

Surgical Management of Intra-Articular Fractures of Upper End of Tibia

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ABSTRACT

Intra-articular fractures of the knee adversely affect the knee function if not managed properly. The objective is to achieve a stable, pain free knee joint with minimal effect on the quality of life. We prospectively studied 49 patients (mean age 44 years, range 21-63 years) with displaced tibial plateau fractures treated operatively. Schatzker type 2 fracture was the commonest pattern (38 per cent). 12 patients were treated with percutaneous screw fixation and 37 were treated with open reduction and plate fixation. Various clinical and radiological criteria were used to calculate final outcome at 1 year. Apart from one patient who died, all fractures were united at final follow-up. There were 13 excellent, 18 good, 15 fair and three poor functional results; and 19 excellent, 18 good, 10 fair and two poor radiological results. There was no significant correlation between the final radiographic appearance and clinical outcome. Postoperative complications included infection in 4 patients and lateral peroneal nerve palsy in 2 patients. Old age, severity of fracture, associated injuries and post-operative complications significantly affected the functional outcome despite acceptable radiological results.

Keywords: Intra-articular Fractures, Tibial Plateau, Schatzker Classification, Operative Management

INTRODUCTION

The objective in the treatment of tibial plateau fractures is to obtain a stable, pain free knee joint with a functional range of motion. The optimal treatment of patients with tibial plateau fractures remains controversial, and a wide variety of treatment modalities have been proposed.^[1-3] Several authors advocate open reduction and internal fixation^[4-6] Other authors have reported good results with limited internal fixation^[7,8] Apley and others have

advocated skeletal traction and early motion for most fractures.^[9-11] Schatzker et al have recommended the use of open reduction and internal fixation utilizing AO techniques and implants with satisfactory results.^[12] Blokker et al reported that only 71% of their patients treated with open reduction and internal fixation had satisfactory results.^[13] The purpose of this study was to evaluate the results of various operative methods in the management of tibial plateau fractures.

MATERIALS AND METHODS

Forty nine patients with tibial condylar fractures were treated with various operative techniques (between January 2009 to June 2012) in our department. Patients with open injuries requiring external fixation (Open grade II or III), vascular involvement, open growth plates, pathological fractures, pre-existing joint disease (Inflammatory arthritis or a prior fracture), severe head injury (initial Glasgow coma scale score less than eight) or other neurological condition that would interfere with rehabilitation and patients with history of previous surgery in the same knee were excluded from the study. If fracture consists of only single fragment with no comminution, with little or no depression, percutaneous fixation with appropriate sized AO cannulated or cancellous screws was done. Otherwise, open reduction and internal fixation (ORIF) was done via standard anterolateral approach. In case of depression, the depressed articular fragment and compressed cancellous bone was elevated with small periosteal elevator after making cortical window below the depression (if needed). Bone grafting was done, if the surgeon felt the need of the same per-operatively. Definitive fixation was done by buttress plate (either T plate, L plate or Proximal Tibia locking plate). Additional medial plate was kept for bicondylar

fractures where medial condyle was comminuted. When the condition of the soft tissues envelope was unsatisfactory, operative procedure was deferred until satisfactory healing of the soft tissues.

The postoperative regimen was individualized to each patients depending upon the stability of fixation. Knee was immobilized for six weeks in patients treated with percutaneous screw fixation. In patients treated with ORIF with stable fixation, knee mobilization was started from the first post-operative day. In unstable fractures, knee was immobilized in a brace for a variable period of time individualized to each patient. Weight bearing was deferred until nine weeks. Patients were followed up at regular interval till the patient resumed to pre-injury activity in both personal and professional aspects; when final evaluation was done.

The functional results were evaluated based on following three sub-scores:

1. Difference in Pre-injury and Final Knee Society Score (KSS)^[14]
2. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)
3. Return to Pre-injury activity (Both Personal and Professional)

The final functional score was calculated by adding the three sub-scores and divided into four categories. (Table 1)

Table 1: Functional Scoring System.

Grade	KSS Difference	WOMAC Score	Return to Pre-injury Activity (Five points were given to each month)		Total Functional Score
			Personal	Professional	
Excellent	<40	<20	<20	<20	≤100
Good	41-60	21-40	21-40	21-40	101-180
Average	61-80	41-60	41-60	41-60	181-260
Poor	>80	>60	>60	>60	>260

The radiological results were evaluated based on following four sub-scores:

1. Metaphyseal-Diaphyseal Angulation
2. Joint line Depression
3. Condylar Widening

4. Arthritis Grade

The final radiological score was calculated by adding the four sub-scores and divided into four categories. (Table 2)

Table 2: Radiological Scoring System.

Grade	Metaphyseal-Diaphyseal Angle (2.5 points for each degree)	Joint Line Depression (2.5 points for each mm)	Condylar Widening (2.5 points for each mm)	Arthritis Grade (Five points for each grade)	Final Radiological Score
Excellent	0-5	0-5	0-5	0-5	0-20
Good	6-10	6-10	6-10	10	21-40
Average	11-15	11-15	11-15	15	41-60
Poor	>15	>15	>15	20	>60

Results were categorized into excellent, good, average and poor.

