

APPLICATION OF AN ILIZAROV EXTERNAL FIXATION DEVICE OVER AN EXISTING INTRAMEDULLARY NAIL FOR THE REPAIR OF A TIBIAL NON-UNION: A Case Study

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Nonunion of tibial diaphyseal fractures remains a relatively common complication following application of an intramedullary nail with a rate being reported around 11% in current studies.^{1,4} Numerous conservative treatments have been described for this complication. These include cast immobilization, electrical bone stimulation, and functional bracing.^{1,5,6} The majority of these cases, however, have required surgical intervention, which in the past has entailed one of the following: dynamization of a statically locked nail, fibular osteotomy, exchange of current nail for a larger diameter one, or removal of nail followed by plating with or without bone graft.⁷ Recently, another option has been successfully used to treat such tibial nonunions. It is the application of an Ilizarov external fixation device over the already implanted intramedullary nail. The combination of the internal and external fixation allows for neutralization of the shearing and rotary forces while maintaining proper fracture alignment and allowing axial compression.^{7,8} It is this option that is the focus of this paper.

In addition to the primary diagnosis of the tibial nonunion, these patients usually present with complicating factors such as significant loss of bone and a scarred soft tissue envelope surrounding the old fracture site.⁷ Closed treatment of the nonunion site with application of an external fixator may be viable option, especially if the surrounding soft tissues have been compromised in the original injury or in a previous surgery. This may also be good choice if the nonunion appears to be hypertrophic in nature.⁷ The procedure would include application of the fixator with cyclical distraction and compression over the already present intramedullary nail. This is thought to stimulate osteogenesis and eventual fusion. If, however, there is a sizable osseous defect or one suspects an avascular nonunion, it is necessary to surgically debride this area and apply autogenous bone graft to the nonunion site. This allows for an increased chance of consolidation in a timely fashion.⁹

There are other measures that can be taken to optimize results when surgically repairing these nonunion sites. If the intramedullary nail was applied in a static fashion, it will be necessary to remove the distal locking screws that may be preventing compression or dynamization of the proposed site of union. Removal of a portion of the fibula may also allow for increased compression at the site of the ununited tibia.¹⁰⁻¹³ It is not uncommon for an associated fibular fracture to heal within 4-6 week while the tibia progresses to a delayed union. At this point a considerable amount of applied axial forces are exerted to deform the intact fibula, thereby decreasing the total compressive load on the tibial fracture.⁴ Removing a 1-2 cm piece of the fibula at the level of the tibial nonunion will allow for the necessary compression to be applied to the nonunion site. Lastly, such items as electrical bone stimulators and orthobiologic products are other ways to contribute to the attempted fusions of these bones.

Construction of the Ilizarov external fixator over a nail can be technically difficult. There are limited sites for safe passage of the wires. It is important to try and avoid contact between the wires and the medullary bone because of the possibility of pin tract infection affecting the internal fixation. This may be difficult because the wires are effectively driven completely intracortical. Copious irrigation and an interrupted driving technique can diminish thermal necrosis. Also, if the intramedullary nail is made of titanium, it is recommended to use like metal titanium wires to prevent a mixed metal reaction in case these parts should come into contact with each other.

CASE STUDY

A 27-year-old male presented with a painful non-union of the right tibia. The patient related having a motorcycle accident 4 months earlier where he experienced an external rotation injury of his right leg and ankle. He was taken to the Emergency Department at which time he was

diagnosed with fractures of his right tibia and fibula. An intramedullary nail was then inserted into his tibia and the patient was placed in a cast. Postoperatively he continued to complain of pain and started developing an ulcer over a prominent spike of tibial bone. Two months later the patient was taken back to the operating room to remove this piece of bone and another cast was applied. Approximately 6 weeks later he continued with complaints of pain during ambulation and was seen as a new patient by the authors.

Radiographs showed an obvious mid-diaphyseal nonunion of the right tibia with a large piece of sclerotic bone along the anterior crest. With no evidence of any osseous consolidation since the time of the injury it was deemed appropriate to surgically intervene to promote union of this bone. Surgical correction was undertaken with the use of autogenous iliac crest bone graft, an Ilizarov external fixation device (True-Lok, Encore), as well as an implantable bone stimulator (EBI). It was deemed appropriate to leave the intramedullary nail in place to resist shearing and bending forces to the leg. The distal locking screws were removed to allow for increased

compression at the level of the nonunion site. In addition, a 1.5 cm section of the fibula was removed at the level of the previous fracture to also allow for axial compression. Care was then taken to remove a significant amount of sclerotic, non-viable bone at the level of the non-union site. There were no signs of infection in this region. The intramedullary nail was visible following the removal of the atrophic bone and appeared to be in good repair. Iliac crest autogenous bone graft was placed in this tibial deficit, beneath the coils of an implantable bone stimulator. Symphony gel (Depuy) was also incorporated in the graft site to improve the healing potential of this bone. Following closure of the surgical site, an Ilizarov external fixator was applied in a 4-ring construct to gain compression of this proposed site of union. Titanium wires were used so as to not react with the metal of the intramedullary nail.

The patient had an uneventful postoperative course with the external fixation device being removed approximately 4 months later. Radiographs showed a complete union of the tibia with no angular deformities. One year postoperatively, the patient is ambulating pain free without assistive devices. (Figure 1A-1I)



Figure 1A. Preoperative AP radiograph.

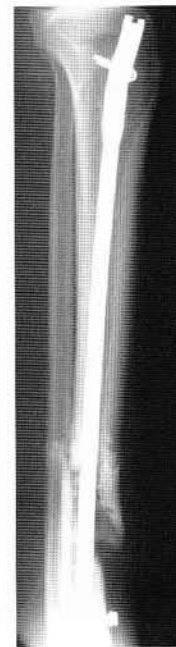


Figure 1B. Preoperative lateral radiograph.

