Osteosynthesis of Distal Tibial Fractures using Anterolateral Distal Tibia Locking Compression Plate

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Abstract

Introduction: The management of distal tibia fractures has been a great challenge to orthopedic surgeons due to soft tissue damage, extensive comminution, intra-articular extension, and lack of vascularity. Conservative treatment of these fractures quite often results in a number of complications including malunion, non-union, and ankle stiffness. These fractures are generally not suitable for intramedullary nailing despite certain studies indicating satisfactory results in some of these fractures. External fixation can be used either as a temporary or definitive method of treatment, especially in fractures with severe soft tissue injury, but malunion and delayed union continue to be the main problems with this method of fixation. Some studies show significant good results in distal tibial fracture fixed with anterolateral distal tibial locking compression plate (LCP) using anterolateral approach.

Materials and Methods: In this study, 36 patients were treated using anterolateral distal tibia LCP plate between January 2017 and August 2018. The functional outcome was measured by Teeny and Wiss clinical assessment criteria.

Results: Of the 36 patients in the study, 29 were male and seven were female. The mean age was 37.86 years with standard deviation ± 9.54. The majority of cases were AO Type B (50%). In majority of cases (77.13%), complete union was achieved by 16–20 weeks. Three patients had immediate complication in the form of infection and one patient had wound dehiscence. Early complication includes deep infection in four patients, of which two progressed to wound dehiscence. One patient develops non-union and two develop malunion, one patient had infection, one united in valgus, and one had non-union. The mean functional score was 78.16 ± 10.02 with one excellent outcome, six good, 24 fair, and five poor outcomes.

Conclusion: Anterolateral plating in the distal end tibial fractures using anterolateral approach is safe, easy, and effective and has fair functional outcome with less complication.

Keyword: Osteosynthesis, Anterolateral Approach, Distal Tibia

Introduction

Tibia is the most commonly fractured long bone. Its subcutaneous location makes it vulnerable to frequent injury [1]. They are approximately 3 times more frequent in males than in females and the average age of patients is about 37 years [2, 3]. With increasing number of vehicles on the roads in India, complex trauma cases caused by road traffic accidents have increased progressively directly increasing the incidence of tibia fractures [4]. Tibial pilon fractures are fractures involving distal tibial articular surface and mostly are result of high-energy trauma with associated soft tissue injuries. These fractures represent a challenge for the treating orthopedic surgeon [5]. Although multiple treatment approaches and protocols have been described, there is no consensus regarding the optimal treatment of these challenging injuries. Conservative treatment of these fractures quite often results in a number of complications including malunion, non-union, and ankle stiffness [6, 7, 8]. These fractures are generally not suitable for intramedullary nailing despite certain studies indicating satisfactory results in some of these fractures [9, 10, 11]. External fixation can be used either as a temporary or definitive method of treatment, especially in fractures with severe soft tissue injury [9, 12, 13, 14, 15], but malunion and delayed union continue to be the main problems with this method of fixation [16, 17]. Conventional plate osteosynthesis with open reduction can further devitalize the fragments and lead to higher incidence of non-union, infection, and implant failure [18, 19]. Historically, an anteromedial approach has been used for the management of tibial pilon fractures, one of the major disadvantages of this approach is the risk of wound breakdown over the subcutaneous tibia border with the...
potential need for flap coverage. In addition, this approach limits the visualization of the lateral Chaput fragment. Recently, the anterolateral approach to the tibia has been popularized for the management of tibial pilon fractures [20]. Some study found that this approach offers the benefit of improved soft tissue coverage and the potential for a lower rate of wound healing complications by avoiding an incision placement over the subcutaneous border of the tibia. Therefore, this present study has been chosen to evaluate the functional outcome and clinical results while treating distal tibial fractures using anterolateral locking compression plate (LCP) [21].

Materials and Methods

The study was prospective, interventional, and hospital based. All the cases which satisfied the inclusion criteria were included in the study. Duration of study was for 18 months from January 2017 to August 2018 and a total of 36 cases were studied.

Inclusion criteria were adults (>18 years of age), both sexes, and closed and compound Grade I fractures and exclusion criteria include compound Grade II and III fractures, fractures with neurovascular complications, chronic moribund conditions, pathological fractures, and patients not willing to participate in the study.

