1952 Wilson W.J.K Jacobs J.E. (JBJS 34A) used patella as bone graft for the depressed fracture and suggested for restoration of damaged articular surfaces of tibial plateau. Kumar *et al* used fibular head auto graft for treatment severely comminuted bi-condylar fracture of tibia in excellent or good results. In 1998 Professor Mast Dr. Garber and R reported have the conception of substitution (Double osteosynthesis) by Lateral MIPPO + Medial external fixator/Medical plate. Recent trend is towards ring fixator (Hybrid/Ilizaraow) in case of bi-conduylar tibial plateau when soft tissue condition is not in favor of plating.

Methods

Patient with fractures of proximal Tibia with intraarticular extension managed by various modality during the period of Jan. 2017 to May 2017 at our tertiary care institute were included in the study. We performed a prospective study in which, we compared the operative results for 50 displaced tibial plateau fractures classified Schatzker [3] types. 5 fractures were randomized to circular external fixation, 4 to external fixator, 13 to C.C. screw and 28 to open reduction and internal fixation. Follow-up consisted of obtaining a history, physical examination, and radiographs; completions of the knee society score at final follow up of 12 months and recording of complication and reoperation rates. Fractures of Proximal Tibia with intraarticular extension are considered to be difficult management problem due to malalignment, incongruity and instability. To achieve stable painless mobile joint, following goals were considered:

1. Anatomical reduction and alignment [4]
2. Stable fixation for early mobilization [5]
3. Repair of associated ligamentous disrupatientions [6]
4. Restoration of articular surface congruity with minimal residual irregularity [7]

On admission, all patients were managed according to ATLS protocol to start with. All patients were hemodynemically stabilized, thoroughly examined for other major associated injury in head, thorax, abdomen or spine along with local limb examination including distal neurovascular status. Patients who were selected for fixations were kept on above knee slab with or without skeleton traction depending on degree of condylar depression till waiting for fixation. We couldn't use CT Scan for detailed fracture anatomy because our hospital mostly deals with non-affordable patients and cost of C.T. scan was not funded by institute at that particular time of study. Any associated illness such as diabetes, hypertension or asthma was controlled prior to surgery. Patients were evaluated for fitness for anesthetist and if some problem occurred it was dealt with prior to fixation. Following surgical techniques used according to requirement. (Figure 1-4)

1. External Fixation [8]
2. Open Reduction and Internal Fixation [9]
3. Ligament Repair with Condylar Fracture [10]
4. Arthroscopically Assisted Reduction and Fixation of Tibial Plateau Fractures [11]

If not associated with ligament laxity and with secured fixation, postoperative physiotherapy in form of isometric exercises such as quadriceps drill and CPM is used after 2-3 post of day. Active range of motion started. Radiological and clinical follow-up was maintained. No weight bearing is allowed for 4-8 weeks, till there is a radiographic evidence of early graft incorporation and healing as suggested by many studies [12]. Partial weight bearing for 4-6 weeks is initiated with full weight bearing allowed at 3 months.

Results: (Tables 1- 8)

Patients of all ages were included in this study; however there were 36% patients in the age group of 41 - 50 years, similarly older patients above 51 years constituted only 16% of cases as they are mostly restrained at home and not as liable to encounter road traffic accident. As many as 94% patients belonged to male gender with only 6% of female gender. 40 % of cases belongs to Schatzker type V, 24 % of cases belongs to type VI. This shows common cause of above fracture is high velocity trauma. In type VI fracture 8 patients out of 12 had soft tissue injury grade II/III. In type V fracture only 2 patients out of 20 had soft tissue injury grade II. None of them having soft tissue injury grade III, remaining patient of type V had grade o/I. The average duration of hospital stay in this study was about 10 days for type V/VI. This is mostly due to the fact that the bulk of patients were treated by plating or hybrid fixator and these patients tended to have severe soft tissue injuries for which either the surgery was delayed for dressing. Patients treated by fixator either by hybrid or external fixator had a relatively shorter duration of hospital stay. 2 patients of hybrid fixator developed pin tract infection.1 patient of external fixator developed abscess treated with intra venous antibiotics, incision and drainage.1 patient of type V fracture with soft tissue injury grade II treated with plating developed infection and plate was exposed. Later on rotation flap coverage done by plastic surgeon. None of the patient from our study had nonunion but only one had delayed union. Maximum number of cases (80%) had union within 16 weeks whereas union in 4 cases occurred between 17 – 20 weeks. One patient had union at 38 weeks, due to infection, plate exposed and flap surgery. At the time of the latest follow-up, radiographic evaluation revealed two cases of lateral joint collapse with >10° varus malalignment.

