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A study on outcome of tibial plateau fractures (TPF) at a tertiary care hospital

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Abstract
The head of the tibia is sometimes obliquely broken; and if it be fractured into the knee joint the treatment which it requires is similar to that which is necessary in the oblique fracture of the condyle of the Os femoris; i.e., Firstly, the straight position of the limb, because the femur preserves the proper adaptation of the fractured tibia by forming a splint to its upper portion, and keeping the articular surfaces in apposition. Secondly, a roller, to press one part of the broken surface against the other. Thirdly, a splint of pasteboard, to assist in the preservation of that pressure and fourthly, early passive motion to prevent ankylosis. All surgeries were performed under either spiral or lumbar plexus block with Sciatic nerve block. Tourniquet was not used in any of the patients. Patient was positioned supine on the fracture table. Traction was given along the axis of the limb, fracture reduced by closed manipulation with the help of C arm. Condyles were fixed with 6 mm cannulated lag screws and olive wires. Most of the patients were followed up for a period of 23 months. The longest follow up was 24 months and the shortest was 3 months. Average duration of follow up was 16.3 months. The maximum flexion achieved was 150 deg [2 patients] and minimum was 90 deg [4 patients] and 7 patients had a flexion of 135 deg. The average flexion achieved was 118.25 deg.

Keywords: tibial plateau fractures, buttress plate, schatzker type VI tibial condyle fracture

Introduction
Management of fractures has been evolving continuously over several centuries. The quest has always been for treatment modalities that achieve the best possible functional outcome.
The fact that such a pursuit continues till date reflects that such "Ideal" treatment protocols remain to be defined in the management of fractures. This uncertainty exists more evidently in the management of intra-articular fractures, with the upper end of tibia being no exception.
Though uncertainty exists regarding the best modality of treatment, there is general consensus as to what constitutes an "Ideal" functional result. The restoration of joint congruity ad normal mechanical axis, achieving joint stability, restoring muscle power and full range of motion and preventing post traumatic secondary OA are the goals of prime importance. With these factors in mind, in the last 2 decades there has been an unmistakable trend towards minimally invasive surgical management of these fractures [1].
The fracture of the tibial plateau has been described in the literature as early as 1825. More than a thousand articles, thesis and books have documented the trials and tribulations of treating these fractures. The earliest documented reports are those of Sir Astley Cooper who in 1825 described the fracture of the head of the tibia as follows:
"The head of the tibia is sometimes obliquely broken; and if it be fractured into the knee joint the treatment which it requires is similar to that which is necessary in the oblique fracture of the condyle of the Os femoris; i.e., Firstly, the straight position of the limb, because the femur preserves the proper adaptation of the fractured tibia by forming a splint to its upper portion, and keeping the articular surfaces in apposition. Secondly, a roller, to press one part of the broken surface against the other. Thirdly, a splint of pasteboard, to assist in the preservation of that pressure and fourthly, early passive motion to prevent ankylosis".
In 1901, Fassbender performed the first ORIF of a TPF, followed by Reidi who performed an open reduction for a split compression type of fracture that he had been unable to reduce manually.

Dehelly (1927) has been credited for the use of bone grafts for elevation of the articular surface in depressed TPF [2].
The *Buttress plate* was introduced in 1963 by the AO group. The techniques of reduction, surgical exposures, IF devices and post op care regimens were outlined by the Swiss ASIF group [3].
It was then in 1988 that Duvelius and Conolly [4], advocated percutaneous fixation of unstable fractures with instability of more than 10 degree in extension. They evaluated 73 cases of tibial plateau fractures of all variables treated by cast brace technique. They followed up the cases for, an average period 5 years with excellent to good result in 89%. They also found no correlation between functional and radiographic results.
Koval KJ *et al.* [5]. in 1992 reported indirect reduction and percutaneous screw fixation attempted in 20 displaced tibial plateau fractures. Among these 18 were successful. Out of 18, 13 reduced anatomically and 5 were considered non-anatomical.
Dendrinos, GK *et al.* [6], published a report in 1996 of treating 24 patients with high-energy fractures of the tibial plateau with Ilizarov frixator and transfixation wires. Patients were followed up for an average period of 24 months. Average time of fracture union was 4.4 weeks. They obtained acceptable results in a satisfactory percentage of patients. They concluded that Ilizarov circular fixator was an ideal method of treatment for these fractures when extensive dissection and internal fixation are contraindicated due to trauma to the soft tissues, deficiency of bone stock and bony comminution.
Milkulak SA *et al.* [7], in 1998 evaluated 24 patients with Schatzker type VI tibial plateau fractures, treated with small wire external fixation with or without limited internal fixation. At 12 months of minimum follow up they observed acceptable results comparable with previous studies for similar type of fractures. They concluded that this technique was an alternative to open plate osteosynthesis, which has disadvantages of frequent soft tissue complications.
Bal GK *et al.* [8], in 2000 published reports on using anterior T frame external fixation combined with percutaneous internal fixation for treatment of high-energy proximal tibial fractures. They followed up 21 closed and 13 open fractures over an average period of 26 months. Fractures united at a mean of 20 weeks. They obtained a functional evaluation score of 83%. They concluded that the anterior T-frame external fixator with percutaneous external fixation is a simple, reliable, inexpensive and effective method to stabilize these complex injuries.
Sirkin *et al.* [9], in 2000 reported that percutaneous treatment is most promising in split unicondylar fractures. Split fractures, particularly those of lateral plateau can be stabilized with two or more screws. Percutaneous plates usually are needed to buttress lateral fractures with metaphyseal comminution and all lesions of medial plateau. For bicondylar lesions, tensioned wire fixators have become the method of choice.

