

Juxtra Articular Compound Fractures of the Tibia Managed by Percutaneous Anatomical Locked Plating- Feasibility in Indian Rural Population

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ABSTRACT

Introduction: Compound fracture of the tibia is the one of the most common injury encountered by orthopaedic surgeon these days. Diaphyseal compound fractures are well managed by primary interlocking nails with good to excellent results. Metaphyseal juxtraarticular and intraarticular compound fractures of upper and lower end of tibia are not good indication for intramedullary nails due to limitation of short proximal and distal fragment and marked comminution at these areas, also mostly intra articular extensions. Till now these fractures were mostly managed by External fixators or rind fixators. Primary conventional open plating in compound fracture is not a preferred method of management till now due to fear of infection and soft tissue complications and risk of plate exposure. We managed these fractures by minimally invasive plating using locked plate and result evaluated.

Material and Method: In this study we have taken compound metaphyseal fractures of the tibia for primary plating using locked anatomical plate using minimally invasive technique. Ninety four (94) cases of tibia out of which 50 cases of proximal tibia and 44 cases of distal tibia compound fracture up to grade IIIA were taken for study. In all cases primary skeleton traction were applied followed by wound management using through irrigation using low pressure pulse lavage and debridement. Plating was done using MIPPO method within 7 days of injury. Cases were followed up at regular interval and functional outcome assessed by using knee society score for proximal fractures and foot and ankle score for distal tibia fractures.

Results: Primary bone was achieved in 88 of 94 cases within usual duration. Low grade infection at fracture site seen in 8 cases and out of these 8 cases union achieved in 5 cases by continuation of same primary fixation. 3 cases required revision surgery with removal of implant and antibiotics cement beads followed by other method of fixation to achieve union. Good to excellent outcome achieved according to knee society score in 93.8% of proximal cases and again good functional outcome achieved according to Foot and ankle score in 85% of distal tibia cases. None of these cases showed any serious complications like amputation or severe life threatening infection.

Conclusion: With our study we can concluded that compound fractures of proximal and distal tibia can also be well managed by primary plating using minimally invasive technique. This is single staged procedure with minimal financial burden of rural population. One has to take care in proper selection of cases, avoid further soft tissue damage and care should be taken not to leave bone and plate exposed to environment. Wound can be closed by other secondary procedure within next few days without any negative consequences.

Key words: Compound fracture tibia, Primary plating, MIPPO, Metaphyseal compound fracture tibia

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INTRODUCTION

With the increasing number of vehicles on road and also high speed vehicles, poly trauma is commonly encountered problem in any emergency. One of the common injury encountered in these cases are compound fracture of leg involving tibia and fibula. Even in rural setup these types of injuries are common. Now days with better knowledge of soft tissue management^{1,2,3,4} combined with primary intramedullary nailing^{5,6,7,8,9}, compound diaphyseal fractures of tibia giving better results. Metaphyseal

proximal and distal compound fractures of the tibia are still area of concern for most of the orthopaedic surgeons. Still metaphyseal compound fractures of leg are managed by various staged procedure. Known method of management of compound fracture is continuous skeletal traction which leads to joint stiffness, External fixation either tubular^{11,12,13,14}, ring fixators^{15,16,17}, hybrid fixator¹⁸, External Fixator followed by Intramedullary nailing in staged procedure.^{19,20,21,22} These external fixators were used with variable results and have limitation of poor patient compliance, pin loosening, pin tract infection and also these fixators now also known as non union machines.^{21,22} Early internal fixation of open fracture was also advocate.^{10,11} Till now conventional open plating in compound fracture is least preferred method of fixation due to extensive soft tissue damage during operative procedure of plate

application.²⁴ To overcome these shortcomings of External fixation and conventional plating we used minimally invasive technique with locked plating in compound fracture of metaphyseal tibial fracture for the management of these cases and result evaluated.

MATERIAL AND METHOD

This study was performed in the department of orthopaedics of UP Rural Institute of Medical Science and Research, (UPRIMS&R) Saifai, Etawah, a 1000 bedded tertiary care centre situated in rural setup in North Central India in Uttar Pradesh. Cases were selected from patients attending trauma centre emergency and orthopaedics OPD of our institute during Aug 2008 to Aug 2013.

