

Functional Outcome of an Anatomically Contoured Locking Plate in Intra-Articular Pilon Fracture with MIPO Technique

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ABSTRACT

Aim: To evaluate the outcome of osteosynthesis by using anatomically contoured locking plates in the management of intraarticular fractures of tibial plafond with minimally invasive plate osteosynthesis (MIPO) technique

Methods: All the 50 patients presenting with intra-articular fractures (Pilon fracture type B and C) in the Accident and Emergency (A&E) department were included in this study. The patients involved in high-energy trauma were treated according to advanced trauma life support guidelines for any associated life- or limb-threatening injuries. The clinical, functional, and radiographic plain anteroposterior and lateral radiographs) evaluations were conducted at 6 months according to Modified Klemm and Borner scoring system and outcome variables i.e. excellent to good was labeled.

Results: There were 76% males and 24% females. Most of the patients 23(46%) were in >45 years, age group. Among 50 patients, 28(56%) had type-B fractures, while 22(44%) had type-C fractures. 36(72%) had BMI <30, while 14(28%) had BMI ≥30. 3(6%) had wound infections. Among 50 patients, 41(82%) had an excellent-good outcome. A good outcome was seen in male patients (78%), as compared to female patients. A good outcome was observed in 39% of patients with age greater than 45 years followed by 32% in 18-30 years. An almost equal percentage of good (56-44%) and poor (55.6-44.4%) outcomes were reported in both types of fractures. 70.7% of patients with BMI <30 reported a good outcome. A good outcome was observed in 41 patients who do not have wound infection. However, 6 patients reported a poor outcome who didn't have wound infection.

Conclusion: Plate osteosynthesis using anatomically shaped locking plates via minimally invasive method is an efficient way of stabilization for distal tibia fracture when considering union rates and final functional outcome.

Keywords: Intra-Articular Fracture, Pilon Fracture, Plate Osteosynthesis.

INTRODUCTION

Fractures of the distal portion of the tibia account for approximately 10% of all tibial fractures. 1 Tibial plafond injuries are classified as extra-articular (43 type A) or intra-articular, which might be partial articular (43 type B) or whole articular (43 type C) (43 type C). 2 The kind and timing of surgery are determined by the period since the accident, the state of the soft tissues, the presence of any secondary injuries, and the presence of an open wound or vascular compromise. The current study aims to assess the efficacy of osteosynthesis employing anatomically contoured locking plates in the treatment of tibial pilon intra-articular fractures. Preliminary stabilization is often performed with an external fixator, with or without fibular fracture fixation. 3 This is done when there is soft-tissue edema. When the state of soft tissues is optimized, definitive surgery is performed. To anticipate potential complications and save time, the surgery must be carefully and thoroughly planned based on radiography and CT results. For an open technique, the fracture pattern should be examined to establish the location and number of incisions. An anteromedial incision above the distal tibia directly lateral to the tibial crest and following the tibialis anterior tendon, on the other hand, provides sufficient exposure for open reduction of the tibial articular fragments. An anatomically shaped locking plate is placed over the medial side of the tibia and progressed percutaneously proximally into the metaphysis, reducing soft-tissue stripping across the bone and soft-tissue damage. Locking contoured plates feature threads within screw holes that engage screw heads to provide a fixed-angle design that enhances fixation in osteopenic bone and multi fragment fractures. Fixation of a femoral fracture is critical. It adds strength to the overall reconstruction and aids in the prevention of valgus deformity. 4 Skin is closed with no stress. In the initial postoperative phase, vascularity and feeling in the toes are reported. The leg is raised at all times.

To guarantee an early diagnosis of compartment syndrome, regular observations are conducted. Active activities are recommended, and antithrombotic medications are used as needed. When the patient is comfortable, he or she is released home. Patients are instructed not to bear weight on the operated leg unless they have been cleared to do so¹⁻⁵.

MATERIALS AND METHODS

A descriptive case series was conducted at the Department of Orthopedic Surgery Department, Shaikh Zayed Hospital Lahore from December 22, 2020, to June 22, 2021 after approval from Institutional Ethical Review Board.

Sample Size & Technique: Sample size of 50 patients calculated with 95% confidence level and 11.5% margin of error with an expected percentage of excellent to good results as 80%. A non-probability consecutive sampling was considered.

Selection Criteria: All Patients of both genders in the range of 18-65 years of age. Patients included with intra-articular fractures (Pilon fracture type B and C) who presented within two weeks of injury. Patients were enrolled who were presented to the emergency and OPD of Shaikh Zayed Hospital. (1) Patients refusing to participate in the study. Those patients were excluded who were with open wounds, with vascular compromise, and with associated fractures of the lower limbs, pelvis, or the spine. Patients unfit for surgery based on pre-operative evaluation (with ASA score IV or above) were also excluded. Cases of severe soft tissue compromise (by identifying the presence of swelling, erythema, and blisters) were not included. Patients with uncontrolled Diabetes Mellitus were excluded.

