CHAPTER **61**

TECHNIQUES OF FIBULAR FIXATION

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The importance of anatomical reduction with stable internal fixation of the fibula have been demonstrated to be the key elements in the successful operative treatment of ankle fractures. Restoration of the fibular length, derotation of the distal malleolar component and maintenance of the ankle joint mortise are necessary to maintain correct tibiotalar contact. Accurate, anatomical fibular fixation is the first step in the surgical treatment of most ankle fractures. The following observations and techniques are a compilation of the author's experience over the last 15 years.

AUTHOR'S EXPERIENCE

Lateral positioning for fixating the fibula is preferred to a supine positon in most cases. Working in a standing position while the patient is maintained in a lateral decubitis position provides many advantages. The patient is stabilized on a vacuum beanbag usually with a mayo stand and pillow to support the ipsilateral arm. One pillow is used to pad between the thighs and two pillows oriented transversally in between the legs provide a good work surface. The surgeon has a better awareness of the cardinal body planes. Physical advantages include less surgeon fatigue and better overall mechanical advantage for performing internal fixation. Radiographs or flouroscopy can easily be peformed without a special x-ray table. The patient can be easily returned to the supine position for the medial exposure.

Anatomic reduction and temporary fixation is not too difficult. This is true especially when the fracture type is first identified, (Lauge-Hansen classification) and the principles of closed reduction are utilized. Recreation of the injury, manual traction and then reversal of the fracture mechanism is performed. The assistant firmly grasps the leg above the malleolli with the knee bent, the surgeon then performs the reduction manuver by grasping the heel in one hand and the dorsal aspect of the foot with the other hand. If reduction is difficult the use of clamps will facilitate the process. The two point reduction clamp can be applied to the malleolar component for extra distractive and reductive forces. The alligator clamp is best used for temporary reduction securing the reduced position with the jaws of the instrument bridging the fracture rather than the tips. An indicator of a successful reduction is proper alignment of the posterior spike. A thumb on this spike can facilitate reduction. In rare cases Kirschner wires, (.062) can temporarily fixate a stubborn malleolar fracture by inserting the K-wire across the reduced fibula into the adjacent tibia or talus.

Use hand instrumentation primarily instead of power. The placement of internal fixation is a precise, tactile, triplanar exercise with a high propensity for complications for the unsuspecting. The use of power drills and taps is more likely to result in stripped out holes, broken drill bits and misplaced screws. A misplaced K-wire hole is less problematic than a larger drill hole. Using a predrill hole with a .062 Kirchner wire provides a guide for the drill bit on a quick connect handle. Both cortices can be felt as the drill is advanced. A T handle for the tap allows the surgeon to actually feel the tapping process. Screws are finally tightened to two finger tightness while grasping the more rounded aspect of the screwdriver handle to reduce torque.

There is no one technique for interfragmentary screw fixation. The recommended AO technique utilizes one or two cortical screws (usually a 3.5) directed from anterior to posterior with a lag technique. In some cases I have found it easier to direct an interfragmentary screw from posterior to anterior primarily because the posterior fibula is flat and the soft tissue is more easily retracted behind the fibula. This is actually fixating the unstable fragment to stable fragment (Figure 1). Most interfragmentary screws are directed anterior to posterior because of the supine orientation of the patient. I prefer a cortical screw when bone density is not a problem as in younger adults. I feel that a fully threaded cancellous screw is preferred in older, less dense bone because of the deeper thread pattern. Countersinking is minimal and the usual size is 20 mm.+/- 2mm. I use a 2.7 cortical screw for a higher Weber C type fracture or in a very small diameter distal fibula. A long oblique fracture will allow two interfragmentary screws one cm. apart.

For plating the fibula three holes proximal to the fracture is ideal. Plates are used to neutralize the rotational and axial forces on the fibula. The longer the plate, the greater the stability. A six hole one third tubular plate

Figure 1. The orientation of the interfragmentary screw is posterior to anterior. Note the 2.7 screw fixating the Wagstaffe fracture.

Figure 2. This is overkill with four proximal screws, and three distal screws with an interfragmentary screw. The distal plate is more prominent than a shorter plate would be.

Figure 3. Standard lengths. The distal screws measure 16 mm., the proximal screws are 12 mm. and the middle screw measures 14 mm.

