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Educational Corner

An Overview of Treatment of Distal Tibial Fracture with Nailing

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Background

Extra-articular distal tibial fractures make up approximately 15% of all distal tibia fractures (1, 2). The main cause for such fractures is axial and rotational forces on the lower extremity (3-5). According to the 2018 AO/OTA Fracture and Dislocation Classification, distal tibia fracture (43A-C class) is defined as the fracture contained within a square with a height equal to the widest portion of the tibial epiphysis, which usually includes fractures within approximately 4 cm of the tibial plafond (6-8).

In some other studies, this type of fracture has been characterized as the fracture that occurs within 12 cm of the tibial plafond (9-11). Understanding the anatomy of the distal tibia is important because of choosing intramedullary fixation technique for these metaphyseal fractures. In this regard, not only turning the shape of the tibia transition from a triangular shape proximally to a rounded shape distally may occur, but also the cortex also becomes thinner and is replaced by spongiosa and cancellous bone near the distal tibial metaphysic (9, 10).

Based on previous research, plating has been accepted as the first choice treatment for distal tibial fractures leading to proper reduction and rigid fixation of the affected limb (11). However, extensive dissection of the host bone and the soft tissue is mandatory that may lead to increased risk for infection and nonunion (1). However, recent advances in both the design of intramedullary nailing (distal shortening of the nail to allow an increased number of distal interlocking screws) applied by routine reaming and use of blocking screws to narrow the medullary canal have improved procedural outcomes and could be useful in management of distal tibial fractures (12, 13).

However, some complications such as anterior knee pain and higher likelihood of malunion and deformity, and even early degenerative arthritis are also expected following such procedure (14). To improve procedural outcome, the weight bearing immediately after surgery is now recommended for patients with diaphyseal fractures undergoing intramedullary nailing (15-20). Based on above, maintaining fracture reduction with intramedullary nailing-related devices remains already challenging, because this type of fixation lacks diaphyseal support, leading to decreased stability (20, 21). Therefore, some surgeons do not recommend such protocol for fixation of distal tibial fracture (15). This review aimed to assess the threshold of nailing in management of distal tibial fracture with respect to the site of fracture, procedural complications, and conclusion of nailing.

Managerial Approach in Applying Intramedullary Nailing for Distal Tibial Fractures

In the first step, assessing baseline characteristics including patients' age, gender, and co-morbidities should be considered. Intramedullary nailing is initially locked with at least three interlocking screws according to standard approach (15). The best technical approach used in many centers such as our center include intramedullary implant, half-pin external fixation, hybrid or thin-wire external fixation, plate fixation, or a combination of these techniques (22, 23).

In some patients, the fixation of fibula should also be considered (15). In recent years, closed reduction with minimally invasive plating as well as locked intramedullary nailing is widely used for distal tibial metaphyseal fractures (23). Technically, intramedullary nailing is performed by creating an entry point just medial to the lateral intercondylar eminence of the tibial plateau through a medial parapatellar approach. Temporary blocking screws, a reduction clamp, a reduction unicortical plate, or a universal fixator is used to achieve reduction and is removed after fracture fixation, except for the reduction unicortical plate when used with a reamed intramedullary tibial nail (23). The nails are primarily locked with about two out-of-plane screws (1).

In some fractures, lateral column support by using fibular plate, fibular intramedullary nail, and fibular fixation are considered (1). Internal fixation is then performed using a distal tibial medial locking compression plate. At least three screws are usually used on both sides of the fracture, and plating is then performed (23). By advancing intramedullary nailing technique in recent years such as distal shortening of the nail to allow an increased number of distal interlocking screws and also routine reaming and applying blocking screws to narrow the medullary canal, the clinical procedural consequences have been considerably improved and the use of this technique for management of distal tibial fractures has found many fans (11).

As the first result of employing such technique and according to the literature, final alignment has been

successfully achieved in most patients as excellent in 25.9% and acceptable in 51.9%, but it might fail in 22.2% (12). In this regard, weight bearing could accelerate bone healing, decrease nonunion rate, and reduce the likelihood of soft-tissue necrosis (15).

However according to some reports, comparing the outcome of intramedullary nailing and plating showed no statistically significant difference between the two treatment options in occurrence of deep vein thrombosis or non-union. However, those who underwent intramedullary nailing had significantly higher numbers of malunion in comparison to plating. There was also a significantly higher incidence of delayed union in former technique (13). But, among those patients treated with plating, deep infections requiring surgical debridement has been more common in the plating group, compared with none of those managed by intramedullary nailing (13).

Milner et al. studied the effect of mal-alignment of tibial shaft fractures over 30 years for 164 patients, concluding that mal-alignment was not the cause of ankle osteoarthritis in these individuals (24). It has been also shown that intramedullary nailing might decrease the rate of infection by 48%, but increase the malunion rate compared to the plating technique (11). In their study, there was no significant difference in the total complication rate, the nonunion rate, the secondary surgery rate, and the implant removal rate. Some studies indicated that the rate of malunion following intramedullary nailing was significantly higher than in the case of plating (25, 26), however in a systematic review, a similar nonunion rate was reported between intramedullary nailing and plating techniques (27).

However in another experiment, there were no significant effectiveness of fibular fixation in the treatment of extra-articular distal metaphyseal tibial fractures (28). In a study by Egol et al. focusing on the results of fibular fixation, 5.6% of patients had poor initial alignment after intramedullary rod, while a much higher rate of malalignment (22.2%) was achieved in another survey (21).

A recent study by Avilucea et al. showed that the use of supra-patellar nailing could decrease the risk of initial mal-alignment of more than 5 degrees compared to the infrapatellar nailing (3.8% versus 26.1%) (22). As another sequel, simultaneous fibular fracture can be observed in about 80% of tibial fractures (29).

In this regard, the role of fibular plating in the setting of extra-articular distal metaphyseal tibial fractures remains controversial (1). It has been shown that fibular fixation with intramedullary nailing of the tibia may not significantly increase stability (1, 6, 30). However some studies showed no difference in final alignment when accounting for fibular fixation (1, 31).

Procedural-related Complications

Overall, common complications related to intramedullary nailing include soft tissue necrosis, local infection, and nonunion (15). In this regard, nonunion is defined as the absence of radiological signs of bone union and pain in the fracture site during weight bearing as 6 months (22). Postoperative infection is usually defined as the infection that occurs before wound healing. Moreover, anterior knee pain, deformity, and even early degenerative arthritis have also been described (9). Valgus deformity is the most common malalignment encountered during nailing of distal tibia fractures, followed by recurvatum and varus (6). Additionally, high rates of malunion have also been reported (6). However, applying intramedullary nailing could reduce the time of surgery and radiation as well as decrease the risk of wound complications compared with plate fixation (1). Additionally, more recent information had revealed that intramedullary nailing fixation provides increased stability compared with baseline after repeated cycling (1).

Conclusion

In total and compared to other techniques such as plating, intramedullary nailing can be considered as a first choice for management of distal tibial fracture in spite of its related manageable complications.

Conflict of Interest

The authors declare no conflict of interest in this study.

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