Six patient developed instability (mediolateral/anteroposterior). Two patients treated primarily for medial collateral ligament. Two patients treated with ACL + MCL ligament reconstruction after removal of implants at 9 months duration. One patient treated conservatively for LCL laxity for low demand. Functional outcome for all patients as assessed by modified knee scoring system was Excellent in 82% (41), Good in 6% (3), Fair in 12% (6) patients. In type I fracture 3 patients had excellent result, 1 patient had fair result as associated with fracture lateral condyle femur and patella. In type II/III/IV fracture all patients having excellent result. In type V fracture patients treated with double plate (2) had excellent result, out of 15 patients treated with plate, 12 had excellent, 2 patients had good and 1 had fair result which was associated with supra condylar femur fracture. 1 patient with preexisting osteoarthritis treated with hybrid fixator complicated by infection had fair result. 1 patient treated with c.c. screw had fair result. In type VI fracture, 6 patients (closed soft tissue injury grade I) treated with plate had excellent result. Out of 4 patients (closed soft tissue injury grade III) treated with hybrid fixator 3 had excellent result and 1 had good result. One patient had excellent and one had fair result treated with external fixator.

Patients in the circular fixator group had less intraoperative blood loss than those in the open reduction and internal fixation group. The quality of osseous reduction was similar in

the groups. There was a trend for patients in the circular fixator group to have superior early outcome and the ability to return to preinjury activities at six months. These outcomes were not significantly different at one year. There was no difference in total arc of knee motion, and the KSS scores at one year after the injury were not significantly different between the groups with regard to the pain, stiffness, or function categories.

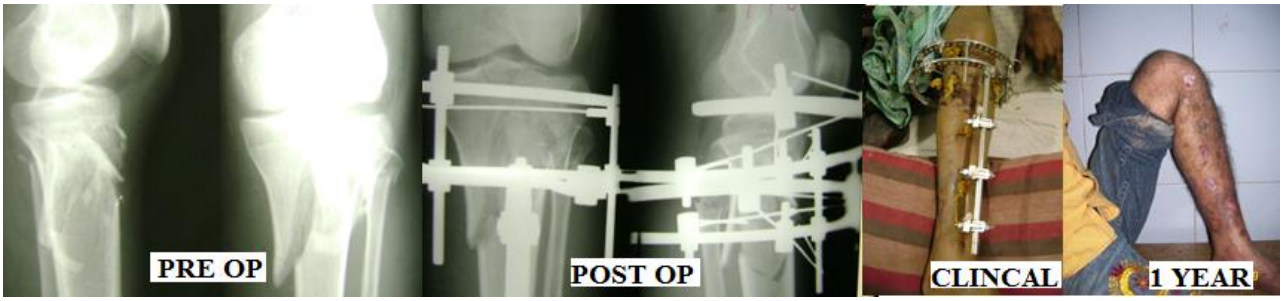

Fig 1: Case of hybrid fixator in Schatzker type VI fracture

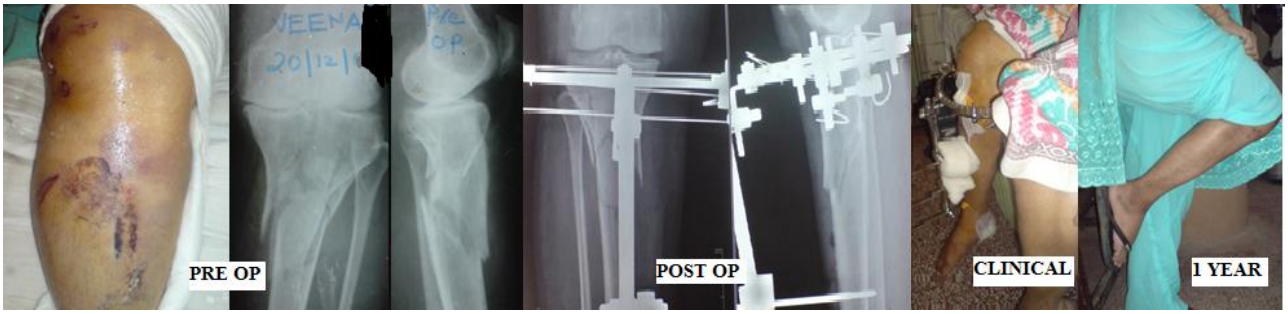

Fig 2: Case of associated soft tissue injury

Fig 3: Case of Schatzker type IV fracture treated with "L" buttress plate

Fig 4: Case of Schatzker type V fracture treated double plating

Table 1: Age Distribution

Age group	Number of patients	Percentage
0 -20	0	0
21 – 30	12	24
31 – 40	12	24
41-50	18	36
51 onwards	8	16

Table 2: Sex Distribution

Sex	Number Of Patients	Percentage
Male	45	90
Female	5	10

Table 3: Distribution According To Schatzker Classification

Schatzker Type	Number Of Patients	Percentage
I	4	8
II	5	10
III	4	12
IV	4	8
V	20	40
VI	12	24

Table 4: Distribution According To Clinical Type of Fracture

Clinical Type	Number Of Patients	Percentage
Closed	47	94
Open	3	6

Table 5: Distibution According To Closed Soft Tissue Injury.

