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Functional outcome of minimally invasive plate osteosynthesis using anatomical locking compression plate for distal tibia fractures: A prospective study

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Abstract

Background: Distal tibia fracture is a therapeutic challenge in modern orthopaedics. Due to fracture pattern, periarticular location, minimal soft tissue coverage, the surgical treatment is complex one. Various modality of surgical treatment such as closed intramedullary nailing, The newer technique of fixation of distal tibia fractures - minimally invasive percutaneous plate osteosynthesis involves less soft tissue handling and the minimal periosteal stripping resulting in low infection rate and faster healing.

Materials and Methods: The prospective study was done at a tertiary care centre on 18 patients from June 2017 to June 2019. The functional outcome is evaluated by clinical and radiological (AP/LATERAL) aspects at 6th, 12th weeks, 3rd, 6th months and one year interval using Olerud-Molander Ankle Questionnaire/ Score (OMAS).

Results: The results were excellent in 54%, good in 29% and fair in 17% of patients. The post-operative pain was minimal and the post-operative ankle function was very good.

Conclusion: Minimally invasive plate osteosynthesis using LCP proves to be a safer technique in the management of distal tibial fractures without intra-articular comminution by providing good fracture healing, enabling rapid functional recovery and avoiding major skin complications.

Keywords: Distal tibia fractures, LCP, MIPO, OMAS

Introduction

Distal tibia fracture is a therapeutic challenge in modern orthopaedics. Due to fracture pattern, periarticular location, minimal soft tissue coverage, the surgical treatment is complex one [1]. Various modality of surgical treatment such as closed intramedullary nailing, Open Reduction Internal Fixation with conventional plate osteosynthesis and external fixation has been tried so far [2]. But none of them have good functional outcome but high complication rate (20-50%) [3]. Closed intramedullary nailing of distal tibia fracture can be a good option in AO type A fractures but the hourglass shape of the distal tibia does not allow anatomical reduction resulting in rotational and angular mal-alignment [4]. Closed nailing is not an option, if the fracture line is less than 5 cm from the articular margin (Type B, C fracture) [5]. External fixation is indicated in severe soft tissue injury or as a temporary stabilizing device [6]. Pin tract infection, mal-reduction and joint stiffness are the drawbacks of external fixation [7].

Though ORIF with conventional plating provides anatomical reduction and addressing the rotational, angular mal-reduction [8]. It is associated with extensive soft tissue dissection and periosteal stripping which devitalize the fracture fragment resulting in nonunion, infections and wound dehiscence [9]. The newer technique of fixation of distal tibia fractures - minimally invasive percutaneous plate osteosynthesis involves less soft tissue handling and minimal periosteal stripping resulting in low infection rate and faster healing [10]. The pre-contoured anatomical locking plate used on the medial aspect prevents varus collapse, implant failure and also secures the fracture reduction without further displacement.

Materials and Methods

The prospective study was done at a tertiary care centre on 18 patients from June 2017 to June 2019.

Inclusion criteria

1. Distal tibia fractures involving the lower one third of tibial metaphysis and metaphyseo-diaphyseal junction. AO/OTA classification type A,B,C distal tibia fractures
2. Ruedi allgower type II&III pilon fractures.
3. Simple fractures.
4. Age: 20-80 years

Exclusion criteria

1. Type I ruedi-allgower pilon fracture.
2. Compound fractures.
3. Delayed presentation of more than three weeks.
4. Non-union distal tibia fractures

Pre-operative assessment

After initial resuscitation a meticulous history was taken and thorough clinical examination was done to rule out other associated injuries. Distal vascularity and neurological status should be assessed. Any open injury should be addressed vigorously with thorough wound debridement and stay sutures applied. Informed and written consent for the surgery and willingness to participate in the study are obtained from all the patients.

Post-op protocol

1. The patient's lower limb is immobilized in a above knee slab
2. Post-op IV antibiotics to cover gram positive and negative spectrum were given for 5-7 days.
3. The sutures are removed on 12th day.
4. At the end of 3 weeks the above knee slab is removed and ankle brace is applied. Initially to start with gentle ankle motion exercise. The patient is then allowed for non- weight bearing mobilization with the help of walking aid.
5. After 6 weeks, based on radiological union allow the patient to partial weight bearing. Full weight bearing advised once the fracture is united clinico-radiologically.