Inclusion criteria:

1. All new cases of compound fracture of proximal and distal tibia
2. Compound proximal and distal tibia fracture up to Grade 3A
3. Fracture without severe periosteal stripping
4. Both Intra and Extra-articular compound proximal tibial fracture included
5. Healthy wound without any pus discharge/deep infection at fracture site
6. Age from skeleton maturity to no upper age limit

Exclusion criteria:

1. Compound fracture more than Grade 3 A
2. Fracture with severe contamination excluded
3. Compound fracture having not adequate soft tissue coverage.
4. Malnutrition or immuno-compromised patients excluded like HIV,
5. Patients with high risk for infection due to medical conditions like diabetes
6. Patients with suspected Peripheral vascular disease like arthrosclerosis/ Berger disease

During period of August 2008 to August 2013, 94 patients of compound fracture of proximal and distal tibia were selected for primary locked anatomical plating using minimally invasive percutaneous plate osteosynthesis (MIPO) method. Out of 94 patients 82 were male and 12 patients were female with age range from 18 yrs to 58 yrs and average age was 32.5yrs. Out of 94 cases 52 cases were of proximal tibial compound fracture and 42 were distal tibial compound fracture. The mechanism of injury were road traffic accident in 72 cases, fall from height in 8 cases and agriculture injury in 10 cases and other causes in 4 cases. Ethical clearance was taken from institutional ethical committee and written informed consent was obtained from each patient.

We classify fracture of proximal and distal tibia according to AO foundation of orthopaedic

Trauma association (AO-OTA) classification. Out of 52 proximal tibial compound fractures 38 cases were 41A, 6 patients were 41B and 8 cases were of 41C group. Out of 42 distal compound fractures 26 were 43A, 10 were 43B and --6 were 43C types. According to Gustilo and Anderson classification²⁵ out of 52 proximal compound fractures 24 were Compound grade I, 18 cases were of compound grade II and 10 cases were of compound grade IIIA. Out of 42 distal compound fractures 19 were of compound grade I, 15 were of compound grade II and 8 cases were of compound grade IIIA group. All patients were managed initially by radical wound debridement, irrigation with low pressure pulse lavage with at least 8 litres of normal saline. Limb kept on Bohlar Broun splint and calcaneum traction applied in all cases. Initially broad spectrum antibiotics started including third generation cephalosporin, 1 gram ceftriaxone with clavulanic acid plus 500mgs Amikacin both IV 12 hrly and 100ml Mertogyl IV 8hrly for 3 days followed by antibiotics according to culture and sensitivity. Repeat daily wound inspection done daily and repeat debridement done if required. Skin and wound condition assessed daily. Patient posted for primary plating within 5 to 15 days of injury with average duration of 7.5 days after injury. All cases were done in supine position in spinal anaesthetics. Precountoured anatomical locked plates were used in all cases. For proximal tibia lateral anatomical locked plate 4.5mm were used from 5 to 11 holes length. For distal tibia medial anatomical hybrid locked plate (3.5mm metaphyseal screw and 4.5 Diaphyseal screws) used ranging from 5 to 9 holes. All plates were inserted without further damaging the already damaged soft tissue coverage using MIPPO method from proximal to distal insertion in proximal tibial fractures and distal to proximal insertion in distal tibial fractures. Reduction were achieved by indirect method under image intensifier control using k wires and Steinman's pin as joy stick where required. Calcaneum traction pin retained till the application of plate and used for per-operative traction if required. Plate length was selected so that at least three good bicortical locked screw purchase were obtained at diaphyseal area. Strength of fixation assessed peroperatively by gentle movement of knee and ankle joints. Every measure was taken to cover the bone and plate with soft tissue at least without and tension. 6 of our proximal tibia cases required lateral release incision to cover the bone with soft tissue and skin. These release incision sited were left for secondary healing. Skin incisions giver during operation were closed in layers and compound wound left open for secondary closure later on either by split thickness skin grafting or left for secondary suturing. Two of our cases required full thickness skin grafting for coverage of exposed bone. At the end of surgery

calcaneum traction pin was removed and well-padded dressing done with crepe bandage and limb kept on Bohler Braun splint.