Methodology
All cases of type VI Schatzker tibial condyle fractures on presentation to the emergency department were treated by initial resuscitation and temporary stabilization of fracture by lower tibial skeletal traction and later treated by definitive surgery.
Plain roentgenograms were taken in the antero-posterior and lateral views and the following points noted.

- Schatzker type VI tibial condyle fracture confirmed
- Amount of articular surface widening
- Amount of articular surface depression

In highly communicated fractures, CT scan with 3D reconstruction was done to know about the fracture fragments. MRI and arthroscopic studies were not done. Preoperative and postoperatively antibiotics were given for all patients.

Surgical procedure
All surgeries were performed under either spiral or lumbar plexus block with Sciatic nerve block. Tourniquet was not used in any of the patients. Patient was positioned supine on the fracture table. Traction was given along the axis of the limb, fracture reduced by closed manipulation with the help of C arm. Condyles were fixed with 6 mm cannulated lag screws and olive wires. The cannulated screws were placed close to the articular surface so that the external fixation pins could subsequently be inserted inferior to the screws at a distance from the joint surface. The fracture at metaphysiodiaphyseal junction was stabilized by preassembled Ilizarov circular external ring fixator. Image intensifier views obtained in two planes assisted in the assessment of the reduction and in the placement of the cannulated screws. Extensile exposures, osteotomies of the tibial tuberosity, meniscal elevations, and other wide exposures of the joint surface were not used. Repairs of the ligaments and meniscectomies were not performed.
In one patient miniarthrotomy was done to reduce the fracture and for bone grafting using G bone. No patient had arthroscopically assisted reduction. The alignment of the shaft with the condyles was evaluated with the aid of fluoroscopy. Open approaches were not used to reduce the shaft to the condyles, thereby minimizing any additional soft-tissue stripping of the proximal part of the tibia.
Post operatively all patients received intravenous antibiotics for seven days (Ceftriaxone and Gentamycin). Sutures if any were removed on tenth day. Immediate non-weight bearing mobilization was advised.
Check X rays were done postoperatively and the following features noted.

- Varus or valgus malalignment was measured
- Joint space was measured to provide a guide for future assessment of joint space narrowing

Follow-up
The fixator remained in place until the fracture had healed clinically and radio graphically: it was then removed in the outpatient clinic. The hybrid external fixator was removed after an average duration of 12.5 wks.
Patients were followed up at an interval of 4 wks until fracture union and later, once in 3 months. At each follow up, the following points were made note of.

Clinical features

- Pain
- Walking ability
- Extensor lag
- Range of flexion
- Squatting
- Pin tracts
- Duck walking stair climbing
- Instability tests
- Thigh atrophy

Radiological features

- Callus formation

- Maintenance of fracture reduction
- Widening and depression of the articular surface
- Varus of secondary osteoarthritis (in weight bearing X-rays)

Weight bearing was initiated once sound bony union was noted on the follow up x-rays.

At the latest follow up visit, all the patients had complete examination of the lower limb. Varus and valgus stress tests were done with the limb in extension and 30^0 of flexion. Anterior and posterior drawer tests were done to the patient lying supine; the range of movement was recorded with a goniometer. If the patient was able to squat, maximum flexion was measured in this position. The presence of pain, ability to walk, Jump, Squat, climb stairs, return to employment and ability to carry out routine activities was enquired upon.

