

ORIGINAL RESEARCH

Outcome of plate fixation in proximal tibia fracture through minimally invasive percutaneous osteosynthesis technique in tertiary care centre

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ABSTRACT

Introduction: The purpose of this study is to assess the outcome of plate fixation in proximal tibia fracture through minimally invasive percutaneous osteosynthesis technique in tertiary care centre.

Materials and Methodology: This study included, 38 men and 7 women aged 19 to 75 (mean, 40; standard deviation [SD], 14) years underwent Minimal Invasive Percutaneous Osteosynthesis (MIPO) for the displaced tibia plateau fractures. Fracture was classified according to Schatzker system. Patient was assessed on the basis of the Rasmussen anatomic score and the Rasmussen functional score. Patients with acceptable and unacceptable outcomes were compared in terms of age using the Chi squared test or Fisher's exact test.

Results: The mean Rasmussen anatomic score was 15.1 (SD, 2.2; range, 10–18); the mean Rasmussen functional score was 25.3 (SD, 3.2; range, 14–29); and the mean range of knee motion was 118° (SD, 10°; range, 90°–140°) [Tables 1]. 27 (68%) of the 40 patients with acceptable anatomic outcome were aged ≤45 years, whereas 3 (60%) of the 5 patients with unacceptable anatomic outcome were aged ≥60 years (p=0.001). Functional outcome was excellent in 19, good in 20, and unacceptable in 6 patients (2 had Schatzker type-I&III and another 2 had each Schatzker type -II&IV fractures). 39 of the patients had a range of knee motion of ≥120°; 28 (72%) of them were aged ≤45 years, whereas 4 (67%) of the 6 patients with unacceptable functional outcome were aged ≥60 years (p=0.001).

Conclusion: MIPO with locking plates can provide effective satisfactory results in proximal tibial fracture. Tibia is a subcutaneous bone in most of its part, MIPO technique leads to less soft tissue damage and less incidence of post operative wound dehiscence, which is a great hurdle for the surgeons. Sufficient numbers of screws in plates in metaphyseal fracture or selection of a long plate for diaphyseal fracture might be a helpful choice to achieve stable fixation of the fracture.

Keywords: tibial fracture, proximal, plateau, MIPO

INTRODUCTION

Tibial plateau fractures are a group of fractures which constitute about 1% of all fractures that is happening and complex bicondylar fractures contribute about 30% of all tibial plateau fractures. Seventy-five years ago, fractures of the proximal tibia were commonly referred as “bumper fractures” since they resulted from the impacted absorbed by the low energy pedestrian versus car fender accidents. Currently, the high velocity injuries like high-speed motor vehicle accidents or falls from heights contribute secondarily to majority of such fractures. Owing to this high velocity in the mechanism of the injury, a greater number of complex tibial condyle fractures were faced. Tibial plateau fractures usually result from direct axial compression which is most commonly associated with a valgus [more common] or varus [less common] component and due to an indirect shearing force. The anterior aspect of the femoral condyle is normally wedge shaped; with the knee in full extension, so the external force generated by the injury directs the femoral condyle into the tibial plateau.

The direction, magnitude and location of the force, the knee position at time of impact and the bone quality determine the pattern of fracture. The complex tibial plateau fractures resulting from direct forces due to high velocity injuries traditionally are elaborated as “Explosion or Shattered” fractures. These fractures pose an inherent difficulty in the therapy due to the extent of soft tissue damage, fracture comminution, displacement of articular fragments, instability and increased risk of compartment syndrome.^{1,2}

Since the closed management of these complex fractures with the conventional cast bracing and traction generally have been ineffective in reducing and maintaining the congruency of the articular surface and axial alignment³ which leads to the malunion and the development of secondary degenerative arthritis.⁴ Anatomical reduction is possible with conventional methods of treatment such as open reduction and internal fixation (ORIF), this procedure has been associated with a large number of soft tissue problems^{4,5,6} and greater number of fixation failures.⁷ This could invariably leads to compromise in the overlying soft tissue envelope and eventually results in the soft tissue necrosis and deep wound infections. In order to avoid such complications and maintain adequate bony reduction, the concept of Biological Fixation was developed recently. The aim and objective of this Biological fixation⁸ is to assist in the physiological process of bone healing carefully and optimally with minimal amount of surgical intervention in the future.