During post-operative period all patients were given IV antibiotics Inj ceftriaxone 1 gm plus clavulanic acid, IV Inj Amikacin 500mg 12 hrly for 7 days. For initial 2 days Inj Metrogyl 100ml IV 8 hrly added. After 7 days need of IV antibiotics again assessed based on any discharge and wound condition. In most of cases IV antibiotics were replaced by Oral Tab Cifixime 200 mg BD for next 21 days. 6 of our cases required extended IV antibiotics and repeat culture obtained in these cases and antibiotics changed accordingly. Routine wound inspection done daily and condition of skin and any potential plate exposure looked for next 5 days. Thereafter alternative dressing was done till the healing of wound. Gradual knee and ankle mobilization started over next 5-7 days depending on recovery from the post-operative pain. Post-operative radiograph taken 2nd or 3rd post-operative day. Non weight bearing physiotherapy advised to the patient. Patients were discharged after 7-15 days of operation depending on wound healing. Cases were followed up every 3 week for first 2 months, then after every 6 weeks up to 6 months and there after every 12 weeks for at least 2 years. Partial weight bearing allowed when there were radiological sign of bridging callus seen. Full weight bearing allowed after solid bridging callus seen on radiograph.

During each follow up cases were assessed and examined for skin condition, sign of any superficial and deep infection, plate and bone exposure, range of knee and ankle movement, rest and activity pain. Routine follow up radiograph were obtained every 6 weeks until solid bridging callus formation was observed. On radiograph AP and med lateral change in angulations assessed. Final clinical outcome of proximal tibial fracture cases were evaluated using Knee- Society clinical rating score²⁶ where excellent result mean 85-100 score, 70-84 score means Good result, 60-69 score means fair result and <60 score means poor result. For Distal Tibia Fractures functional outcome was assessed with the modified American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hind foot score, as described by Mora et al,²⁷ at final follow-up. The high score of this survey was 68 points, with 40 points for pain and 28 points for function; a higher score indicated a better outcome.

The chi-square test and regression analysis were used to determine the nature of relation between fixed clinical outcomes, complication and possible influencing factors, such as fracture pattern (AO-OTA) and grade of open fracture (Gustilo-Anderson). The analysis was conducted using SPSS ver 17.0 and statistical significance was accepted for p-value <0.05.

RESULTS

During the period of August 2008 to August 2013 total 94 cases of compound fracture of tibia were treated by primary plating using MIPPO technique. In proximal compound tibial fracture out of 52 cases 48 cases completed the follow up of at least two years. The average follow up were 30.4 months. Out of 48 cases 45 cases (93.8%) show complete bony union in follow up radiographs. The average radiological union time in proximal compound fracture cases was from 12 weeks to 18 weeks with average 14.2 weeks. Out of 48 cases one case (2%) show loss of reduction and marked varus angulation due to deep infection at fracture site, this case was managed by removal of plate and external fixator application. This case of early plate removal was belonging to Compound grade IIIA group to start with. Plate screw back out and breakage was seen in none of these cases. Two of these cases (4%) required delayed removal of plate after attaining bony union as they complaints of continuous sinus discharge due to low grade infection. These two cases of delayed plate removal was also from compound grade IIIA group to start with. Out of 48 cases 43 cases (90%) in this series have full range of knee movement. 5 cases (10%) cases show some terminal restriction of movement with extension lag of 5-10 degree. 45 of cases (95%) show no sign of infection in follow up.