Grade/ (No. Of Patients)	Mode Of Treatment				
	C.C Screw	Hybrid Fixator	Double Plating	External Fixator	T-/ L Plate
0/(14)	5(10%)	0	0	0	9(18%)
1/(22)	7(14%)	0	3(6%)	0	12(24%)
2/(6)	0	1(2%)	0	2(4%)	3(6%)
3/(5)	0	4(8%)	0	1(2%)	0

Table 6: Degree of Range Of Movement

Mode Used	Degree
C.C. Screw	0-130
Hybrid	0-115
Double Plate	0-125
External Flexion	0-115

Table 7: Complications

Complications	Mode Of Treatment				
	C.C Screw	Hybrid Fixator	Double Plating	External Fixator	T-/ L Plate
Infection	0	2	0	1	1
Malalignment	1	0	0	0	1
Loosening Of Implant	3	1	0	2	2

Table 8: Functional Results

Mode Used	% Of Cases	No. Of Patients.			
		Excellent	Good	Fair	Poor
Hybrid (5)	10	3(60)	1	1	0
C.C. Screw (13)	26	11(84.6)	0	2	0
L/T- Plate (25)	50	21(84.6)	2	2	0
Double Plate (3)	6	3(100)	0	0	0
Ext. Fixator (4)	8	3(75)	0	1	0
Total(50)	100	41(82%)	3(6%)	6(12%)	0

Conclusion

More number of cases was belonging to Schatzker type V and VI following high velocity trauma. TYPE I and II Schatzker fracture were satisfactory fixed with Cannulated Cancellous screws while TYPE III and IV Schatzker fracture were fixed with plating along with cancellous bone graft where required. TYPE V and VI Schatzker fracture was treated with Hybrid Fixator where internal fixation was done in form of plate and screws augmented with external fixator either on medical or lateral side. Careful pre- operative planning often clarified the need for supplemental bone grafting, shortened operative time, minimized intra – operative decision making, as well as ensured proper implant availability during surgeries. Whenever needed traction radiographs in different in planes, CT scan should be considered pre- operatively. Articular surface should be reconstruction to normalcy and supported if necessary by cancellous bone graft. Medial Collateral ligament injury occurred most often with Schatzker TYPE III fracture whereas meniscal injury occurred most often with Schatzker TYPE IV. The fractured are stabilized by choosing the type of plate i.e. 'T buttress' plate, ' L buttress' plate, 'hockey plate', depending on configuration of fracture and soft tissue envelope, to obtain stability. With increasing degree of metaphyseal comminution or soft tissue injuries added external fixation should be considered, for a period of six to ten weeks until three is radiographic evidence of healing. The spectrum of injuries to tibial plateau is so great that no single method of treatment has proven uniformly successful. However intermediate and high energy trauma in physiologically young patients, involving articular joint surface of upper end tibia, usually require surgical intervention. On weight bearing, Loads are not applied equally to entire Joint surface, but are transmitted over small area of tibial plateau, with medial Joint Surface bearing a larger load than lateral surface. Menisci are major load transmission and load bearing structure. Entire load of weight borne on lateral Compartment is carried by the lateral meniscus. In contrast load distribution on medial 'side is' showed equally by the menisci and exposed articular cartilage. That's why functional results after lateral plateau Fracture are usually good to excellent despite unsatisfactory radiographic picture. Functional and Subjective tolerance of varus deformity is lower than valgus deformity. Fractures associated with severe soft-tissue injury or swelling, predominantly metaphyseal-diaphyseal comminution and displacement, fracture extension into the tibial shaft, and less severe intra-articular fracture displacement are ideal for closed or limited open reduction and circular frame fixation. Fractures associated with extensive intra- articular displacement and comminution is ideally suited for formal open reduction and internal fixation with use of a two-incision technique. The utility of this method has been augmented by the advent of precontoured plates for the proximal part of the tibia and the use of minimally invasive techniques for the application of these plates distally along the shaft.

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