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TECHNIQUE

Distraction Arthroplasty for the Ankle Using the Ilizarov Frame

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ABSTRACT

Treatment options for ankle arthrodesis continue to be an area of interest for orthopaedic surgeons. Distraction arthroplasty for the ankle has been shown to be a viable alternative to ankle fusion for some people. This paper reviews the various treatment options for ankle arthrodesis while describing in detail the use of the Ilizarov frame in distraction arthroplasty of the ankle.
Keywords: ankle arthrodesis, Ilizarov, distraction arthroplasty, surgical technique, foot and ankle

HISTORICAL PERSPECTIVE

Ankle arthritis and its management continue to be a vexing problem for many orthopedists today. The complex biomechanics and unique articular cartilage properties of the ankle make this area particularly challenging. Unlike the hip and knee, primary osteoarthritis of the ankle is uncommon and in most cases appears to be posttraumatic.[1]

Ankle fusion continues to be the gold standard of treatment for ankle arthritis refractory to conservative management. This, unfortunately, is not a perfect solution and can be complicated by malunion, nonunion, degenerative arthritis of bordering joints, and wound problems. Loss of function and increased energy expenditures with ambulation are disadvantages of this procedure for both patient and surgeon.

Ankle arthroplasty has resurfaced as a means to treat the patient's symptoms of pain while preserving function. Despite its catastrophic failure in the late 1970s and 1980s, new designs and techniques have made this treatment modality possible. Unfortunately, long-term studies are still lacking, and with salvage options limited, other alternatives are still necessary.

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Distraction arthroplasty was first pursued in the management of hip arthritis.[2] This was met with limited success and, given the successful and satisfying outcomes with total hip replacement, has largely been abandoned. This did, however, provoke interest in its use for ankle arthritis. van Valburg et al have developed a new technique using the Ilizarov for joint distraction over a 3-month period.[3] Retrospective and prospective studies have followed that show encouraging results.[4] Long-term data are still not available at this time, but by preserving the ankle joint, it may be a useful alternative to fusion or arthroplasty.

The theory is contingent upon 2 factors: mechanical unloading of the joint and maintenance of intraarticular intermittent flow. The mechanical stress is unloaded by means of distraction allowing the chondrocytes to repair themselves. The intermittent flow is facilitated by the use of hinges placed in the frame allowing range of motion of the ankle. Also, by allowing the patient to walk with the frame in place, there is intermittent increase in hydrostatic pressure due to the flexibility of the frame.[3]

INDICATIONS

This procedure is indicated in patients who have failed conservative measures, such as nonsteroidal antiinflammatory drugs, and who would otherwise be offered an arthrodesis or arthroplasty. Ideally, these are patients who are younger and higher-demand individuals who would likely develop early failure of ankle arthroplasty. This procedure is also an alternative to fusion for those patients reluctant to commit to a fusion. Contraindications include advanced arthrosis with limited range of motion and active infection. These patients may be better served with an ankle arthrodesis. These contraindications are relative, however, and these patients may be considered for distraction, especially if they are young in age. More experience and follow-up are needed to see whether this may be sound treatment.