There was 100% union rate in comp grade II and Compound grade I group fracture case in this series without any sign of early or delayed infection. Further Final outcome of these patients were assessed after two years of follow up using Knee society score. Excellent results were seen in 35 (73%) cases and good result in 10 (20.8%) cases. Total 45 cases (93.8%) cases show good to excellent result according to this score. 3 cases show fair to poor score and all these cases were from Compound grade III group. Out of total 10 compound grade III proximal tibia cases 8 cases completed the follow up and out of these 8 cases 5 cases show good to excellent results (62.5%), Two cases (25%) were in fair group which required delayed plate removal. Total 7 cases (87.5%) gives good to fair result and one case requires early plate removal and external fixation and shows poor result. In distal tibial compound fracture group out of 42 cases 40 cases completed their follow up of at least 24 months with average follow up of 34 months. Out of 40 cases 35 cases (87.5%) shows complete bony union of follow up radiograph with average union time of 15.4 weeks with range from 14 to 20 weeks. Out of 40 cases 4 cases shows sign of infection (10%) and skin problem over plate so removal of implant were done in these cases and further managed by triangular fixator. All these four cases were from compound grade IIIA group cases to start with. Out of 40 cases

3 cases show some delayed loss of alignment on AP ant lat view but not more than 10 degree. Functional outcome of all these cases assessed with the modified American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hind foot score, as described by Mora et al,⁶ at final follow-up. The high score of this survey was 68 points, with 40 points for pain and 28 points for function; a higher score indicated a better outcome.

Out of 40 cases 20 (50%) cases scores more than 58 points showing excellent result. Out of 40 cases 14 (35%) cases scores between 48-58 giving good result. Over all good to excellent result seen in 34 (85%) cases. 2 cases shows fair result and poor result seen in total 4 (10%) cases. Other complications recorded is distal tibia fracture group were superficial skin infection, plate prominence and skin itching in 4 cases. All these 4 cases giving poor results due to infection and again belong to compound Grade IIIA group. Two cases required revision surgery of removal of plate and other two cases were managed by retaining of locking plate and delayed removal of implant once union achieved.

DISCUSSION

Compound fracture of tibia is one of the most common injuries encountered now days. Most of these patients are young male adults. The prime concern in these cases is soft tissue management. Soft tissue generally takes weeks to month to settle. Various methods were used to manage the underlying fracture with compound fracture ranging from POP immobilization with window, continuous skeletal traction with regular dressing and left the fracture to unite conservatively, Ilizarov fixation, tubular external fixation, hybrid external fixator and locked intramedullary nailing for diaphyseal fracture.

Plaster immobilization of compound fracture is nowadays least preferred method as it has poor patient compliance, high rate of joint stiffness, high rate of malunion and prolonged morbidity. External fixation is also known as non-union machine and again has complications like pin loosening, pin tract infection and secondary loss of reduction. Ilizarov ring fixation is well known method for management of compound fracture with bone loss. Without bone loss and metaphyseal fracture Ilizarov have limitations like pin loosening, loss of reduction. Ilizarov also have poor patient compliance due to bulky ring around limb and also difficulty dressing through ring fixator.

Recent trends going toward the use of primary locked intramedullary nail for the management of compound fractures. Closed interlocked nailing is best biological fixation method done without any further damaging the surrounding tissue with good to excellent results. The main

limitation this cannot be used in juxtraarticular and intraarticular fractures.

Bhandari et al²⁸ fixed compound diaphyseal fracture of tibia with intramedullary nail with good results. He concluded that the risk of reoperation was as high as 18%, implying that one reoperation would be avoided for every five patients treated with IM nailing instead of external fixator. He also reported that external fixator group have higher revision surgery rate then intramedullary nail.

Sarmiento et al²⁹ reported that external fixation in compound fracture suffer from up to 33% malunion, angulation rate.

Bach et al³⁰ showed up to 50% revision surgery required when compound tibial fracture treated with conventional plating. He compared conventional open plating to external fixator for compound tibial fracture. He noted that 50% of patients treated with tibial conventional plate required further operation as opposed to 6.7% in the external fixator group.

Whittle et al³¹ reported cases of compound fractures of tibia managed by intramedullary nailing up to compound grade IIIB with infection rate of 3-8% with rate of 12% for compound grade IIIA and 25% for IIIB fractures. But the metaphyseal and intraarticular fractures of tibia cannot be managed by intramedullary nails due to high incidence of mal-reduction and instability. Furthermore, nailing is contraindicated in intraarticular fractures.