Little is known about patient related outcome. It has been shown that older age corresponds to poorer outcomes in patients over 55 years of age, and that radiographic fracture severity corresponds to poorer outcomes^{28,29}.

Both conservative and operative treatments have achieved good results for tibial plateau fractures.^{8,9} And surgical intervention is usually recommended for fractures with more than 5 mm displacement or $>5^\circ$ varus or valgus in order to restore the joint congruity and limb alignment and enable early knee mobilisation.^{10,11}

The aim and objective of this Biological fixation⁸ is to assist in the physiological process of bone healing carefully and optimally with minimal amount of surgical intervention in the future.

MATERIALS AND METHODOLOGY

This study was conducted in IGIMS Patna from June 2016 to Dec 2021; the study was performed in accordance with the ethical standards and review board. This study included, 38 men and 7 women aged 19 to 75 (mean, 40; standard deviation [SD], 14) years underwent Minimal Invasive Percutaneous Osteosynthesis (MIPO) for the displaced tibia plateau fractures. The exclusion criteria include those patients with neurological injury, various other fractures involving the ipsilateral or contralateral lower limb open fractures other than Gustilo type I, or mentally/physically handicapped patients. Written informed consent of each patient was obtained after explaining the protocols of the study to be carried out. According to the Schatzker system, the tibial plateau fractures were classified as types I (n=4), II (n=10), III (n=12), IV (n=7), V (n=7), and VI (n=5). Six patients out of 45 had Gustilo type I fracture; 2 of them underwent debridement and then MIPO after confirmation of no growth in tissue cultures 72 hours later. 10 patients needed additional bone grafting along with MIPO. Radiography and computed tomography with 3-dimensional reconstruction (for complex injuries) were obtained to measure the size, location and extent of articular depression of fracture fragments. For the anatomic Rasmussen score, 18 was considered as excellent, 12 to 17 as good, 6-11 as fair and <6 as poor. For functional Rasmussen score 28-30 was considered as excellent, 24 – 27 as good 20-23 as fair and <20 as unacceptable. Patients with acceptable and unacceptable outcomes were compared in terms of age using the Chi squared test or Fisher's exact test.

RESULTS

The mean operating time was 113 (SD, 28; range, 65– 180) minutes; the mean length of hospital stay was 9 (SD, 1.5; range, 3–19) days; the mean Rasmussen anatomic score was 15.1 (SD, 2.2; range, 10–18); the mean Rasmussen functional score was 25.3 (SD, 3.2; range, 14–29); and the mean range of knee motion was 118° (SD, 10°; range, 90°–140°) [Tables 1]. Anatomic outcome was excellent in 11, good in 29, and unacceptable in 5 patients (two had Schatzker type I and one each had Schatzker type-II, -III, and -IV fractures). 27 (68%) of the 40 patients with acceptable anatomic outcome were aged ≤ 45 years, whereas 3 (60%) of the 5 patients with unacceptable anatomic outcome were aged ≥ 60 years ($p=0.001$). Functional outcome was excellent in 19, good in 20, and unacceptable in 6 patients (2 had Schatzker type-I & III and another 2 had each Schatzker type—II&IV fractures). 39 of the patients had a range of knee motion of $\geq 120^\circ$; 28 (72%) of them were aged ≤ 45 years, whereas 4 (67%) of the 6 patients with unacceptable functional outcome were aged ≥ 60 years ($p=0.001$).