In cases associated with tibial deformity, a supramal-

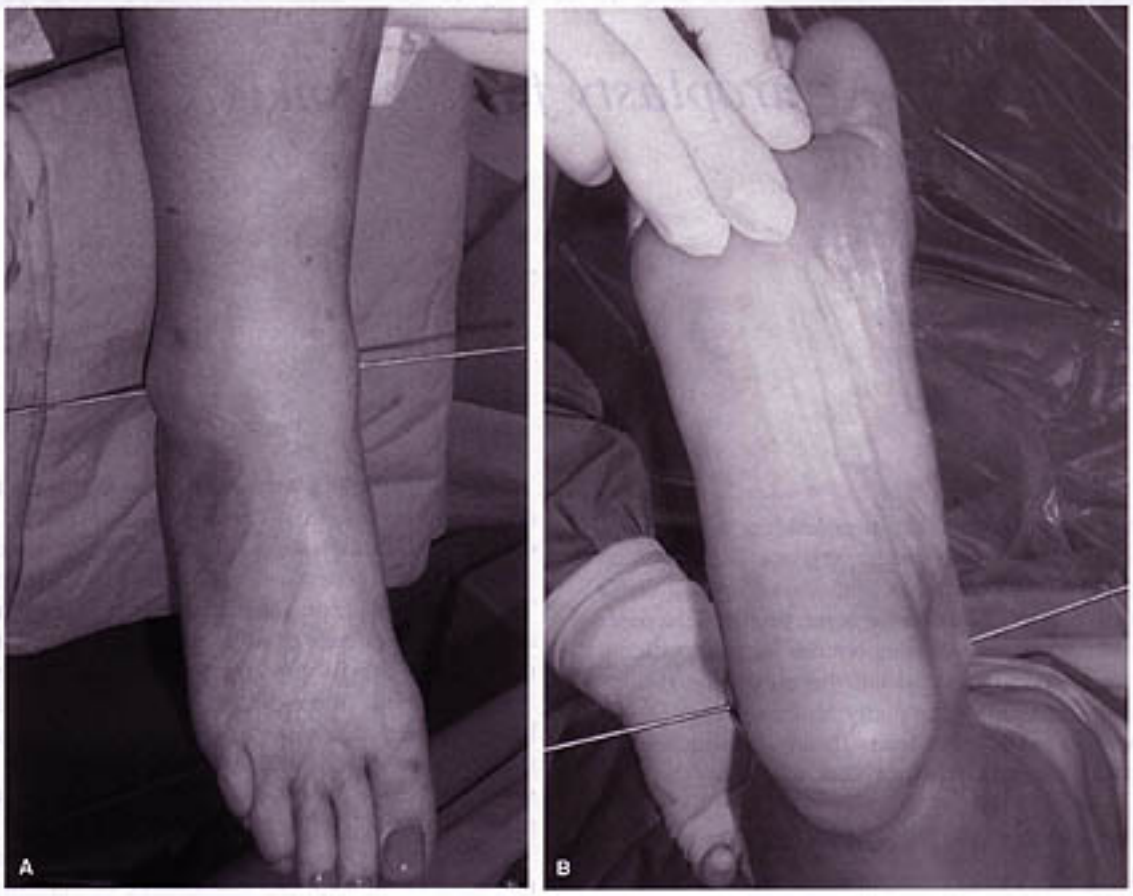

FIGURE 1. A temporary smooth K wire is inserted from the tip of the lateral malleolus to the tip of the medial malleolus. The direction is posterolateral to anteromedial. This represents the axis of the ankle joint.

leolar osteotomy can be performed in the same surgical setting. The osteotomy can be stabilized with a ring placed at the middle of the tibia and with a ring at the distal tibia. Distraction can then take place between the distal tibia ring and the foot ring. This technique has also been used in a case involving avascular necrosis of the talus. We did notice increased osteopenia of the talus while the ankle was distracted. This may suggest increased vascularity of the affected area, but longer follow-up is needed. Thus far, however, patients did show improvement of their symptoms and absence of collapse.

■ PREOPERATIVE PLANNING

Preoperative work-up should start with weight-bearing views of both ankles and feet. Weight-bearing views are extremely important when looking for deformities as well as assessing more accurately for arthritis. Computed tomography scans can also be obtained to further delineate the extent of arthritis or possible osteochondritis dissecans lesions. Diagnostic injections are also helpful to help isolate the main source of pain and to quantify the amount of relief expected from the procedure.