Patients were evaluated for functional outcome and fracture union according to standard protocol. Patients were followed up periodically and detailed observation was recorded using pro forma. The results were analyzed by statistical methods using Student’s t-test, Chi-square test, and Fisher’s exact test and compared with other studies in literature.

Results

This study was conducted at the department of orthopedics, at tertiary care hospital from January 2017 to August 2018. The study comprised 36 patients, which included 29 males and seven females. All patients were followed up for minimum 6 months duration. The maximum follow-up was of the first patient who was 13 months. The functional assessment was done using Teeny and Wiss [22] clinical assessment criteria, and final results were graded as excellent, good, fair, and poor based on these criteria.

Of the 36 patients studied, 13.9% of patients were between 25 and 30 years, 52.8% of patients were between 31 and 40 years, 19.4% were between 41 and 50 years, and 13.9% of patients were between 51 and 60 years. Mean age was 37.86 years with standard deviation (SD) of ± 9.54. During our study, we used the Orthopaedic Trauma Association (OTA) fracture classification and we observed three fracture patterns in our cases. Of the 36 patients, 27.77% of patients (Table 1) had OTA 43 A-type fractures, 50.00% of patients had OTA 43 B-type fractures, and 22.22% of patients had OTA 43 A3-type fractures.

During this study, interval between injury and surgery was recorded. Of 36 patients, 16.66% of patients (Table 2) were operated between 5 and 7 days, 47.22% of patients were operated between 8 and 10 days, and 36.11% of patients were operated >10 days after surgery. Of 36 patients, fracture united in 14–15 weeks in 14.28% of patients (Table 3) in 16–17 weeks in 42.85% of patients, in 18–20 weeks in 34.28% of patients, and in >20 weeks in 8.57% of patients. Non-union occurred in one patient. In our study, functional

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**Table 1: OTA fracture classification**

| OTA fracture classification | Frequency (%) |
|-----------------------------|--------------|
| 43–A                        | 10 (27.77)   |
| 43–B                        | 18 (50.00)   |
| 43–C                        | 8 (22.22)    |
| Total                       | 36 (100)     |

**OTA: Orthopaedic Trauma Association**

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**Table 2: Interval between injury and surgery in days**

| Interval between injury and surgery (days) | Frequency (%) |
|-------------------------------------------|--------------|
| 5–7                                       | 6 (16.66)    |
| 8–10                                      | 17 (47.22)   |
| >10                                       | 13 (36.11)   |
| Total                                     | 36 (100)     |

Mean±SD

9.94±3.17

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**Table 3: Time taken in radiological union in weeks**

| Time taken in radiological union (weeks) | Frequency (%) |
|-----------------------------------------|--------------|
| 14–15                                   | 5 (14.28)    |
| 16–17                                   | 15 (42.85)   |
| 18–20                                   | 12 (34.28)   |
| >20                                     | 3 (8.57)     |
| Total                                   | 35 (100)     |

**SD: Standard deviation**

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**Table 4: Functional outcome**

| Functional outcome | Frequency (%) |
|--------------------|--------------|
| Excellent          | 1 (02.77)    |
| Good               | 6 (16.66)    |
| Fair               | 24 (66.66)   |
| Poor               | 5 (13.88)    |
| Total              | 36 (100)     |

Mean±SD

78.16±10.03(fair)

SD: Standard deviation
outcome was assessed using Teeny and Wiss [22] clinical assessment criteria score (100 points), and the result was graded as excellent (>92), good (87–92), fair (65–86), and poor (65). Final functional outcome was “excellent” in 1 (0.277%) patients (Table 4), “good” in 6 (16.66%) patients, “fair” in 24 (66.66%) patients, and “poor” in 5 (13.88%) patients. Mean functional outcome score was 78.16 with SD of 10.03 which corresponds to “fair” outcome.