Data Collection: After approval from the hospital's ethical committee, all the patients presenting in the Accident and Emergency (A&E) department, fulfilling the mentioned criteria were included in this study. Patients were admitted after pre-treatment evaluation consisting of a detailed medical history, physical examination, X-ray ankle joint anteroposterior, lateral and mortis view and computed tomography (CT) scans.

Clinical and Surgical Management: The patients involved in high-energy trauma were treated according to advanced trauma

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life support guidelines for any associated life- or limb-threatening injuries. The back slab was given and the affected leg elevated. The antibiotics and analgesia were administered along with an anti-tetanus toxoid. All the patients with mild to moderate swelling and no blisters were operated under fluoroscopy within the first 36 hours with open reduction and internal fixation using an anatomically contoured locking plate and for associated fibula fracture, the one-third tubular plate was used. A patient was advised non-weight bearing crutch walking while still in the hospital. Sutures were postoperatively removed in the 3rd week. Protection was supplied by the use of a short-leg, non-weight-bearing cast for 6 weeks. The specific fracture pattern determines weight-bearing status. Patients were non-weight bearing for the first three weeks before beginning toe-touch weight-bearing in the fourth postoperative week. Outpatient physiotherapy was started immediately after the cast was removed permanently after six weeks to optimize the range of motion in the foot and ankle. At 6 months, clinical, functional, and radiographic plain anteroposterior and lateral radiographs were evaluated using the Modified Klemm and Borner grading method, and outcome factors ranging from excellent to good were labeled as in operational definitions. All the procedures were done by the researcher under the supervision of the consultant supervisor. All the data were collected in a pre-designed proforma.

Data Analysis: The data were entered in SPSS v25.0. Quantitative variables like age, mean Modified Klemm, and Borner score were presented as Mean±S.D. Qualitative variables such as gender and outcome (excellent to good) were presented as frequency and percentage. Data were stratified for age, gender, fracture type (B and C), BMI (<30, ≥30), and wound infection. Following stratification, the Chi-square test was applied.

RESULTS

Patients Included: All the 50 patients presenting with intra-articular fractures (Pilon fracture type B and C) in the Accident and Emergency (A&E) department were included in this study.

Age and gender distribution: There were 38(76%) males and 12(24%) females. Most of the patients 23(46%) were in the >45 years age group, while 15(30%) and 12(24%) patients were in 18-30 and 31-45 years age groups respectively. The mean age of the patients was 41.1±14.4 years.

Fracture Types: Among 50 patients, 28(56%) had type-B fractures, while 22(44%) had type-C fractures.

BMI, Wound Infection, and Outcome: 36(72%) had BMI <30, while 14(28%) had BMI ≥30. 3(6%) had wound infections. Among 50 patients, 41(82%) had an excellent-good outcome.

Stratification of Outcome Concerning Gender: A good outcome was seen in male patients (78%), as compared to female patients. However, there existed an insignificant association between gender concerning outcome (excellent-good) (Table 1). Overall, a good outcome was reported in 82% of patients.

Table-1: Stratification of outcome with respect to gender

Gender	Outcome (Excellent-Good)		Total
	Yes	No	
Male	32(78%)	6(66.7%)	38(76%)
Female	9(22%)	3(33.3%)	12(24%)
Total	41(82%)	9(18%)	50(100%)

P value: 0.469 (insignificant results)

Stratification of Outcome Concerning Age Groups: A good outcome was observed in 39% of patients with age greater than 45 years followed by 32% in 18-30 years. 78% of patients with >45 years reported a poor outcome. There existed an insignificant association between age groups with respect to outcome (excellent-good) (Table 2).

Table-2: Stratification of outcome with respect to age

Age groups	Outcome (Excellent-Good)		Total
	Yes	No	
18-30 years	13(31.7%)	2(22.2%)	15(30%)
31-45 years	12(29.3%)	0	12(24%)
>45 years	16(39%)	7(77.8%)	23(46%)
Total	41(82%)	9(18%)	50(100%)

P value: 0.072 (insignificant results)

Stratification of Outcome Concerning Fracture Type: Almost equal percentage of good (56-44%) and poor (55.6-44.4%) outcomes were reported in both types of fractures (i.e., type-B and type-C). There existed an insignificant association between fracture types with respect to outcome (excellent-good) (Table 3).