■ TECHNIQUE

The patient is taken to the operating room and placed under either regional or general anesthesia with the appropriate limb prepped and draped in the usual sterile fashion. The patient can then undergo either an arthroscopic or formal ankle arthrotomy to remove any ankle spurs from the distal tibia or talus, if this is deemed necessary. This can be done with or without a thigh tourniquet, based on surgeon's preference. The amount of decompression is based on the preoperative work-up outlined earlier. This is then followed by placement of the Ilizarov frame.

The use of a tourniquet during this portion of the procedure is not necessary and is discouraged. The frame includes a proximal circular ring placed about 8 cm above the ankle joint, a foot ring, and hinges at the ankle joint.

Proximal Ring

Remaining mindful of the important neurovascular structures at this junction, the surgeon places one 1.8-mm smooth wire in the distal third of the tibia. This reference wire is inserted perpendicular to the diaphysis of the tibia in the coronal plane. This is then secured to the ring and tensioned to 130-kg torque. Two 6-mm half pins are then inserted off cubes attached to this ring. These are placed so that the ring is made perpendicular to the tibia in the sagittal plane as well as the coronal plane.

A temporary smooth K-wire is inserted through the talus from the center of the tip of the fibula and then directed to the center of the tip of the medial malleolus in a proximal and anterior direction (Fig. 1). This is then checked under the fluoroscope to ensure proper placement (Fig. 2). This is perhaps the most crucial portion of the procedure because it marks the true oblique axis of the ankle joint. This wire will mark the hinge position to allow the talus to move smoothly with in the mortise as it is distracted.

Distal Foot Ring

A foot ring is then secured to the hindfoot and midfoot by placing 2 smooth wires in an oblique fashion through the calcaneus and cuneiforms/cuboid, respectively. These

FIGURE 2. Flouroscopic view of the temporary ankle joint axis wire. Note that this wire travels through the center of the talus.

FIGURE 3. Hinge placement along the axis of the ankle joint. Note the use of the temporary joint axis wire.

are then tensioned and secured as described above. The foot ring is positioned parallel to the plantar surface of the foot. A transverse midfoot wire is inserted and tensioned to the ring.

Hinge Placement

Using the previously placed guide wire for the true axis of the ankle joint, the surgeon secures 2 universal hinges to the foot ring attached at points defined by the temporary joint axis wire. The joint axis wire may then be removed. The hinges are then secured to the proximal ring placed on the tibia using threaded rods and short connection plates (Fig. 3). These rods should be perpendicular to the ankle in both the coronal and sagittal planes. A compression/ distraction rod is placed anteriorly to control ankle range of motion, thus completing the frame (Fig. 4). The ankle joint is then taken through a range of motion under fluoroscopy to ensure smooth symmetric motion of the talus within the mortise. With the frame secured, the ankle is distracted approximately 2 mm. This is then taken through a range of motion under fluoroscopy to check the amount of distraction as well as