Statistical method:

All calculations were done using the software Epi-Info version 1.1. Categorical results were compared using Chi-square test. And nominal values were compared using t-test. P values were calculated according to these values and 95% confidence interval were taken for significance.

RESULTS

Mean age of the patients was 44 (21 to 63 years) years. Fracture was common in males (68%). Road traffic accidents were found to be the commonest mode of trauma (76%). Seventeen patients had associated injuries, 14 of which affected lower limb. Thirteen patients had soft tissue injuries (Tschere grade C1 or C2). There were two Type I, 19 Type II, five Type IV, nine Type V and 14 Type VI fractures. None of the patient had type III fracture. Average articular surface depression was 5.4 mm. Thirty-seven patients were treated with open reduction and internal fixation with buttress plate and 12 were treated by percutaneous screw fixation. Bone grafting was required in 10 patients. Four patients developed infection and two patients developed lateral peroneal nerve palsy.

Average duration of hospital stay was ten days. Cases with soft tissue injury had increased duration of hospital stay (17 days). The average period of knee immobilization was 2.84 weeks. Average time to weight bearing was 12 weeks.

At final follow-up, there were 13 excellent, 18 good and 15 fair and three poor functional results. While there were 19 excellent, 18 good, 10 fair and two poor radiological results.

Of the 12 Low-grade fractures (Type I and II) treated with Closed Reduction and Internal Fixation (CRIF), there were five excellent, one good and five fair and one poor functional results. There were five excellent, five good, and two fair radiological results.

Nine patients with low-grade fractures were treated with ORIF three excellent, three good and three fair functional results. There were four excellent, four good, one fair radiological results.

All patients with high-grade fractures were treated with ORIF. There were five excellent, 14 good, seven fair and two poor functional results. There were ten excellent, nine good, seven fair and two poor radiological results.

DISCUSSION

Open reduction and internal fixation continues to be the method of choice for the management of intra-articular fractures of upper end of tibia. Various recent studies show that the long-term results after open reduction and internal fixation for tibial plateau fractures are excellent.^[15] Our findings are consistent with these studies. Results both functional and radiological were better with ORIF group even for low-grade fractures. Schatzker classification system is appropriate not only in deciding surgical management it is also appropriate

predictor of prognosis. These fractures are occurring in younger age group and mostly due to accidents. This may be due to increase in frequency of vehicular accidents in recent years. Low-grade fractures are common in older age group (Average age 51 years). These fractures are common in males due to their pre-dominant outdoor activity and active professional behavior in Indian scenario.

Tibia plateau fractures are notorious for soft tissue involvement. In this region, there is marked lack of adequate subcutaneous tissue on the medial side and the bone directly lies below the skin. On lateral side, only a few muscles get either originated or inserted. The arrangements of the fascial compartments also favor increased susceptibility to soft tissue injury. Moreover, these fractures are frequently caused by direct trauma over the area. These are some of the causes responsible for frequent occurrence of soft tissue injury. These injuries delay the operative management. We found better results in patients with compromised soft tissue if operative treatment was preceded by a brief period of conservative management.

In contrast to previous studies, high-grade bicondylar fractures occur in increasing frequencies. In recent days, there is increase in the occurrence of high velocity injuries to the knee. This has resulted in a major shift in the incidence from low energy lateral condyle fractures towards high-energy bicondylar patterns. This partly describes high incidence of bicondylar fractures in our study.

In our study, four (8.2%) patients showed infection and two patients developed lateral peroneal nerve palsy.

All cases in which infection occurred were treated by ORIF. Amongst four cases, three cases occurred in patients with single plate while one case occurred in patients with dual plates. Amongst four patients with

infection, knee was temporarily immobilized. Two were superficial infections. Intra-venous antibiotics were started according to culture-sensitivity report and they were resolved within an average period of 19 days (17 day and 23 day) with regular dressing, without any need for additional surgery.

Two were deep infections, which did not responded to antibiotics and dressing and thorough surgical debridement was done. In one patient, the implant was removed after five weeks and knee was immobilized for additional four weeks. The infection resolved subsequently. The fracture was united at final follow-up but the functional result was poor in this patient. The other patient refused the removal of implant.

Dual plates were used in four patients. Radiological results were better^[16] with dual plates as compared to functional results possibly because of higher rate of infection and associated soft tissue injury. One (25%) showed superficial infection. Moore^[17] et al reported deep infection or dehiscence in four of eleven (36%) patients treated with dual plates. Barei^[18] et al showed 13% incidence of infection in his study of dual plate fixation of bicondylar fracture in his study of 41 patients. The inadequate number of patients in our study precludes any comparison.

Twenty three percent of the patients with soft tissue injuries developed infection in our study. This is supported by the study of Canadian orthopaedic trauma association,^[19] which showed 20% chances of infection in patients with high energy bicondylar fractures with soft tissue injury.