Table-3: Stratification of outcome with respect to fracture type

Fracture type	Outcome (Excellent-Good)		Total
	Yes	No	
Type B	23(56/1%)	5(55.6%)	28(56%)
Type C	18(43.9%)	4(44.4%)	22(44%)
Total	41(82%)	9(18%)	50(100%)

P value: 0.072 (insignificant results)

Stratification of Outcome Concerning BMI: 70.7% of patients with BMI <30 reported a good outcome. However, more patients (77.8%) reported poor outcomes. 29% of patients with an age greater than 30 years showed a good outcome. There existed an insignificant association between BMI with respect to outcome (excellent-good) (Table 4).

Table-4: Stratification of outcome with respect to BMI

BMI	Outcome (Excellent-Good)		Total
	Yes	No	
<30	29(70.7%)	7(72%)	36(72%)
≥30	12(29/3%)	2(22.2%)	14(28%)
Total	41(82%)	9(18%)	50(100%)

P value: 0.670 (insignificant results)

Stratification of Outcome Concerning wound infection: A good outcome was observed in 41 patients who do not have a wound infection. However, 6 patients reported a poor outcome who didn't have wound infection.

Table-5: Stratification of outcome with respect to wound infection

Wound infection	Outcome (Excellent-Good)		Total
	Yes	No	
Yes	0	3(33/3%)	3(6%)
No	41(100%)	6(66.7%)	47(94%)
Total	41(82%)	9(18%)	50(100%)

P value: Chi-square cannot be calculated due to one zero cell value

DISCUSSION

The fracture is an intra-articular fracture, which tends to extend into the tibiotalar joint and also proximally into the metaphysis. They occur in an anatomic region where there is particularly poor soft tissue coverage and precarious blood supply. The surgical treatment of these fractures comprises anatomical reduction of the articular surface, stable fixation, and alignment restoration. Treatment must consider not only the stability of the fracture but also the care of soft tissue damage, which is a common source of later problems. We assessed the efficacy of osteosynthesis employing anatomically contoured locking plates in the treatment of tibial pilon intraarticular fractures with the MIPO technique. Because distal tibial fractures treated with plate osteosynthesis, particularly after high energy traumas, had greater complication rates, many surgeons chose the IM interlocking nailing approach to avoid surgical insult to the fracture and accompanying soft tissue.

However, proximal and distal tibia fractures might be difficult to manage with an IM device, resulting in malunion rates of 5–58%⁵. The less intrusive plating approach decreases surgical stress while also preserving a more biological environment for fracture repair⁶. Despite recent reports of efficacy with locking plates for distal tibia fractures, the best therapy for these remains debatable.⁷⁻⁸ In our study, there were 38(76%) males and 12(24%) females. The mean average age incidence was 41.1 years. The youngest individual was 18 years, and the oldest was 65 years. Among 50 patients, there were 28 cases of type-B fractures. The average period of radiological union was determined to be 24.2 weeks in the current investigation. We found that male patients had a better prognosis (78%) than female ones. 39% of patients over the age of 45 had a favorable result, whereas 32% of those aged 18 to 30 had a favorable outcome. In both types of fractures, a nearly equal number of favorable (56-44%) and bad (55.6-44.4%) outcomes were recorded. 70.7% of patients with a BMI of 30 had a favorable outcome. In 41 individuals who did not have wound infection, the result was favorable. However, 6 patients who did not have wound infection had a bad prognosis.

According to one study, the average union duration was 22.6 weeks. It has been shown that adopting indirect reduction procedures to preserve the soft tissue envelope and blood supply surrounding the fractures promotes fracture healing independent of the type of fixation^{6,10}. Reports of 7–35% of distal tibia fractures treated with MIPO have had problems with malalignment¹¹. Teeny et al. observed that patients who experienced at least one severe complication, such as skin slough, wound dehiscence, infection, nonunion, malunion, or implant failure. Furthermore, 16.6% of patients with recurrent osteomyelitis or soft tissue dehiscence require amputation¹²⁻¹³. Recently, minimally invasive plating of injuries in this area has shown reduced soft tissue concerns and a lower risk of infection¹⁴.

Percutaneous plating shows rates of secondary surgery ranging from 0% to 20% for delayed fracture healing, compared to rates of up to 42% for nailing, suggesting that plating may be more effective in attaining prompt fracture union without the need for further treatments.⁶ Plate osteosynthesis and intramedullary nailing were shown to be equally efficient methods of stabilization in research. Malunion, nonunion, and subsequent operations, on the other hand, were more common following IM interlocking nails. In the outcome of a previous study, plating results were 40% excellent, 40% good, 13.3% fair, and 6.6% poor whereas, intramedullary nailing had 40% excellent, 53.3% good, 13.3% fair, and 13.3% poor results according to modified Klemm and Borner score¹⁵.

CONCLUSION

When evaluating union rates and eventual functional results, plate osteosynthesis with anatomically contoured locking plates via

minimally invasive procedure is an effective form of stabilizations for distal tibia fracture.

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