The results were assessed as per the criteria of Honkonen and Jarvinen and also using IOWA knee evaluation. The Iowa knee score is a l00-point scale with which five categories of knee function are assessed according to numerical values assigned to the answers. The categories include functional activities such as walking, stair-climbing, and household chores (35 points); pain (35 points indicates no pain and 0 points, severe, continuous pain); gait (10 points); range of motion (10 points, with 1 point for each 15 degrees of movement); and absence of deformity, ligamentous laxity, locking of the joint, or contractures (10 points).

Criteria of Honkonen and Jarvinen includes subjective, clinical, functional as well as radiological assessment. The primary data obtained from the series of 20 patients who underwent surgery was statistically analyzed. The statistical methods employed and the results thus obtained are presented herewith. Statistical methods employed.

Results

Table 1: Implant removal after [wks]

I/R (WKS)	Frequency	Percent	Cum Percent
3	1	5.0%	5.0%
8	1	5.0%	10.0%
10	2	10.0%	20.0%
11	1	5.0%	25.0%
12	10	50.0%	75.0%
14	2	10.0%	85.0%
16	2	10.0%	95.0%
28	1	5.0%	100.0%
Total	20	100.0%	100.0%

The hybrid external fixator was removed after an average duration of 12.5 wks, with min of 3 wks [due to severe pin tract infection] and a max of 28 wks [due to associated # both bones of the same leg].

Table 2: Duration of follow up

Duration of follow up [months]	Frequency	Percent	Cum Percent
3	1	5.0%	5.0%
5	2	10.0%	15.0%
7	2	10.0%	25.0%
8	1	5.0%	30.0%
9	1	5.0%	35.0%
12	1	5.0%	40.0%
21	2	10.0%	50.0%
22	3	15.0%	65.0%
23	6	30.0%	95.0%
24	1	5.0%	100.0%
Total	20	100.0%	100.0%

Most of the patients were followed up for a period of 23 months. The longest follow up was 24 months and the shortest was 3 months. Average duration of follow up was 16.3 months.

Table 3: Pin tract infection

Pin tract infection	Frequency	Percent	Cum Percent
Nil	11	55.0%	55.0%
Minimal	4	20.0%	75.0%
Moderate	3	15.0%	90.0%
Severe	2	10.0%	100.0%
Total	20	100.0%	100.0%

Only 2 patients had severe pin tract infection which required implant removal and immobilization using pop cast.

Table 4: Pain

Pain	Frequency	Percent	Cum Percent
None	12	60.0%	60.0%
Slight	5	25.0%	85.0%
Moderate	2	10.0%	95.0%
Very	1	5.0%	100.0%
Total	20	100.0%	100.0%

Table 5: Walking ability

Walking ability	Frequency	Percent	Cum Percent
Normal	9	45.0%	45.0%
Slight limp	7	35.0%	80.0%
Severe limp	4	20.0%	100.0%
Total	20	100.0%	100.0%

Table 6: Flexion

Flexion (Deg)	Frequency	Percent	Cum Percent
90	4	20.0%	20.0%
105	5	25.0%	45.0%
115	1	5.0%	50.0%
120	1	5.0%	55.0%
135	7	35.0%	90.0%
150	2	10.0%	100.0%
Total	20	100.0%	100.0%

The maximum flexion achieved was 150 deg [2 patients] and minimum was 90 deg [4 patients] and 7 patients had a flexion of 135 deg. The average flexion achieved was 118.25 deg.

Table 7: Squatting

Squat	Frequency	Percent	Cum Percent
Normal	5	25.0%	25.0%
Impaired	14	70.0%	95.0%
Unable	1	5.0%	100.0%
Total	20	100.0%	100.0%

Table 8: Stair climbing

Stair climbing	Frequency	Percent	Cum Percent
Normal	8	40.0%	40.0%
Impaired	3	15.0%	55.0%
One at a time	8	40.0%	95.0%
Unable	1	5.0%	100.0%
Total	20	100.0%	100.0%

Table 9: Jumping

Jumping	Frequency	Percent	Cum Percent
Normal	4	20.0%	20.0%
Impaired	1	5.0%	25.0%
Unable	15	75.0%	100.0%
Total	20	100.0%	100.0%

Table 10: Duck walking

Duck walking	Frequency	Percent	Cum Percent
Normal	4	20.0%	20.0%
A few steps	2	10.0%	30.0%
Unable	14	70.0%	100.0%
Total	20	100.0%	100.0%

Table 11: Deformity [Varus or valgus]

DEF(DEG)	Frequency	Percent	Cum Percent
0	14	70.0%	70.0%
3	4	20.0%	90.0%
7	1	5.0%	95.0%
8	1	5.0%	100.0%
Total	20	100.0%	100.0%

