External Fixation by Locking Plate as a Definitive Treatment of Tibial Distal Metaphyseal Fractures

Arash Arfa,¹, * Seyed Mohammad Javad Mortazavi,¹ Mohammad Javad Dehghani Firoozabadi,¹ and Mohammad Zarei¹

¹Department of Orthopedic Surgery, Imam Khomeini Hospital Complex, Tehran, Iran

*Corresponding author: Arash Arfa, Department of Orthopedic Surgery, Imam Khomeini Hospital Complex, Tehran, Iran. Tel: +98-9123076295, Fax: +98-2166192253, E-mail: arash.arfa@dr.com

Received 2017 January 02; Revised 2017 January 31; Accepted 2017 February 20.

Abstract

Background: Traditional external fixation used for open or soft tissue compromised tibial distal metaphyseal fractures is used both as a temporizing or definitive treatment to minimize more traumas to the soft tissue, but it has its own shortcomings such as joint spanning and bulky construct. Lower profile locked plates used as external fixation may overcome such problems.

Methods: A series of 16 open or with soft tissue compromised tibial distal metaphyseal fractures were treated using locking plate as a definitive external fixator. Time to union, nonunion, malunion, device failure, function for the knee and ankle, and deep and pin tract infections were evaluated.

Results: All fractures healed without any complications (nonunion, malunion, device failure, or infections including deep and pin tracts). The mean time of fracture healing was 18 weeks (ranged 12 to 26). After walking with full weight-bearing for 1 month, the patients underwent plate removal. The mean hospital for special surgery (HSS) score was 89 (ranged 84 to 100) and 95 (ranged 91 to 100), and the mean American orthopaedic foot and ankle society (AOFAS) score was 93 (ranged 89 to 100) and 95 (ranged 92 to 100) at 4 weeks postoperatively and final follow-up (mean period of 16 months).

Conclusions: Application of the locking plate as an external fixator for definitive treatment of distal tibial fractures had the advantages of traditional external fixators and at the same time overcame its shortcomings due to its low-profile frame; therefore, it was more acceptable to patients and joint-sparing frame gave the opportunity for early range of motion and function exercise. It was a safe and reliable technique with minimal complications and excellent outcomes.

Keywords: Locking Plate, External Fixator, Tibial Distal Metaphyseal Fractures

1. Background

There are no simple set of rules to treat the fractures of the tibia due to their nature. Open fractures and compromised soft tissue problems are more common here than in any other major long bones; hence, wound complications after immediate open reduction and internal fixation of such fractures are always a major issue in their treatment, particularly in distal metaphyseal part (1-3). Traditional external fixation was used for such cases, both as a temporizing and definitive treatment, for many years (4, 5). However, several problems such as joint stiffness and patient acceptance remained. Recently there is a developing trend to use internal locked plates as external fixation construction, either in 2-staged treatment plans or for definitive ones (6-11). These are attractive options due to the benefits of traditional external fixation in minimizing soft tissue trauma, and overcoming disadvantages such as joint stiffness and muscle atrophy due to bridging across the joint or patient acceptance of their bulky frames. However, there is few information available about effectiveness and also complications of this treatment in the literature; hence the current study aimed at evaluating the outcomes of the experiences of treating the patients by this method.

2. Methods

From March 2014 to April 2015, a total of 16 patients with an open or soft tissue compromised tibial distal metaphyseal fracture underwent external fixation by locking plate as definitive treatment at the under study institute. There were 13 males and 3 females with a mean age of 40 years (ranged 23 to 67). Four patients sustained a fracture as a result of falls from height and 12 patients sustained a fracture in traffic accidents. There were 11 open fractures, including 3 Gustilo type I, 4 Gustilo type II, and 4 Gustilo type IIIA (Table 1).

All patients were evaluated clinically and radiographically at the time of admission, immediately postoperatively, and every 1 to 3 months at follow-up for: time to...
union (counted from the initial trauma) defined as painless full weight bearing and 4 cortices bridging callus in radiographs; complications defined by fixation failure, nonunion, malunion, deep and pin tract infections and also functional outcomes of the joint using the hospital for special surgery (HSS) knee scoring system and American orthopaedic foot and ankle society (AOFAS) ankle scoring system.

2.1. Surgical Technique

Under general or spinal anesthesia, in the supine position the affected lower limb was prepared and draped in a standard sterile fashion, without tourniquet.

For open fractures, after initial debridement, external plating was performed primarily during the emergency operation. By indirect or direct methods, tibia was reduced and aligned; it was achieved through the open wound or short incisions extending from the wound, or if necessary, by making small incisions around the fracture site; followed by using a clamp or K-wires for provisional stabilization. Then, before definitive external fixation, soft tissue was closed.

Anatomical locking plate of distal of tibia was placed on the anteromedial aspect of the tibia as close as possible to the skin and 4-5 bicortical locking screws on each end of the fracture were applied through stab incisions in the intact overlying soft tissue, and then, the position and orientation of them were checked by fluoroscopy.

Screw tracks were cleaned with 75% alcohol daily, patients were allowed partial weight-bearing from the second postoperative day and taking shower with the external fixator in place from 5 days after wound closure. Once cortical bridging was observed on radiographs, the patients were allowed to walk with full weight-bearing for 1 month before removing the plate in the clinic.

3. Results

All patients were followed up for a mean period of 16 months (ranged 13 to 21).

