Correction of distal tibial malunion with locking plate.

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Abstract

Posttraumatic deformities of the distal tibia are treated with a variety of methods. To our knowledge, use of the locking plate has not been reported for fixation of a distal tibial osteotomy indicated for malunion. We report two cases stabilized with a distal tibial locking plate. Both osteotomies healed within six weeks. Complications were absent. There was no loss of position or fixation. Time to full weight bearing without crutches was six weeks in one case, and twelve weeks in the other. Full motion of the knee and ankle was achieved within the first week. Return to normal activities including motocross, was within twelve and eighteen weeks, respectively with no pain and complete satisfaction. The use of the locking plate is an alternative to other forms of fixation. We believe the locking plate proves to be a safe and effective treatment of malunions of the distal tibia.

Key Words: distal tibia; locking plate; malunion

Introduction

Posttraumatic deformities of the tibia that result from malunion are a common clinical problem, and correction using external fixation can be difficult. The Ilizarov technique is a satisfactory form of external fixation however; many patients refuse this method of treatment because of the discomfort associated with distraction osteogenesis, the duration for which the frame must be applied (1), and frequent postoperative visits (2). Other problems associated with external fixation include pin site infections (3), joint infection, (4), refracture, higher rates of delayed and non-unions (5), malunion, pin breakage, tendon transfixion, and vascular and nerve injury (6). Schwartsman, Choi, & Schwartsman, 1990, concluded that the Ilizarov method has a long learning curve and according to Helfet et al., the main indication for the Ilizarov circular frame is a non-union that is infected or has major soft-tissue or osseous defects. While external fixators are mainly used today to provide temporary fixation in fractures after severe injury, the internal fixator offers flexible fixation, maintaining the advantages of the external fixator but allowing long-term treatment (8). As locking plates have gained popularity in orthopaedics, they are being applied as an alternative to intramedullary nails for stabilization, (9) and they are being substituted for blade-plates and dynamic condylar plates to stabilize osteotomy sites after correction of deformity (10). Although no method of treatment is applicable for all patients, locking plate osteosynthesis appears to have several distinct advantages. It can be used to treat non-unions along the entire length of the tibia, it can assist in the angular correction of deformity when applied to the tension side, and it usually provides stable internal fixation without extensive soft-tissue stripping, eliminating the need for the use of a postoperative cast or brace, (5) and allowing earlier attention to joint motion and soft tissue rehabilitation. Designers of the locking plate have postulated that, by preserving the blood supply to bone, it would be possible to minimize or avoid refracture after hardware removal and avoid the potential complications of infection in a sequestrum under the deep surface of the plate, delayed union, and nonunion (11). Avoiding extensive contact of the implant with the periosteum prevents damage to the blood supply (11), necrosis, and temporary porosity (8). Locking plates act as “bridge plates” which preserve fragmentary blood supply and provides fixed angular stability (10). They also reduce the risk of primary loss of reduction, as exact plate contouring is not required (10). According to Kubiak et al., locked plates have been clinically successful in their application to the distal tibia where dual compression plates were once used and show promise for stable fixation of malunions. We believe that the use of the locking plate not only provides a very stable form of fixation, but also allows for a faster recovery due to earlier load bearing capability and avoids the external hardware which may inhibit the range of joint motion. To our knowledge, the use of a distal tibial locking plate to stabilize an osteotomy made necessary by fracture malunion has not been reported. We report the results of two distal osteotomies; one an opening and the other a closing wedge.

Materials and Methods

Case 1

This patient was a 16-year-old male motocross racer who sustained a fracture of the distal tibia and despite placement of a locked intramedullary rod, developed a sterile 20 degree valgus malunion (Fig. 1-A, Fig. 2-A).

After administration of general anesthesia and instillation of antibiotics, an anterior approach to the upper and lower tibia and was made taking the anterior tibial tendon laterally and preserving the saphenous vein. The failed rod was removed. Through a short lateral incision, a fibular osteotomy was performed.

A distal tibial plate (Synthes, Paoli, Pa.) was selected and fixed to the distal tibia with locking screws. These screws were placed parallel to the ankle joint in the frontal plane. A saw was then used to perform an oblique osteotomy of the distal tibia near the fracture site and through cancellous bone on the distal side. Copious irrigation was used to avoid thermal necrosis of bone at the osteotomy site. A small closing wedge was removed based on the medial side and the plate was reduced to the upper tibia. Because the distal screws were parallel to the joint, and perpendicular to the plate, the deformity was corrected, and visualized with the C-arm in both planes. The articulated tension device was used to compress the osteotomy, and the proximal screw holes were filled with locked screws.

Exercises for the ankle and foot were started on the first postoperative day. Crutch training was started on the second postoperative day, before discharge. Exercises and restricted weight bearing was continued until after the sixth week, when radiographs showed consolidation of the osteotomy. At that time crutch support was discontinued.

At three months, he returned to racing with normal range of motion and no pain (Fig. 2-B).