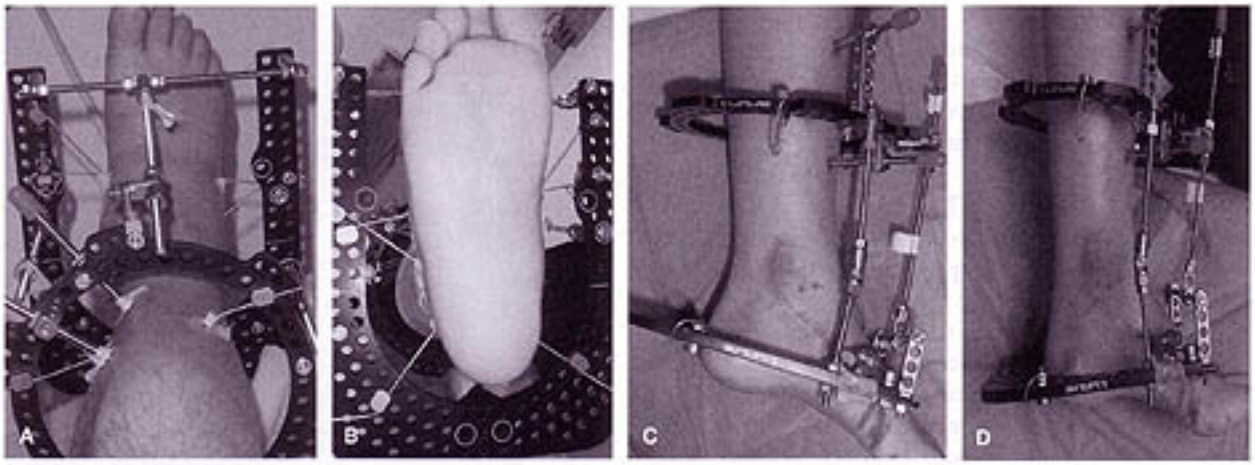

FIGURE 4. A, B, Completed frame showing pin and wire placement. C, D, Note anterior distraction/compression rod used to move the ankle into plantar flexion and dorsillexion respectively.

to double check the alignment (Fig. 5). Gradual distraction of 1 mm per day in 4 separate daily adjustments for 1 week is prescribed. A total of 9 mm of distraction is achieved.

■ PRELIMINARY RESULTS

We have performed 9 articulated distractions of the ankle. Three have been combined with a supramalleolar realignment osteotomy. Three patients underwent ankle arthroscopy, and 2 patients underwent ankle arthrotomy and debridement at the same setting. Two patients had a percutaneous tendo-Achilles lengthening. The average follow-up is 1 year (range 3 months to 2.5 years). All patients have had improvement in the radiographic appearance of the ankle. A wider joint space has been observed in all cases. All patients have reported satisfaction with the procedure and improvement in pain. Ankle dor-