Figure 4. A posterior antiglide plate with one interfragmentary screw through the plate and the other oriented anterior to posterior.

is most often used with a Weber B fracture, only three holes are usually required proximal to the fracture. This amply fulfills the required number of cortices AO recommends. However, distally, two holes, (two cortices because only the lateral cortex is engaged) are considered sufficient. A hole, (or two) are routinely skipped because of the interfragmentary screw(s) (Fig. 2). A tip for sound insertion of the distal plate cancellous screws without stripping the hole is to only drill through and tap the lateral cortex and allow the cancellous screw to "self tap" through the cancellous portion of the distal fibula.

Simplify plate contouring with a two step process. The plate is first bent in accordance with the distal bowing of the fibula. Two holes distal to the fracture have proved to be sufficient. Excessive bending of the distal plate does not have to be routinely performed. The distal plate is therefore less prominent. The second component is then anterior rotation of the distal plate to account for the natural rotation of the fibula. The plate is then checked for accuracy by using a freer elevator. If the elevator can not be passed under the plate then the plate is then applied. There is no need for eccentric screw placement with an anatomic interfragmentary screw. Prebending the plate is kept to a minimum.

There is no difference in using cortical versus cancellous screws proximally in the plate. In fact it may be more efficient and avoids confusion with the surgical technician to use the same instrumentation and employ fully threaded cancellous screws for plate fixation both proximally and distally. Although, be aware, some of the older Synthes small fragment sets have cancellous screws that start at 14 mm, slightly longer than usually measured along the proximal fibular shaft.

There are standard screw lengths for the fibular fixation. It is imperative not to violate the distal syndesmosis or the distal tibiofibular joint. A recent study performed by Kim and associates utilized 30 CT scans to determine the width of the distal fibula below the syndesmosis. The results showed that a 16 mm screw could be used with a plate dstal to the syndesmosis 100% of the time in male subjects and in 87% of female subjects.[1] This study did not take into account the practice of slightly angulating the distal screws to further avoid the lateral gutter. We can apply this anatomic knowledge to the other screws crossing the distal fibula above the malleolus to have a general idea of the correct screw size. The more proximal screw size along the distal diaphysis is 12 mm. +/- 2mm. Screws in the distal metaphyseal fibula usually measure 14 mm. +/-2 mm. Intraoperative radiographs or flouroscopy is recommended to ensure proper reduction and optimal fixation placement (Figure 3).

The posterior antiglide plate is a stable alterntive form of fixation when bone density is a problem. Because of osteoporosis geriatric ankle fractures that require ORIF will often times benefit from the plate placed posteriorly that blocks posterior lateral displacement. The author has allowed patial weightbearing for transfers and even ambulation while the patients were casted. The patients all healed unvenfully without displacement. Interfragmentary screws both through the plate and oriented anterior to posterior enhance the internal fixation (Figure 4).

Syndesmotic screws are not always necessary in a pronation exteral rotation injury. Boden's research demonstrates that in a low PER injury with the fibular fracture 3 cm. from the ankle joint a syndesmotic screw is not necessary for stability if a medial malleolar component is adequately fixated and the fibula is stable to external rotatory forces[2] (Figure 5). Fractures located 3-4.5 cm. above the ankle were found to be indeterminate. If screw fixation is chosen, either one or two 3.5 or 4.5 mm. cortical screws should be used (Figure 6). Two screws are more stable than one. Only three cortices are necessary when usng two screws. When one syndesmotic screw is employed it should be placed through both cortices of the fibula and two cortices of the tibia. Some consideration should be made for an above knee cast for a patient with a Maisonneuve fracture.

Alternative methods of fixation may prove useful in a bind. Challenging, high energy fractures with segmental bone loss require extraordinary fixation techniques. A 3.5 mm. dynamic compression plate can be used to bridge a comminuted segment. This will occasionally require bone grafting. Cerclage wire can be used to fixate a communited section to a plate (Figure 7). Tension band wire is utilized for a transverse Weber A fibular fracture. Three distal interfragmentary screws are considered an option to plate fixation however never in a higher fibular fracture (Figure 8). Grip plates are used overseas on osteoporotic bone. An occasional unstable fracture that cannot undergo operative treatment due to skin problems can be stabilized in a reduced position by transarticular pin fixation and casting. Bostman and colleagues research showed the merits of using biodegradable fixation for syndesmotic fixation remains to be questioned because of the 9% occurrence of sterile sinus formation.[3] Rush rods have proven to be unsable allowing shortening and rotation, however there is a place for single screw axial fixation in Weber A, transverse fractures.