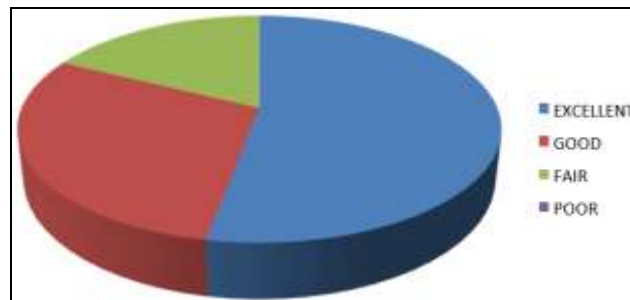
Post-op follow up

The functional outcome is evaluated by clinical and radiological (AP/LATERAL) aspects at 6th, 12th weeks, 3rd, 6th months and one year interval using Olerud-Molander Ankle Questionnaire/ Score (OMAS).

Results

80% of the patients were between 30- 50 yrs. Both male and female were included, majority being males. Right side was common and no bilateral cases were studied. 44% of the fractures were compound injuries. 44% of patients had associated injuries. Mean duration between injury and surgery was 1 week. Average time for bone union was 18 weeks. Average ankle dorsi flexion was 20 degrees. The results were excellent in 54%, good in 29% and fair in 17% of patients. The post-operative pain was minimal and the post-operative ankle function was very good. Though we had marginal skin necrosis in 4 cases, they healed with regular dressings and none of the cases went for skin and soft tissue procedures.

Grading	No of cases	Percentage
Excellent	9	54
Good	5	29
Fair	4	17



Discussion

Ruedi and Allgower were the pioneers in open reduction and internal fixation (ORIF) of pilon fractures [11]. They changed the outlook of management of distal tibia fractures in the early twentieth century. They achieved 74% good functional results following ORIF for distal tibia fractures [12]. But it was later recognized that all their cases were results of low velocity injuries. They could not reproduce similar results following the principles of open reduction internal fixation in high velocity injuries. This led to the development of procedures that respect the soft tissue envelope. These biological methods of fixation are currently the procedures of choice in the challenging distal tibia fractures [13].

Two methods are currently popular in pilon fracture [41] management.

1. Hybrid external fixators are used in severely comminuted pilon fractures with significant soft tissue damage.
2. Minimally invasive plate osteosynthesis (MIPO), is used in fractures without articular comminution and with minimal soft tissue damage.

Ours is a prospective study of 18 cases of distal tibial fractures treated with MIPO using specially designed distal tibial LCP. We did medial plating in all cases. The age group of our patients varied from 21 years to 51 years with the mean age of 36.5 years. 95% of our patients were males. 50% of our cases were extra articular and 50% intra articular fractures. 44% of the fractures were compound in nature. 44% of our cases had associated injuries. We did not perform preliminary external fixation as in the Helfet *et al.* series. We selected patients with apparently good soft tissue condition. Thus a single stage MIPO protocol was followed thereby providing a shorter duration of treatment. This single stage procedure reduced the surgical insult thus preventing complications like wound dehiscence, sepsis, delayed or non-union. The MIPO technique enables a bridging fixation without disturbing the comminuted segments and the surrounding soft tissue [14]. We used an anatomically prevent plate unlike Helfet *et al.* thus achieving stronger fixation in the metaphyseal region as it permitted insertion of 2 or 3 cancellous 6.5 mm screws in the small distal segment [15]. The mean duration between injury and surgery in our study was 1 week. The average time for bone union was 18 weeks. We achieved 54% excellent, 29% good and 17% fair results. The average ankle dorsiflexion was 20°. All our cases were followed for a mean period of 14.2 months averaging from 28 months to 4 months. 2 cases had delayed union. The prime reason for delayed union in both the cases was intact fibula which made the fracture site to distract. There was no case of implant failure. The average time of bony union was 18 weeks compared to 18.5 weeks by Shrestha *et al.* and 21.2 weeks by Hasenboehler *et al.* [16, 17]. There were 2 cases that were complicated by ankle stiffness. Both the patients had poor compliance in the post-operative period which was the result of ankle stiffness. Shortening of

<2 cm was seen in two patients both of which had highly comminuted distal tibial fractures with diaphyseal extension. They were managed with heel raise. Though we had marginal skin necrosis in 4 cases, they healed with regular dressings and none of the cases went for skin and soft tissue procedures. Thus, with regards to functional outcome, our results are comparable to those of Shrestha *et al.* These results were possible because of proper case selection, perfect articular reconstruction and meticulous soft tissue handling.

Conclusion

The locking compression plate preserves the fracture hematoma, does not endanger periosteal blood supply and provides a biomechanically stable construct. MIPO stabilises the fracture without disturbing the soft tissue cover, decreases the risk of infection and helps in early mobilization of the joint. Thus minimally invasive plate osteosynthesis using LCP proves to be a safer technique in the management of distal tibial fractures without intra-articular comminution by providing good fracture healing, enabling rapid functional recovery and avoiding major skin complications.

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