Table 12: Residual widening of condyles

Widening	Frequency	Percent	Cum Percent
None	2	10.0%	10.0%
1-5 mm	18	90.0%	100.0%
Total	20	100.0%	100.0%

Table 13: Residual articular depression

Depression	Frequency	Percent	Cum Percent
None	18	90.0%	90.0%
1-3 mm	1	5.0%	95.0%
4-6 mm	1	5.0%	100.0%
Total	20	100.0%	100.0%

Table 14: Osteoarthrosis

Osteoarthrosis (Grade)	Frequency	Percent	Cum Percent
0	16	80.0%	80.0%
1	2	10.0%	90.0%
2	1	5.0%	95.0%
3	1	5.0%	100.0%
Total	20	100.0%	100.0%

Discussion

Drennan *et al.* [10], in 1979 published a report on conservative management (closed reduction and pop cast) of tibial plateau fractures.

Apley [11], in 1979 also reported conservative treatment of tibial plateau fractures by traction mobilization methods. He studied 60 cases of all types followed up over an average period of more than 5 years. He found 80% excellent to good results, which did not deteriorate with time. He also advocated that degenerative changes seen on radiographs did not imply bad function.

Burri *et al.* [12], in 1979 studied 278 cases of tibial plateau fractures over an average follow up period of 2.5 years, all treated by surgical methods. They had 89% acceptable results "when inexperienced surgeons performed surgery and 97% results when treated by experienced surgeons. They concluded that prognosis improves with the experience of the surgeons, accurate reconstruction of articular surface and rigid internal fixation to allow early mobilization. They also said that the percentage of post-traumatic osteoarthritis was directly proportional to the severity of the displacement.

Dennis Jensen *et al.* [13], in 1982 evaluated the long term results of 109 tibial plateau fractures, 61 treated by skeletal traction and early knee movement and 48 treated by surgery, at an average follow up of 70 months. The functional results were much the same, though meniscectomy had been performed in almost half of the surgical patients. Time in bed and duration of hospital stay were clearly shorter after surgery. They concluded that conservative management is a valid alternative to surgery, but should probably be reserved to cases where operation is undesirable.

Bowes and Hohl [14], in 1982 reported 52 cases of tibial plateau fractures of all types treated with conservative (72%) and surgical (18%) methods. They followed Hohl's numerical method of evaluation and had minimum follow up of 1 year. They had 84% overall excellent to good results. Minimally displaced fractures treated by cast brace gave good functional results; whereas surgical treatment of severely comminuted fractures had unsatisfactory results.

Blokker CP *et al.* [15], in 1984 received and assessed sixty patients with tibial plateau fractures over an average follow up of 3 years, of which 38 were treated by open reduction and internal fixation and 22 patients treated conservatively. They said that the single most important factor in predicting the outcome in a patient with tibial plateau fracture was adequate reduction. They also concluded that for comminuted bicondylar fracture, open treatment was superior to conservative methods.

Lansinger *et al.* [16], in 1986 published a long-term result of 102 cases of tibial plateau fractures of all varieties, treated by conservative (45%) and surgical (55%) methods. They evaluated the functional outcome using Rasmussen's criteria and obtained an overall excellent to good result in 90% of the cases. They advocated treatment of depressed and split depressed fractures by open reduction and bone grafting.

The long term outcome of tibial plateau fractures treated by cast bracing was followed up over a period of 10 years by Decoster TA *et al.* [17], in 1998. They observed that cast bracing of minimally displaced fractures have satisfactory results, whereas cast bracing of displaced bicondylar fractures produced variable functional results and 70% of them developed degenerative joint disease.

Lachiewics and Fucnik [18], in 1990 reported treating 43 displaced tibial plateau fractures with surgical methods (AO-ASIF principles) and followed up over an average period of 2.7 years. They obtained excellent to good results in 93% of cases. Poor results were due to technical faults or absence of bone graft. Bicondylar fractures had 110^0 motion, 18^0 less than other types.

Stokel EA *et al.* [19], in 1991 reported 20 patients with tibial plateau fractures treated by operative AO technique. 13 patients had good results and poor results were attributed to severity to fractures, associated soft tissue injuries and post-operative complications.

Tscherne H [20], in 1993 reported objective of treatment is precise reconstruction of articular surface and stable fragment fixation allowing early motion. Preferred management was ORIF in all displaced and unstable tibial fractures. Out of 244 cases, 190 cases showed good results after operative treatment.

Segal D, Arati R *et al.*, [21]. in 1993 published a report on treatment of 86 lateral tibial plateau fractures treated by conservative (49%) and surgical (51%) methods. All lateral tibial plateau fractures with depression of more than 5mni were treated operatively. Overall, 95% of patients with Hohl type I, II or V had satisfactory results. Type III fracture, treated operatively had satisfactory results.