The results in our study are comparable to other studies. Surgeries around proximal tibia itself are associated with more chances of infection due to poor soft tissue coverage, less blood supply, subcutaneous position of the bone and

implant prominence. Separate medial and lateral incisions for dual plating increase the amount of soft tissue disruption. Early surgeries in view to stabilize the fractures as early as possible only add to the injury of the already compromised soft tissue rather doing any good. Adequate duration to allow for the healing of the soft tissue injuries decreases the chances of infection without compromising the fracture treatment.^[20]

Two (4.2%) patients had peroneal nerve palsy in our study. Clinical evaluation and Nerve conduction studies showed partial recovery in both of them at final follow-up. Rasmussen^[21] observed peroneal palsy in 4.5% of the operatively treated patient. This complication can be minimized by improvement in surgical techniques.

The major advantage of surgical management is early rehabilitation. Knee can be mobilized earlier and weight bearing can be started. Early rehabilitation of the knee adds to improvement in overall functional results of the patient and allows for early resumption to pre-injury activity. Prolonged duration of knee immobilization is associated with poorer functional outcome. (Hohl^[22] , Jensen^[23]). The plate-screw construct buttresses the fracture fragment and prevents collapse of the fractured fragments when axial load is applied (i.e. weight bearing is started). Thus, in operatively treated patients, weight bearing can be resumed earlier than conservatively treated patients without risk of developing late deformity. These patients have improved functional outcome. Plus, a generalized sense of satisfaction regarding the treatment is achieved earlier that adds to the psychological benefit of the patient, as the patient starts walking earlier. This helps the patients to return to pre-injury activity earlier and more confidently.

Various factors affected the functional outcomes. Age of the patient significantly lower the functional results.

Some of the old age patients had medical comorbidities that precluded any surgery, even though operative management was indicated. Various other factors like general ill health, debility and high prevalence of osteo-arthritis were also responsible for the observation. Grade of the fracture also affected functional outcomes significantly. High-grade fractures were having more risk of unsatisfactory results. Some patients had associated lower limb injuries. In these patients, the overall functional outcome was affected by these associated injuries also. Many of the patients had unsatisfactory functional outcome despite of satisfactory radiological results and a well-functioning knee. Soft tissue injuries also affected the functional outcome. As such, they were usually associated with high grade fractures which inherently had unsatisfactory functional outcome as stated earlier. Moreover, they increased the risk of infection, which significantly worsened the functional outcome. Infection also detrimentally worsened the functional outcome. Infection is a known factor for poor function. Prolonged knee immobilization, repeated surgeries, and the need of implant removal before satisfactory consolidation of the fracture were some of the reasons for poor functional outcome. Early rehabilitation significantly improved the functional outcomes. Early knee mobilization avoided problems related with knee stiffness. Some of the operative cases where knee was immobilized for prolonged duration, either due to unstable fixation, complex fracture pattern or due to post-operative infection, had unsatisfactory functional outcomes. Early weight bearing allowed early resumption to activity boosting the patient's confidence and increased the general sense of well being.

Despite of the results, this study had several limitations. Several reports have suggested that the accuracy and

reproducibility of plain radiographic measurements of articular congruity may be suboptimal.^[24] While improved measurement accuracy has been demonstrated with computed tomography scanning, only preoperative computed tomography scans were performed for the patients in this study so that potentially improved radiographic accuracy was not available to us postoperatively.

Similarly, the fact that mechanical axis in full length standing radiographs was not taken into account to evaluate radiological outcomes; it may have been a source of error in our determination of radiological results.

Furthermore, we did not assess the patients' socioeconomic status, level of education, or type of employment, which, along with several other unknown factors, may be confounding variables affecting functional outcomes and rehabilitation associated with these injuries.

In addition, the final follow-up evaluation was only 8 months after the injury. It is possible that, with time, many of these patients may have posttraumatic arthritic changes develop in the knee, especially since the articular reduction was imperfect in some of them. We could not also assess other late complications like deformity and hardware related problems that may occur at long term.

We did not treat any patients with circular fixator with or without minimal internal fixation. Recent studies show encouraging results of this modality of treatment in high energy bicondylar tibia fractures, particularly Schatzker type VI with compromised soft tissues. They have several benefits in terms of less chances of infection, maintenance of limb alignment, early knee motion and weight bearing.^[19] However, inability to reduce the depressed fragments, poor patients compliance, hindrance in terminal knee motion and frequent incidence of pin track infection

leading to septic arthritis in some cases are major limiting factors.

CONCLUSION

Intra-articular fractures of the knee are pretty common injuries and yet difficult to manage. The exact guidelines are not clear. Certain factors affect the final functional outcome. Old age, fracture severity, soft tissue injury, associated injuries and post-operative complications are some of the many factors that affect the functional outcomes. In absence of these factors, short term results of the surgical management of these fractures are excellent with acceptable fixation. However, longer follow-up is required to assess the long term effects on knee function in these patients.

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