Ankle Distraction

Bradley M. Lamm*
International Center for Limb Lengthening, Rubin Institute for Advanced Orthopedics, Sinai Hospital, Baltimore, MD, USA

Abstract

Many patients with arthritis of their ankle joint wish to maintain their joint and resist the notion of a joint destructive procedure (fusion or replacement). Thus, joint distraction of the ankle joint with external fixation is a joint preservation procedure that is known to decrease pain associated with arthritis. Presented is a case of a 51 year old female with severe post-traumatic ankle arthritis who underwent hinged ankle joint distraction with external fixation. Joint distraction for later-stage arthritis has proven to be a viable treatment method for joint preservation. The utilization of a hinge to maintain motion during external fixation joint distraction of the ankle joint along with soft-tissue and osseous realignment procedures makes this technique a successful joint preservation option. The use of a series of intra-articular injections of human growth hormone during joint distraction of the ankle has further enhanced the treatment results.

1 Brief Clinical History

A 51 year old female patient had sustained dislocation and fracture of the right ankle 40 years previously. Despite surgical repair, the patient developed post-traumatic arthritis of the ankle. Four years previously, she underwent core decompression and removal of internal fixation of the right ankle. She had some relief from this procedure but gradually developed further ankle joint pain. She had zero degrees of ankle dorsiflexion due to blocking osteophytes but had 35° of ankle plantar flexion. Given her ankle joint congruency, mobility, and arthritis, arthrodiastasis (joint distraction) was performed.

2 Preoperative Clinical Photos and Radiographs

See Figs. 1, 2, and 3.

3 Preoperative Problem List

(a) Ankle arthritis.
(b) Anterior ankle osteophytes.
(c) Equinus (osseous vs. soft tissue), perform the anterior osteophyte resection then reassess the equinus to see if the posterior muscle group needs lengthening.

*Email: blamm@lifebridgehealth.org
*Email: bradankle@yahoo.com
4 Treatment Strategy

The indications for ankle distraction are congruent joint surfaces, pain, joint mobility, and moderate to severe arthritis. Joint distraction reduces the mechanical stress on the cartilage by using an external fixation device and provides an interval healing of the cartilage surfaces.

Realignment of the soft tissue and bone is as critical to joint preservation as the joint distraction technique to obtain maximum benefits. Therefore, I utilize adjunctive procedures combined with hinged joint distraction to maximize ankle joint preservation which includes osseous realignment, soft-tissue rebalancing, and resection of osteophytes/loose bodies as required. Procedures such as core decompression, micro-fracture of osteochondral lesions, intra-articular injection of human growth hormone, and nerve decompression are also utilized when necessary.

5 Basic Principles

Joint distraction (ligamentotaxis) with external fixation for a 3-month period reduces joint loading and provides an environment in which the joint cartilage can recover. Studies have confirmed that fibrocartilage forms to restore the arthritic joint surface during distraction treatment (Salter et al. 1980, Lamm and Gourdie-Shaw 2009, van Valburg et al. 1995). Joint distraction also produces a decreased

Fig. 1 Preoperative weight bearing photograph obtained during maximum ankle dorsiflexion showing right ankle equinus deformity with compensated genu recurvatum
thickness of the subchondral bone, which is beneficial to increase the resiliency of the entire joint cartilage and fibrocartilage overlying the subchondral bone. Hinged ankle joint distraction with external fixation allows range-of-motion exercises and weight bearing (intermittent hydrostatic joint loading) during treatment, which increases the synovial fluid and thus provides healing of the joint cartilage.

The goals of ankle joint distraction with external fixation are to decrease pain and improve function. Joint pain is diminished by the formation of fibrocartilage, which adequately seals the cartilaginous cavity to the subchondral bone cyst and therefore eliminates increased fluid pressure and pain (Paley et al. 2008). The formation of fibrocartilage is the reason why ankle distraction leads to lasting pain relief of osteoarthritis of the ankle joint. Joint distraction typically will not improve the amount of joint range of motion but more importantly can alter the arc of motion. The arc of ankle joint motion can be adjusted based on the amount of ankle dorsiflexion planned into the hinged ankle distraction, thereby creating a more functional ankle joint without increasing the amount of joint range of motion.

6 Images During Treatment

See Figs. 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14.
Fig. 3 Preoperative lateral-view radiograph revealing right ankle arthritis. Note the anterior osteophytes of the ankle and subtalar joint arthritis.