All fractures healed without any complications (nonunion, malunion, device failure, or infections including deep and pin tracts). The mean time for fracture healing was 18 weeks (ranged 12 to 26). After walking with full weight-bearing for 1 month, the patients underwent plate removal.

The mean HSS scores was 89 (ranged 84 to 100) and 95 (ranged 91 to 100), and the mean AOFAS scores was 93 (ranged 89 to 100) and 95 (ranged 92 to 100) at 4 weeks postoperatively and final follow-up.

4. Discussion

External fixation is an accepted and useful tool to treat tibial fractures. These devices are commonly used to treat open or closed fractures with compromised soft tissue throughout the length of the tibia, because they provide fixation and at the same time preserve soft tissue and bone vascularity and access to the wound. There are several indications to use them instead of internal fixation, both as a temporizing and definitive treatment, such as severe open fractures, open fractures receiving delayed treatment (>24 hours), severely contaminated fractures, management of fractures with bone loss, patients with very small medullary canals, fractures associated with burns or wounds over the tibial nail entry portal, fractures with vascular injury, war injuries, and in some patients with multiple-system trauma; also, in patients with unstable closed fractures, fractures with compartment syndrome, segmental fractures with a periarticular component, and head injury or impaired sensation. However, they are associated with problems such as joint stiffness and muscle atrophy due to bridging over joints for a long time and there is a patient acceptance issue because of their bulky instructions.

It seems that the idea to use locked plating for angular stability principle was described for internal fixation (12) even before that of external fixation. A group of Polish surgeons in the 80s developed a system with conventional plates and screws, which was applied to the medial aspect of the tibia, but outside the skin and were locked with some sort of washers in the screw holes (13). They were attractive options because of having benefits of traditional external fixation in minimizing soft tissue trauma and preserving soft tissue vascularity; due to their lower profile, they can overcome traditional external fixation disadvantages such as patient acceptance issues of the bulky frames, and can also provide stable fixation without bridging over joints, and therefore, prevent joint stiffness and muscle atrophy, which is a major problem with the traditional fixations. Recently, using locked plates as external fixation find its way back to management of several conditions such as infected nonunion and open fractures.

Kloen et al., used locking compression plate as an external fixator and called it supercutaneous plating (9,10). The LCPs were used as temporary or definitive external fixators to manage infected nonunion fractures and concluded that this technique was versatile, low profile, and well tolerated by their patients. Although its indications are relatively limited, it can be a useful adjunct to treat complex reconstructive cases.

Ma et al., (6-8) designed a 2-stage protocol to treat open tibial injury using locking plates as external fixation; they
first used low profile locking plates for temporary external fixation after debridement and anatomic reduction, followed by soft tissue reconstruction. They used locking plates for definitive internal fixation. Also, 8 open tibial fractures healed without major complications by only the first-stage treatment due to patients’ refusing the second-stage treatment. These patients also experienced a comfortable clinical course, excellent knee and ankle joint motion, satisfactory functional results and an acceptable complication rate (11).

In the current study, anatomical distal tibia locking plates were used as an external fixator for definitive treatment of a series of 16 open and closed plates with compromised soft tissue distal tibial metaphyseal fractures, and the clinical outcomes and complications were evaluated.

Application of lower profile locking plates as joint-sparing frame of external fixation provided the advantage of early range of motion of joints and avoiding stiffness, which is a major issue in spanning frames of traditional external fixation. Koulouvaris et al., found that patients with external fixation and the ankle spanning experience reduced activity, compared with the ones with external fixation and the ankle sparing to treat severe pilon fractures (14). In the current study, the functional recovery of adjacent joint was evaluated using HSS knee scoring system and the AOFAS ankle scoring system.

The mean HSS scores was 89 (ranged 84 to 100) and 95 (ranged 91 to 100), and the mean AOFAS scores was 93 (ranged 89 to 100) and 95 (ranged 92 to 100) at 4 weeks post-operatively and final follow-up that was satisfactory.

Infection is always a major problem in the treatment procedure of open or closed compromised soft tissue distal tibial fractures. Dillin and Slabaugh (15) reported 36% rate of skin slough and a 55% rate of deep infection on a total of 11 patients with severe tibial plafond fractures treated with early ORIF (the open reduction internal fixation). However, the employment of the 2-stage treatment decreased the high complication rates. Sirkin et al., (4) reported the results of pilon fractures treated with staged management. The deep infection rates were 3.4% and 10.5% for closed and open pilon fractures, respectively. The rates of partial thickness skin necrosis were 17% in patients with closed pilon fractures and 10.5% in patients with open pilon fractures. In the current study, all of fractures in the patients healed completely without any signs of deep or pin tract infections.

In conclusion, using the locking plate as an external fixator for definitive treatment of distal tibial fractures had the advantages of the traditional external fixator including minimized trauma to the soft tissue and complications after immediate open reduction and internal fixation of tibial fractures with compromised soft tissue, and at the same time overcome the shortcomings of standard external fixators due to its low-profile frame; therefore, it is more ac-
Figure 1. A, a 23-year-old patient with an open distal tibial fracture; B, fracture healing and plate removal after 20 weeks.

Acceptable to patients and joint-sparing frames give the opportunity for early range of motion and function exercise. It is a safe and reliable technique with minimal complications and excellent outcomes. However, more studies are needed to definitely confirm the results of this technique.
Footnote

Conflict of Interest: Authors declared no conflict of interest.

References