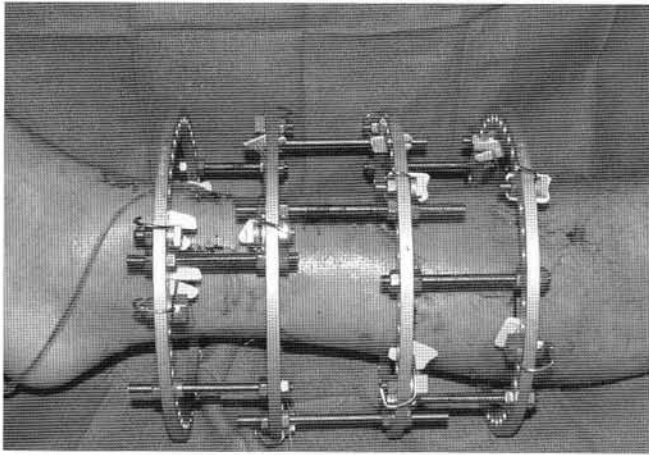


Figure 1C. Intraoperative view following application of external fixator.

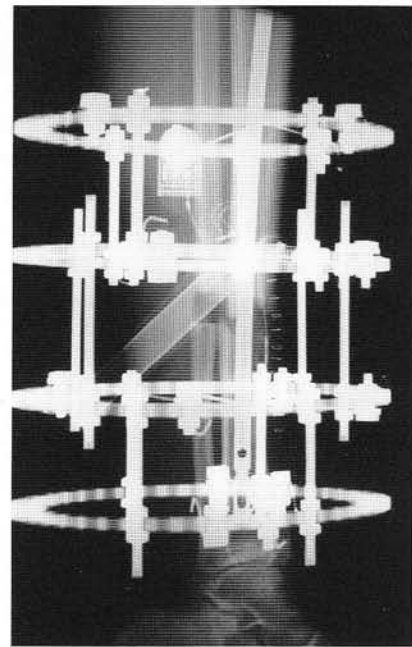


Figure 1D. Postoperative lateral radiograph on the day of surgery.

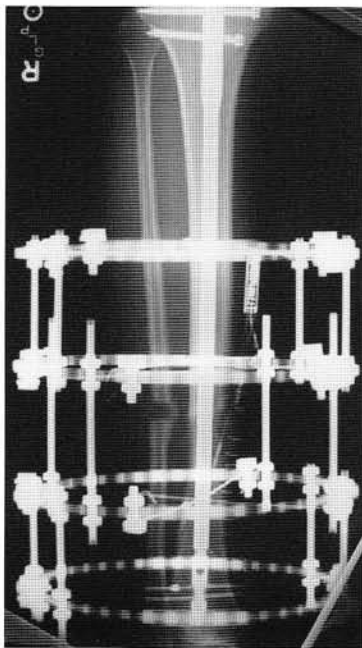


Figure 1E. Postoperative AP radiograph the day of surgery.

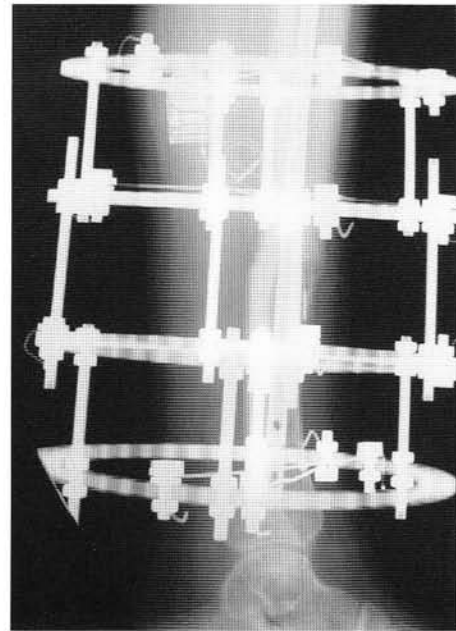


Figure 1F. Lateral radiograph 4 months postoperative.

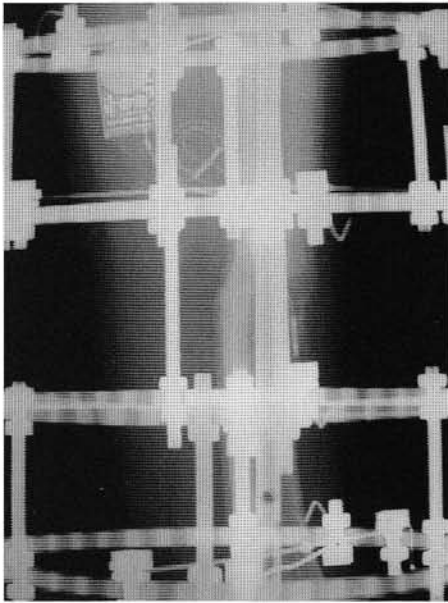


Figure 1G. AP radiograph 4 months postoperative.



Figure 1H. Lateral radiograph 6 months postoperative.



Figure 1I. AP radiograph 6 months postoperative with complete union of tibia.

DISCUSSION

Nonunion of tibial diaphyseal fractures remains a relatively common complication following application of an intramedullary nail. The lower extremity surgeon must consider many factors when choosing the best way to deal with this diagnosis. Application of an Ilizarov external fixator over an intramedullary nail is yet another option that may be used in the treatment of these injuries. The combination of the internal and external fixation allows for a neutralization of the shearing and rotary forces while maintaining proper fracture alignment and allowing axial compression. Though technically difficult, this surgical route has proven to be successful in gaining bone consolidation of tibial nonunions.

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ADDITIONAL REFERENCES

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