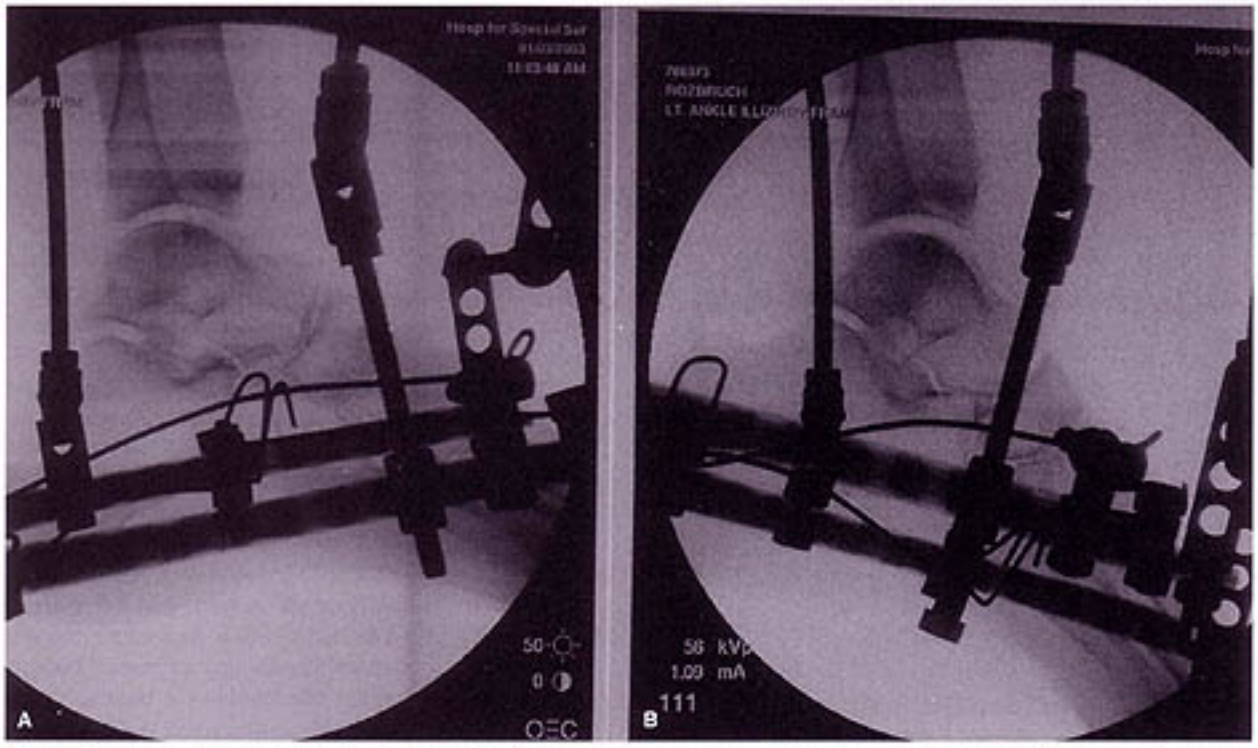

FIGURE 5. A, B, Flouroscopic view showing ankle distraction and congruent ankle movement in dorsiflexion and plantar flexion. This confirms correct hinge placement.

siflexion did improve in all patients, which was facilitated by concomitant use of tendo-Achilles lengthening, removal of osteophytes, and range of motion while in the frame. Despite this, the overall arc of motion did not substantially improve. None of the patients developed ipsilateral stiffness of their subtalar or tarsal joints as a result of the procedure, nor did any require any additional ankle surgery. We will continue to observe these patients, and we plan to report the clinical outcomes in the future.

■ COMPLICATIONS

The most common complication is superficial pin site infection, which is treated with local wound care and oral antibiotics. Other theoretical concerns are inadvertent neurovascular injury with errant placement of the wires, but this has not occurred. Failure, ankle stiffness, and progression of arthritis are other potential complications. There have been no cases of regional pain syndrome associated with this procedure. The use of gradual distraction is probably important to prevent this problem.

■ POSTOPERATIVE MANAGEMENT

Postoperatively, most patients are admitted overnight for pain control and neurovascular exams. The pin site care is initiated the next day using a mixture of peroxide and saline and xeroform gauze around each pin site. The patient is maintained on oral antibiotics for 10 days following the procedure. Weight bearing is begun immediately with the frame locked at neutral for the first 2 weeks. Range of motion is then begun gradually and increased as much as possible. This is accomplished by adjusting the compression/distraction rod, which controls ankle dorsiflexion and plantar flexion. The patient is encouraged to sleep with the ankle in the neutral position. The anterior compression/distraction rod is removed after 2 months, allowing free motion of the distracted ankle. This continues for 1 more month, and the frame is removed after a total of 3 months. This removal is done as an ambulatory surgery under intravenous sedation.

■ POSSIBLE CONCERNS AND FUTURE OF THE TECHNIQUE

This is a minimally invasive yet technically demanding procedure and requires thorough knowledge of the Ilizarov frame and its application. One possibility for its future use is in patients undergoing mosaicplasty or allograft implantation for large chondral defects. This would allow for earlier weight bearing during implant incorporation. The use of this technique for avascular necrosis of the talus and following repair of high-energy intraarticular ankle pilon fractures may hold promise for joint preservation.

■ REFERENCES

1. Saltzman C, Buckwalter J. Ankle arthritis: emerging concepts and management strategies. *AAOS ICL*. 1999;48: 233–240.
2. Judet R, Judet T. Arthrolyse et arthroplastie sous distracteur articulaire. Rev. de chirurgie. *Orthopedisque*. 1978;64:353.
3. van Valburg A, van Roermund P, Lammens J, et al. Can Ilizarov joint distraction delay the need for an arthrodesis of the ankle bone? *J Bone Joint Surg Br*. 1995;77:720–725.
4. van Valburg AA, van Roermund PM, Marijnissen AC, et al. Joint distraction in treatment of osteoarthritis: a two year follow up of the ankle. *Osteoarthritis Cartilage*. 1999; 7:474–479.