Case Profile: *Submitted by Paul Tornetta, III, MD*

A 38-year-old man presents 48 hours after a motor vehicle accident in which he sustained a proximal tibia fracture (Fig. 1); it is a Tscherne type I closed fracture. The patient's neurovascular system is intact, and he has soft compartments.

OPINION: Plate Fixation

To determine the best option for this patient, the subtleties of the fracture (including location and pattern), soft tissue and associated injuries, patient comorbidities, and patient demand level must be considered. Minor variations in any of these factors could alter the treatment recommendation. As with most fractures, surgical options in this case include open reduction and internal fixation (ORIF), external fixation, and intramedullary (IM) nailing. The ideal fixation device would help provide reliable and rapid healing, anatomic alignment, early motion of the knee, early weight bearing and have low associated morbidity and risk. In this case, I would advocate plate fixation for the following reasons.

This is a young man with a proximal tibia and fibula fracture sustained in a motor vehicle accident. He has a relatively minor associated soft tissue injury (Tscherne type I, neurovascularly intact with soft compartments) that makes plate fixation a viable option. With a higher grade closed or open soft tissue injury, plate fixation would be less attractive, but not contraindicated.

Examination of the radiographs with attention to the fracture location indicates that any of the three aforementioned fixation options would provide adequate fixation in the proximal and distal fragments. If the fracture were more proximal, external fixation and plate fixation would be more attractive. Conversely, a more distal fracture location could make intramedullary nailing more advantageous. The oblique nature of the fracture helps differentiate between the three methods of fixation. This pattern begs for dynamic compression plating with interfragmentary lag screw compression. Neither external fixation nor intramedullary nailing could provide this mechanical stability. If the fracture were more transverse, nailing might be more attractive because nailing in dy-

FIGURE 1. A, AP view, (B) oblique view, (C) lateral view.

namic mode would provide compression with early weight bearing.

Postoperatively, each method of treatment would allow for early knee range of motion. The wires associated with external fixation can impinge on the local soft tissues, however, and inhibit motion exercises. Immediate full weight bearing is not likely to be advocated with any of the methods; however, it might be initiated earlier with external fixation or nailing than with plate fixation. This represents the only significant disadvantage of plate fixation in this case.

Each of the three methods has its own inherent risks of complications. Malalignment has been reported in up to 59% of cases of proximal tibia fractures treated with intramedullary nails.[1] Multiple technical methods have been advocated, such as the use of blocking screws, to avoid this complication.[2–4] These can be successful but are technically demanding. Similarly, malunion has been associated with treatment of these fractures with external fixation.[5,6] ORIF offers the most reliable method to obtain and maintain satisfactory alignment.

The risk of deep infection is low in this case, regardless of the method selected. Superficial infection about pin tracts has been shown to occur with external fixation, however.[7] Usually these infections are easily treated with oral antibiotics, but sometimes they can be more serious if the knee joint becomes seeded with infection. The capsule of the knee has been shown to extend 7 cm from the joint.[8]

Fractures at the metaphyseal/diaphyseal junction can be problematic with regard to union. Plate fixation in this case should be performed using indirect reduction techniques to preserve maximally the soft tissue envelope. The fracture site does not and should not be directly exposed. This fracture is amenable to percutaneous submuscular fixation either using a plate system designed specifically for such an insertion technique or using more traditional designs. The proximal portion of the proximal fragment is exposed through a longitudinal split in the iliotibial fascia that is centered over Gurdy's tubercle. This is extended distally to include the fascia of the tibialis anterior muscle. A small portion of the muscle is elevated to provide access for submuscular placement of the plate. Screws can be inserted through separate percutaneous wounds as needed.

I would recommend plate and screw fixation in this case because it offers the most stable construct with the greatest chance of uncomplicated union. I would argue that this outweighs the minor relative disadvantage of slightly prolonged protected weight bearing compared with external fixation and intramedullary nailing. Subtle variations from this case might tip the scales in favor of intramedullary nailing. Regardless of the treatment method, the fibula fracture should not be addressed surgically, and this patient should be monitored closely for compartment syndrome.

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OPINION: Tensioned Wire External Fixation

Tensioned wire (Ilizarov) external fixation offers several advantages over internal fixation methods for proximal tibial fractures, such as the fracture sustained by this 38-year-old man. Treatment with a full ring tensioned wire external fixator that has been preconstructed before the operation allows for precise anatomic reduction using Ilizarov wire reduction techniques.[1] These reduction techniques are analogous to the indirect reduction techniques that currently are advocated by the AO group. Proper placement of opposing tensioned olive wires reliably prevents loss of reduction. Because of the biomechanical advantages of circumferential fixation, immediate full weight bearing not only is allowed, but also is well tolerated by the patient and promotes rapid bony union. Immediate full knee joint range-of-motion exercises also are permitted. Because the procedure does not require a surgical exposure of the fracture site, the local biology and blood supply at the fracture is not impaired further, again promoting bony union.

Plate fixation allows for anatomic reduction with stable fixation, but it requires a significant soft tissue dissection, which impairs the local blood supply and biology and may impede bony healing. In addition, wound complications related to healing and infection following a wide soft tissue dissection can be disastrous. Other complications include hardware failure or loss of purchase of the screws with malalignment at the fracture site. Although plate fixation allows for early knee joint range of motion, weight bearing is commonly not permitted for several months.

Intramedullary nails are designed to act as an internal splint; splinting allows for some degree of sliding between the implant and the bone. The ideal ap-

plication for intramedullary nail fixation is a fracture of the diaphysis of the long bones. The technique is more difficult and offers less reliable fixation for metaphyseal and epiphyseal fractures in which there is a large mismatch between the diameter of the nail and the medullary canal. Although poller screws and a variety of other reduction maneuvers can minimize this mismatch, achieving and maintaining a stable anatomic reduction (including length, angulation [on the anteroposterior and lateral radiograph], rotation, and translation) is unpredictable even in experienced hands.

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OPINION: Reamed Intramedullary Nail

This 38-year-old man has a low-grade closed tibia fracture, which needs to be stabilized with a reamed intramedullary tibial nail. Difficulties with proximal third fracture patterns of the tibia have been identified in the past and have led some authors to question the indications for intramedullary nailing with this particular fracture pattern.[1] This proximal fracture pattern can be treated most safely using an interlocked reamed tibial nail. Reaming has been shown to increase the incidence of fracture healing and is the preferred treatment for this low injury fracture.

Several surgical pearls need to be considered in treating these proximal third tibia fractures with intramedullary nailing. The lateral starting point described by Tornetta et al[2] is crucial to avoid valgus malalignment. Careful attention to the lateral starting point on the anteroposterior fluoroscopic view and the anterior starting point on the lateral fluoroscopic view identifies the correct starting point required for the proximal third tibial shaft fracture. The use of a distractor as previously described by other authors is important as this facilitates proper fracture alignment.[3–6] The fracture must be reduced in extension with the proper proximal tibial jig. Modern tibial nails allow for more distal and more proximal interlock screws to address these metaphyseal/diaphyseal fracture patterns safely and reliably. Intramedullary nailing is the choice for this proximal third fracture pattern.

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