Table 1 Patient distribution according to fracture types and outcomes

Schatzker type	Number of patients (n-45)	No. of patients	
		Acceptable anatomic outcome	Acceptable functional outcome
I	4	2	2
II	10	9	9
III	12	11	10
IV	7	6	6
V	7	7	7
VI	5	5	5



Case 1. pre-op pic

Case 1. Post -op pic

follow - up



Case 2. pre-op pic

Case 2. Post -op pic



Case 3. Percutaneous elevation of depressed fracture; Plate fixation after elevation of depressed fracture

DISCUSSION

MIPO procedure facilitates indirect fracture reduction along with the placement of percutaneous submuscular implant.¹² the resultant favourable outcome is not due to MIPO but because of the less extensive manipulation of the soft-tissue envelope and lesser devitalisation of fracture fragments. In a study where bumper fractures are treated by ORIF, 20% of patients ended with superficial or deep infections even after acceptable functional outcome.¹³ In this current study, all the study participants had acceptable fracture healing with no wound dehiscence or infection, except the one fracture which had a closed Schatzker type-III fracture that developed late-onset (at month 5) deep infection which was later treated with wound debridement and plate removal.

MIPO usually results in reportedly lesser incidence of soft-tissue problems and the following complications which achieves better outcome than ORIF procedure.¹⁴ 89% of our study group patients attained acceptable anatomic (reduction) outcome, which was later comparable to other studies which were reporting 91% to 100%.¹⁵ 87% of our patients gained acceptable functional outcome, which was also comparable to other studies which were observing the values at 64% to 91%.^{15,16} In this study, 4 of the 6 patients with unacceptable functional outcome were aged more than 60 years. Since the elderly patients usually have an underlying degenerative change in the joints that is usually induced after intra-articular fractures which indicates that age is the main predictor that mostly determines the functional outcomes.¹⁶ Moreover, treatment principles are usually the same for both elder and younger patients.¹⁷

In our study, anatomic outcome was mostly associated with functional outcome, except in one younger patient who achieved good functional outcome with a reportedly fair anatomic outcome. Four of the six patients with unacceptable functional outcome, each two had Schatzker type-I & III fractures, whereas all 12 patients with Schatzker type-V and -VI fractures achieved acceptable outcome. Schatzker type-V and -VI fractures are usually associated with worse outcome. MIPO procedure was observed to reduce postoperative pain and encourages early rehabilitation and thereby improving the articular cartilage nutrition and wound healing.¹⁸ it is aesthetically very acceptable because of its capability of less scar formation.¹⁹ Also in our study, computed tomography with 3-dimensional reconstruction was used to assess the complex injuries. It should have been done for all cases to delineate the fracture pattern and guide the operation plan.²⁰ the use of more modern implants with locking screws and pre-contoured locking plates usually provides better stability which may further improve outcome, particularly for the elderly patients. Patience is the key factor effective for soft-tissue management, particularly when the soft-tissue envelope is severely contused. A simple anterior spanning external fixator across the knee should be performed as an interim measure. There is a risk of developing late onset post-traumatic secondary arthritis when the intra-articular fractures are inadequately and ineffectively treated. Long-term follow-up is therefore mandatory in such cases.²¹

With the damage to soft tissue following the high energy of proximal tibial fractures, conventional open reduction and internal fixation may often results in consequential soft tissue complications such as wound breakdown and deep infection.^{22,23,24} In order to avoid these complications, the hybrid or circular wire external fixator is a good option to be considered but there are associated problems of non-union, mal-union and pin track infections are relatively common.²⁵ Recently, the MIPO technique has been developed which

not only to improve the rate of fracture healing²⁶ but also to limit soft tissue elevation at the fracture site.²⁷

CONCLUSION

MIPO with locking plates can provide effective satisfactory results in proximal tibial fracture. Tibia is a subcutaneous bone in most of its part, MIPO technique leads to less soft tissue damage and less incidence of post operative wound dehiscence, which is a great hurdle for the surgeons. Sufficient numbers of screws in plates in metaphyseal fracture or selection of a long plate for diaphyseal fracture might be a helpful choice to achieve stable fixation of the fracture.

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