Honkonen SE, [22]. in 1994 reported treating 212 tibial plateau fractures of all types. The residual radioanatomic changes influencing the functional, subjective and clinical outcome of 131 tibial condyle fractures were studied. They concluded that a medial unicondylar fracture with any displacement and all medially tilted bicondylar fractures should be operated upon.

In fractures of the lateral tibial condyle, open reduction and internal fixation is indicated when lateral tilt or varus malalignment exceeds 5°, articular step-off exceeds 3 mm or condylar widening exceeds 3 mm.

Conclusion

4 patients had minimal pin tract infection which was treated by local cleansing with antiseptic solution and oral antibiotics, and 3 patients had a moderate pin tract infection, which required hospitalization and intravenous antibiotics without removal of the implants. Two patients had severe pin tract infection, especially in the proximally placed tension wires, for which implant removal was done and immobilization was given using POP cast until fracture union and intravenous antibiotics (inj. cefotaxim). None of the patients developed septic arthritis of the knee.

References

1. Hohl M. part -1: fractures of proximal tibia and fibula. In: Rockwood c, Green D, Bucholz R, eds. Fractures in adults, 3rd ed. Philadelphia: JB Lippincott, 1991, 7125-1761.
2. Bucholz RW, Carlton A, Holmes R. Interporous hydroxyapatite as a bone graft substitute in tibial plateau fractures. Clin Orthop. 1989; 240:53-62.
3. Muller ME, Ailgower M, Schneider, Rand Unlilnegger. Manual of Internal fixation. New York, springer-vexlag, 1979.
4. Duvelius PJ, Conolly JF. Closed reduction of the tibial plateau fracture: A comparison of functional and roentegenographic end results. Clin Orthop. 1988; 230:116-125.
5. Koval KJ, Sanders R, Borelli J. Indirect reduction and percutaneous screw fixation of displaced tibial plateau fractures. J Orthop Trauma. 1992; 6:340-351.
6. Dendrinos GK, Kontos S, Katsenis D, Dalas K. Treatment of high-energy tibial plateau fracture by the Ilizarov circular external fixator. JSJS. 1996; 78(b):710-717.
7. Mikulak SA, Gold SM. Small wire external fixation of high-energy tibial plateau fractures. Clin Orthop. 1998; 366:230-238.
8. Bal G, Kuo RS, Chapman JR. The anterior T-frame external fixator for high energy proximal tibial fractures. Clin Orthop. 2000; 380:234-240.
9. Sirkin MS, Bono CM, Reilly MC. Percutaneous methods of tibial plateau fixation. Clin Orthop. 2000; 375:60-66.
10. Drennan DB, Locher FG, Maylahn DJ. Fractures of the tibial plateau: Treatment by closed reduction and spica cast. JBJS. 1979; 61:989-995.
11. Apley AG. Fracture of the tibial plateau. OCNA. 1979; 10:61.
12. Burri C, Bartzle G, Coldway J. Fractures of the tibial plateau. ClinOrthop. 1979; 138:84-93.
13. Dennis Jensen. Tibial plateau fracture. JBJS (Br). 1990; 72-B: 49-52.
14. Bowes DN, Hohl M. Tibial condyle fracture: Evaluation of treatment and outcome. Clin Orthop. 1982; 171:104.
15. Blokker CP, Rorabeck CH, Bourne PB. Tibial plateau fractures. An analysis of the results of treatment in 60 patients. Clin Orthop. 1984; 182:193-198.
16. Lansinger O, Bergman B, Korner L. Tibial condylar fracture, a twenty-year follow up. JBJS. 1986; 68:13-19.
17. De Coster TA, Nepola JV, EI Khoury GY. Cast Brace treatment of proximal tibial fracture: A ten-year follow-up. Clin Orthop. 1988; 231:196-204.
18. Lachiewics PF, Funcknik T. factors influencing the results of open reduction and internal fixation of tibial plateau fractures. Clin Orthop. 1990; 259:210-215.
19. Stokel EA, Sadasivan KK. Tibial plateau fractures: Standardized evaluation of operative results. Orthopaedics. 1991; 14:263-270.
20. Tscherne H, Lobenhoffer P. Tibial plateau fractures, management and expected result. Clin Orthop. 1993; 292:87-1000.
21. Segal D, Arati R, Mallik. Early weight bearing of lateral tibial plateau fractures. Clin Orthop. 1993; 294:232-237.
22. Honkonen SE. Indications for surgical treatment of condyle fractures. Clin Orthop. 1994; 320:199-205.