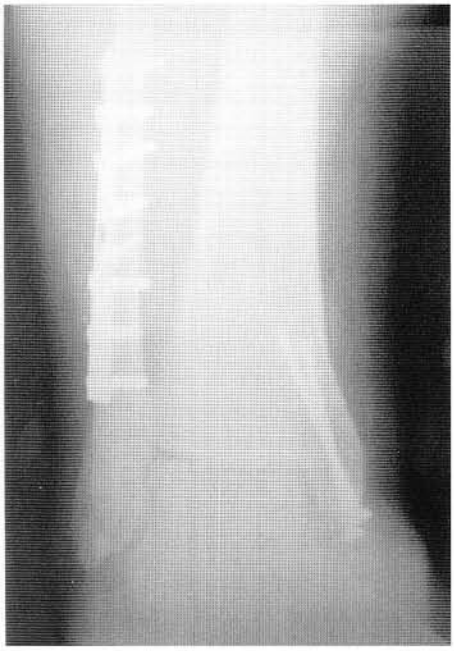

Figure 5. Pronation external rotation injury with a stable syndesmosis after fiation of the medial malleolus.

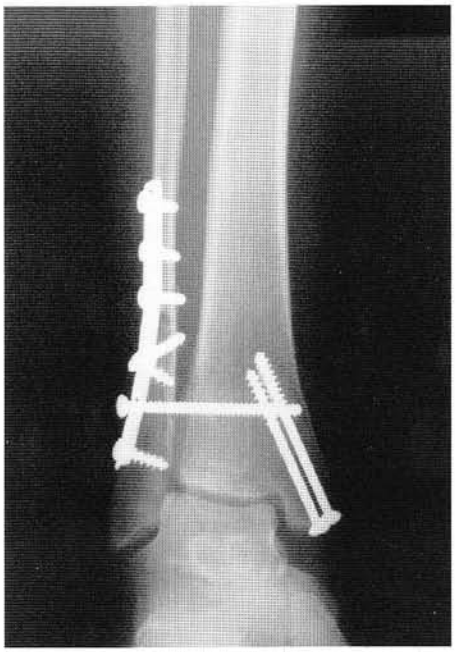

Figure 6. Pronation external rotation injury with unstable syndesmosis that required a transyndesmotic screw.

Figure 7. Cerclage wire used to fixate comminuted section to a long plate.

Figure 8. Three interfragmentary screws used instead of a plate in a long, spiral, oblique fracture.

POSTOPERATIVE CARE

The management following operative treatment of ankle fractures remains controversial. There is a tradeoff between early mobilization that allows joint function and prevents cast disease versus prolonged immobilization and nonweightbearing which insures anatomic osseous healing, sometimes with a price. The postoperative course should be individualized depending on the age of the patient, fracture type, patient compliance, stability of the fixation, and coexistent soft tissue injuries (ligament rupture). Generally the patient is maintained nonweightbearing in a Jones compression cast immediately postoperatively for 3-6 days. A below knee synthetic cast is usually then employed for the next 2-3 weeks. This allows time for healing of the skin and ligamentous structures injured at the time of the ankle fracture. I feel that this three to four week time frame allows for the skin and soft tissue structures, (ligaments and capsulei) to heal as well as early fracture healing to occur. By the end of this period the pain and swelling has subsided sufficiently to allow early rehabilitation. Instituting joint mobilization, muscle contraction and proprioceptive excercises at this time allows the joint function to "catch up" to the surrounding healed or healing osseous and soft tissue structures. Full weightearing is allowed after radiographic fracture healing has occurred.

CONCLUSION

The successful operative treatment of displaced ankle fractures has become the standard of care because of better outcomes and less complications. The advancement of modern surgical technique has reduced the most common complication of traumatic arthritis. When present, traumatic arthritis is probably due more to incidental articular damage occurring at the time of the injury rather than the lack of anatomic reduction and stable fixation. Another complication, arthrofibrosis can occur in spite of perfect anatomical reduction due to capsular or synovial injury. It is hoped that the reader will gain a pearl or two from this brief summary of my experience with ankle fractures.

REFERENCES

1. Kim KH, Botte MJ, Rooney RC, Parr RR. Screw length selection in metaphyseal fibula fixation. *Foot & Ankle Int.* 2000; 21(10):870-71.
2. Boden SD, Labropoulos PA, McCowan P, et al. Mechanical considerations for the syndesmosis screw. *JBJS* 1989:71-A(10):1548-55.
3. Bostman O, Partio E, Hivensalo E, Rokkanen P. Foreign-body reactions to polyglycolide screws. Observations in 24/216 malleolar fracture cases. *Acta Orthop Scand* 1992;63(2):173-6.