Discussion

The purpose of this study was to evaluate the functional outcome of this pre-contoured LCP in managing distal tibial fractures. Mean age of patients who sustained distal tibial fractures was 37.86 years in our study with an SD of 9.54 years. It was comparable with the mean age of 38 years in the study by Vallier et al. [23] and mean age of 37.2 years in the study of distal tibial fractures by Shabbir et al. [24]. Thus, we can overemphasize the fact that the younger and economically productive segment of our society sustains these fractures. In our study, mean time interval between injury and surgery was 9.94 days with an SD of 3.17 days. We operated the patients only when the swelling settled and wrinkle sign appeared. Hence, we can say that in majority of the patients (63.88%) tissue edema settles and wrinkle sign appears within 10 days of injury (5–7 days in 66.66% and 8–10 days in 47.22%). The average injury surgery interval was 10.75 days in the study by Shabbir et al. [24]. In our study of 36 patients, fracture united in 14–15 weeks in five (14.28%) patients, in 16–17 weeks in 15 (42.85%) patients, in 18 and 20 weeks in 12 (34.28%) patients, and in >20 weeks in three (8.57%) patients. There was non-union in one patient, in whom secondary surgical procedure in the form of bone grafting was done. We can interpret from our results that most of the fractures (27 [77.13%] patients) united between 16 and 20 weeks. Aksekili et al. [25] reported a mean duration of radiological union to be 20.7 weeks (Range: 16–28 weeks) in open and 17.96 weeks (Range: 10–36 weeks) in closed fractures. While Gupta et al. [26] recorded mean union time as 19 weeks with range of 16–32 weeks. Similarly, Lee et al. [27] while comparing medial and lateral plating recorded mean union time of 18.2 weeks in medial plating group and 16.1 weeks in lateral plating group. In our study of 36 patients, 5 (14.28%) patients started full weight-bearing in 14–15 weeks, 15 (42.85%) patients took 16–17 weeks, 12 (34.28%) patients took 18–20 weeks, and 3 (8.573%)
patients took >20 weeks. One patient with non-union was unable to bear full weight. During our study, we allowed full weight-bearing only after complete radiological union occurs, due to that results of the duration of radiological union are similar to the results of time taken in full weight-bearing. Shabbir et al. [24] in his study recorded full weight-bearing at 9–12 weeks in 61.6% of the cases and at 13–16 weeks in the rest of 38.4% of the cases. This difference in results is due to the reason that period of radiological union in the study by Shabbir et al. [24] was 9–12 weeks in 67.1% of cases and 13–16 weeks in 32.9% of cases which is much earlier in comparison to our study. The mean time of full weight-bearing was 16 weeks with the range of 13–32 weeks in the study by Gupta et al. [26] which is more or less comparable with our results.

Mean clinical score (Teeny and Wiss [22] clinical assessment score) was 78.16 in our study of anterolateral plating which lies in fair clinical grade of Teeny and Wiss functional assessment score. Garg et al. [28] in their study of comparative prospective study between medial and lateral distal tibial LCP for distal third tibial fractures in 36 patients evaluated using Teeny and Wiss clinical assessment criteria found that of 18 patients of medial plating group, one had excellent outcome, eight had good, seven had fair, and two had poor outcome. Moreover, of 18 lateral plating group, three had excellent outcome, seven had good, seven had fair, and one had poor outcome.

Complications
In our study of 36 patients, three patients had immediate complication in the form of infection and one patient had wound dehiscence. Early complications included deep infection in four patients, of which two progressed to wound dehiscence. Delayed complications included infection in two patients, non-union in one patient, and malunion in one patient. Infection and wound dehiscence were treated with dressing and secondary wound closure while one case of non-union was treated later on with bone grafting. Cheng et al. [29] while comparing MIPO with ORIF recorded wound complication as high as 15% in MIPO group. In the ORIF group, one case (6.67%) developed post-operative tibial osteomyelitis and non-union, one case (6.67%) had a delayed union at 32 weeks, and two cases (13.33%) had local soft tissue irritation symptoms from the implants.

While studying 101 cases of distal tibial fractures, Joveniaux et al. [30] recorded 14 non-unions including two septic non-unions, nine infections, nine skin necrosis, six second day displacements, one compartment syndrome, one refracture, and one nerve injury.

Conclusion
We conclude that the anterolateral distal tibial LCP plating is very effective technique to fix the distal tibial fracture, especially with the intra-articular involvement and significant soft tissue injuries. It is a precise surgery without associated significant complications. It also offers advantage such as adequate fracture exposure, soft tissue preservation, and reliable fracture healing.

Limitations of the study are its low volume of patients, short duration of follow-up, and no control group to compare the
results. To label the anterolateral distal tibial LCP as a best surgical procedure for distal tibial fracture, further studies should be done in future by enrolling a large number of patients and comparing the results with other surgical techniques.

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