Case 2

This patient was a 15-year-old male motocross racer with nearly closed physes who two months earlier had suffered a pilon type fracture of the distal tibia repaired with a closed reduction and percutaneous screw placement. The fracture went on to heal with a moderate varus deformity (Fig. 1-B, Fig. 3-A), and over 30 degrees of dorsiflexion (recurvatum) of the distal tibia. Motion of the ankle was severely restricted and infection was absent.

After administration of general anesthesia and instillation of antibiotics, an anterior approach to the lower tibia was made taking the anterior tibial tendon laterally and preserving the saphenous vein. The previously placed distal screw was removed.

A saw was then used to perform a transverse osteotomy of the distal tibia and fibula above the fracture site and through cancellous bone about five centimeters above the ankle joint. Copious irrigation prevented thermal necrosis of bone. A lamina spreader was used to open the osteotomy anteriorly in order to reduce the recurvatum deformity.

A distal tibial plate (Synthes, Paoli, Pa.) was selected and fixed to the distal tibia with locking screws. These screws were placed parallel to the ankle joint in the frontal plane.

The articulated tension device was placed proximally and the medial side of the tibia was lengthened to reduce the varus deformity. Because the distal screws were parallel to the joint, and perpendicular to the plate, the deformity was corrected, and documented with the C-arm in two planes. The proximal screw holes were filled with locked screws and the bone defect was filled with autogenous cancellous bone graft from the upper tibia.

Exercises for the ankle and foot were started on the first postoperative day. Crutch training was started on the second postoperative day, and the patient was discharged. Exercises and restricted weight bearing was continued until after the sixth week, when radiographs showed consolidation of the osteotomy. At that time ambulation with one crutch was continued for an additional six weeks to allow for further consolidation of the cancellous graft. At three months, radiographs showed complete healing, and six weeks later he returned to racing with normal range of motion and no pain (Fig. 3-B).

Results

The patients began therapy the day after surgery and were followed for six months. Both osteotomies healed within six weeks without complications. There was no loss of position or fixation. The average time to full weight bearing without crutches was nine weeks. Full flexion and extension of the knee and ankle occurred by the end of the first week. The patients returned to normal activity racing off road motorcycles within twelve and eighteen weeks respectively, with full range of motion, no pain, and complete satisfaction.

Discussion

Many different methods exist for the treatment of a distal tibial malunion. External fixators can be used but there are many complications associated with its use both for the surgeon and the patient. Internal fixators such as intramedullary nailing and blade plates have also been used for malunion treatment but none with the fixation stability of the locked plate. The locking plate is relatively new, and therefore information on the use of them is limited.

There are many reasons that we believe the locking plate to be a superior form of fixation over external fixators and other forms of internal fixation. The locking plate acts as an external fixator but is enclosed within the skin and can be left in place indefinitely. By maintaining a closed soft tissue envelope, pin tract infections and repeated clinic visits for adjustments of the external device are minimized.

An intramedullary nail may be used for fixation of the tibia, however due to the widening of the intramedullary canal in the distal third of the bone, the intramedullary nail, absent successful placement of blocking screws, is not always a stable construct even with distal locking screws in place. We agree with Strauss et al., who opined that locked plates showed generally increased fixation stability compared to intramedullary nails at the tibia's distal metaphysis.

In addition, the locked plate has advantages over older compression plates with non-locking screws. Whereas conventional screws fail by toggling within the bone and act in series, each screw functioning effectively alone, locking screws effectively act together in parallel preventing any screw track deformation or widening (10). Because there is no compression between the plate and the bone, periosteal blood supply is restored earlier resulting in prompt healing. The ability of the locked plate to act as a "bridge plate" and its extreme stability by design contributes to prompt healing. The plate also allows the patient to begin soft tissue rehabilitation, joint motion, and weight bearing earlier than with other devices.

The ability to bear weight prevents disuse osteoporosis, speeds fracture healing, and has considerable psychological benefit. The absence of external hardware permits early range of motion to be achieved and prevents fracture disease. Accordingly, if the patient cannot perform appropriate exercises due to weak fixation, and/or cannot participate in early motion because of pins transfixing the soft tissues, the length of time needed in rehabilitation increases.

A locking screw through the distal fragment of the tibia parallel to the ankle joint, and a locking screw through the proximal fragment of the tibia parallel to the knee joint ensure that the tibia is aligned properly in the frontal plane, and that the frontal plane deformity has been corrected.

Although this preliminary communication reports on only two cases, we believe that the distal tibial locking plate will be proven safe and effective in the treatment of sterile malunions of the distal tibia and shows great promise in resolution of these difficult problems.

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Figures

Fig. 1-A **Fig. 1-B**

Preoperative photographs of Case 1 (Fig. 1-A) and Case 2 (Fig. 1-B).

Fig. 2-A **Fig. 2-B**

Anteroposterior and lateral radiogrpaphs of Case 1 preoperatively (Fig. 2-A) and six months postoperatively (Fig. 2-B).

FIG. 3-A **FIG 3-B**

ANTEROPOSTERIOR AND LATERAL RADIOGRAPHS OF CASE 2 PREOPERATIVELY (FIG. 3-A) AND SIX MONTHS POSTOPERATIVELY (FIG. 3-B).