Fig. 4 Intraoperative fluoroscopic lateral view revealing the use of osteotomes to deepen the neck of the talus. The two osteotomes serve as a guide for resection. Note that the ankle is maximally dorsiflexed to match the portion of tibia resected. Care must be taken not to resect too much talar bone because doing so could lead to fracture, and care must be taken to resect the minimal amount of tibia to prevent subluxation of the ankle joint.
7 Technical Pearls

Distraction begins on postoperative day 1 after application of the external fixator and continues for a total of 5 days. The patient is instructed to turn one one-quarter turn four times per day (a rate of 1 mm/day). The goal is to achieve 8–10 mm of symmetric ankle joint distraction. The external fixation device is maintained for 3 months while allowing weight bearing as tolerated. The posterior distraction rod can be removed by the patient to perform daily ankle range-of-motion exercises and to attend physical therapy three times a week. A nursing staff member provides the patient with pre- and postoperative education, which helps to ensure better outcomes.

Ankle intra-articular injection of human growth hormone (Nutropin 10 mg reconstituted in 5 cm³ of injectable saline) can be added in a series of weekly injections for 5 weeks during distraction treatment to augment the restoration of the joint surface. Growth hormone provides angiogenesis and thus produces an environment of regenerative tissue to form within the joint.

8 Outcome Clinical Photos and Radiographs

See Figs. 15, 16, 17, 18, 19, 20, and 21.

9 Avoiding and Managing Problems

1. Failure to address all soft-tissue and osseous deformities will lead to failure of the distraction.
Fig. 6 Intraoperative photograph showing exposure of the joint after deepening the neck of the talus and removing residual osteophytes from the tibia with bone wax embedded into the resected bone.

Fig. 7 Intraoperative fluoroscopic anteroposterior view used to determine the center of rotation of the ankle joint with placement of the temporary transmalleolar wire along Inman’s axis of the ankle.
2. During distraction obtain 8–10 mm of ankle distraction
3. Treatment of equinus with gradual correction and ankle distraction requires maintenance of the maximum dorsiflexion position beyond the normal to apply overstretch of the posterior muscle group. Typically, 5–10° of rebound equinus occurs after removal of the external fixator. Therefore, overcorrection of dorsiflexion is planned to maximize the functional arc of motion.
4. Physical therapy administered during and after treatment is important. The posterior distraction rod is removed for active and passive range of motion. The goal is to maintain the ankle motion acquired during surgery.

Fig. 8 Intraoperative fluoroscopic lateral view confirming placement of the transmalleolar wire in the talar body

Fig. 9 Intraoperative photograph after application of the tibial block showing the hinges are aligned at the level of the transmalleolar axis with the medial hinge more proximal and anterior to the lateral hinge
5. Two talar wires ensure symmetric distraction at the ankle joint. Metatarsal wires typically are problematic; thus, midfoot wires are used. In the foot, smooth wires are used exclusively.

6. It is important to evaluate the patient’s external fixator for stability at each postoperative visit (biweekly and then monthly).

Fig. 10  Intraoperative fluoroscopic lateral view showing placement of the medial to lateral talar neck wire and oblique talar wire. Note the removal of the transmalleolar wire.

Fig. 11  Intraoperative fluoroscopic lateral view showing combined symmetrical distraction of the ankle and subtalar joints.
7. Address osteochondral lesions with micro-fracture or core decompression techniques to maximize success of the ankle distraction treatment.

Fig. 12 Postoperative photograph showing the final construct for ankle distraction with the walking ring and cast shoe that allow weight bearing as tolerated. Note the tape with arrows denoting the direction of turning for ankle distraction and the forefoot custom-molded plastic splint fabricated, which prevents digital contractures. Note that the posterior distraction rod can be removed to perform range of motion of the ankle by loosening the long sockets on the distal tibial and foot rings.
Fig. 13  Postoperative lateral view radiograph showing symmetrical distraction at the ankle joint.
Fig. 14 Postoperative anterior-posterior view radiograph showing symmetrical distraction at the ankle joint
Fig. 15 One year postoperative lateral weight bearing radiograph view of the ankle. Note the talar neck deepening and the slight increase in ankle joint space.

Fig. 16 One year postoperative anteroposterior weight bearing radiograph view of the ankle. Note the slight increase in ankle joint space.
**Fig. 17** Postoperative clinical weight bearing photograph showing a plantigrade foot

**Fig. 18** Postoperative clinical photograph showing increased functional dorsiflexion of the ankle
Fig. 19  Postoperative clinical photograph showing functional plantar flexion of the ankle
Fig. 20  T1-weighted ankle coronal-view magnetic resonance images preoperative (a) and 1 year postoperative (b) after ankle distraction. The ankle joint cartilage thickness is wider after surgery, and the subchondral bone thickness after surgery has decreased.

Fig. 21  T1-weighted sagittal-view magnetic resonance images preoperative (a) and 1 year postoperative (b) after ankle distraction. The ankle joint cartilage thickness is wider after surgery. The subchondral bone thickness after surgery has also decreased.
10 Cross-References

- Equinus Contracture Correction with External Fixation
- First MTP Joint Distraction

References and Suggested Reading