To overcome these limitations of intramedullary nails, proximal and distal compound fracture of the tibia can be managed with plating but using minimally invasive technique without further jeopardising the vascular damage to the underlying bone. Anatomical locked plate can be applied to metaphyseal area with minimal exposure and percutaneous under image intensifier control. This gives advantage of both intramedullary nail and plate.

Giannoudis PV et al²⁴ in his systemic review of 11 studies used conventional plating for the management of severe open tibial fractures. The overall union rate ranged from 62-95% with time to union ranging from 13-41 weeks. The reoperation rate ranged from 8-69% and deep infection rate was 11%.

Stannard at al³² in his study reported that LISS- less invasive stabilization system can be used as an alternative for the management of compound proximal tibia fracture with 5-8% deep infection rate. The incidence of deep infection as per Gustilo and Anderson classification was Type I and II- 0%; Type II- 2.7%; Type IIIA- 7.7%; TypeIIIB-7.1%.

Kim JW et al³³ used minimally invasive plate osteosynthesis for open fracture of proximal tibia. He reported deep infection rate up to 16.7% but no severe complication requiring procedure like implant removal or amputation. They also noted that

lower grade open fracture had significantly lower infection rate.

Sohn et al³⁴ used staged protocol in treatment of open distal tibial fracture using lateral MIPPO with good results. The average union time in his study was 21 weeks. In his study average delay for plating was 15 days after injury.

Young et al³⁵ also reported satisfactory results of compound fractures treated by staged protocol using MIPPO, on open distal tibia fracture patients.

Collinge et al³⁶ and Boren et al also reported good result using staged protocol using MIPPO in open distal fracture of tibia.

CP pal et al³⁷ also conducted primary plating osteosynthesis in open fracture in small series of 12 cases with satisfactory result. They reported that good to fair result in 90% cases and deep infection in 6.5% cases. Overall union rate was good with one case requiring bone grafting.

In our series most of our cases were from rural setup. Cases up to compound grade IIIA of metaphyseal fractures selected for primary definitive plate fixation of metaphyseal fractures by minimally invasive plating using percutaneous anatomical locked plate system. This procedure avoids repeated surgeries in rural population and gives them less economical burden also. All care was taken to cover the plate and bone by soft tissue and plating is followed by regular wound dressing. Wound closure attained by 15 day in most of the cases either by secondary suturing. Split thickness skin grafting required only in 5 cases. Two of our cases required full thickness rotation flap due to skin necrosis and bone exposure. All these minor secondary procedure were without any further financial burden to the rural population as these are OPD/minor procedures.

One case of compound grade IIIA fracture of proximal tibia and two cases of compound grade IIIA of distal tibia required removal of plate after 5 days of plating due to uncontrolled deep infection and patient further managed by ring fixator. Average duration of soft tissue healing in distal tibial fracture cases were 23 days whereas in proximal tibial fracture cases were 15 days. Average union time was lower in proximal tibial fracture that is 14.2 weeks and of distal tibial were 15.6 weeks.

Skin problems related to plate were more in distal tibial compound fracture again patients of distal compound fracture complaints more of plate prominence and pain compared to proximal plating group.

Plating of proximal compound fracture is better tolerated than distal tibial compound fracture.

In conclusion primary plating of compound fracture is a good method of management for proximal and distal metaphyseal and intraarticular fracture of tibia. This is single stage surgery giving

less financial burden to rural population and better acceptance as early mobilization of joints allowed with lesser complication. Up to compound grade II primary plating can be used with excellent to good result without any risk of increase infection and delayed union. In Comp grade IIIA most of the cases can be managed with primary plating with proper selection of the patients and wound condition without any severe complications like amputation. Locked plating used by MIPPO technique in metaphyseal compound tibia fracture is a very good method of management of metaphyseal compound fracture without risk of any severe complications in rural population.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ETHICAL STANDARDS

The protocol of this study was approved by the institutional review board. This study was authorised by the local ethical committee and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000. The well informed written consent was obtained from every case in this study.

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