Distraction Arthroplasty: How Annoying?

Douglas N. Beaman, MD
Portland, Oregon

ANKLE JOINT DISTRACTION

Ankle distraction arthroplasty is a component of ankle joint preservation for arthritis. Joint preservation generally includes correction of associated bony and soft tissue deformities, joint debridement, and ligament and tendon balancing. Distraction arthroplasty is based on the hypothesis that articular cartilage repair can occur when the joint is unloaded and subjected to intermittent fluid pressure changes. Mechanical unloading is achieved for several months with a ring external fixator device. During this period, loading and unloading of the joint during weight-bearing results in intra-articular hydrostatic pressure changes. In vitro and animal studies have demonstrated that mechanical unloading and intermittent fluid pressure changes can alter cartilage matrix turnover. Also, subchondral bone remodeling occurs with distraction and may affect cartilage repair. Subchondral bone remodeling has been linked to clinical improvement. Clinical studies have demonstrated improved pain and mobility, with a delay for the need of ankle arthrodesis or replacement.

Patient evaluation for ankle distraction arthroplasty includes a thorough history and physical examination. The optimal candidate is a compliant, motivated patient younger than 50 years who has post-traumatic arthritis or chronic ankle instability with arthritis, no previous history of ankle joint sepsis or ankylosis, and an appropriate psychosocial support system to facilitate recovery and in-frame care. Also, overall general good health without diabetes, vascular disease, neuropathy, or other significant medical problems affecting function is a pre-requisite for ankle distraction. Furthermore, physically demanding occupations may prevent optimal clinical results, and preferred recreational activities are non-impact, such as swimming and bicycling.

Ankle motion (approximately 25 to 30 degrees), including dorsiflexion (5 to 10 degrees), is preferred for successful ankle distraction arthroplasty. Ankle joint stability is assessed clinically and is confirmed with ankle stress radiographs in addition to the radiographic evaluation of any co-existing tibia, ankle, and/or foot deformity. Asymmetric loss of anterior ankle articular cartilage has been associated with less successful results in our experience.
Although clinical studies have demonstrated similar success rates for ankle distraction in all age groups, older patients, in our practice, tend to have less overall capacity to tolerate the rigors of distraction arthroplasty. These include persistent pain, functional limitations, and the long recovery time (typically 1-2 years) to reach maximum improvement.

The above indications are not absolute, however, and clinical judgment must be exercised. This requires careful preoperative evaluation and counseling. For example, a 35-year-old physical laborer with severe ankle pain and ankylosis due to post-traumatic arthritis without deformity may best be managed with an ankle arthrodesis. Whereas, a 55 year old with post-traumatic arthritis and a significant distal tibial deformity with arthritic symptoms related to the deformity may best be managed with deformity correction and distraction.

ANKLE DISTRACTION/DEFORMITY CORRECTION - RESULTS AND COMPLICATIONS

Judet and Judet published the first study in western medical literature of ankle distraction for posttraumatic ankle arthritis with a hinged distraction apparatus. 13 of 16 (81%) patients had good results at 16-month follow-up. A subsequent study of patients with hip arthrosis showed that articulated distraction of the hip yielded good results in 42 of 59 (71%) patients who were younger than 45 years but poor results in patients older than 45 years and in patients with inflammatory arthritis.

In a prospective study of 57 patients followed for an average of 2.8 years after ankle distraction, significant clinical improvement was noted in three fourths of the patients, improvement increased over time, and joint distraction had significantly better results than ankle joint debridement alone. A subsequent review by the same researchers at minimum 7 years of follow-up evaluation after ankle distraction for osteoarthritis showed that 16 of 22 (73%) patients had significant improvement of all clinical parameters and 6 (27%) patients had failed treatment. Tellisi et al reported on 23 patients at an average follow-up of 30.5 months, with 17 (74%) having significant improvement in the AOFAS score (average preoperative score was 55 and postoperative score 74). In 2012, Saltzman demonstrated in a prospective randomized controlled trial a significant improvement in distraction results with motion compared to fixed distraction.

Our early results with ankle distraction were presented in conjunction with osteotomy for deformity correction. In 11 patients with ankle arthritis associated with deformity of the distal tibia (five deformities, most commonly valgus or recurvatum and valgus) or foot (seven deformities, most commonly cavovarus), treatment consisted of ankle joint distraction with the Ilizarov device, and deformity correction. Tibial deformity correction was gradual in three patients and acute in two patients, and all seven foot deformity corrections were acutely performed. Ninety percent were very satisfied or satisfied, dorsiflexion range directly correlated with AAOS score. It was concluded that deformity correction can augment the efficacy of distraction and that dorsiflexion may be an important factor in the success of an ankle distraction procedure. Our further experience with distraction has shown that anterior asymmetric joint wear is a poor prognostic indicator.

Distal tibia deformity correction alone can also provide satisfactory results in the arthritic ankle. Several small retrospective series have shown the majority of patients with ankle arthritis who undergo distal tibial osteotomy for either varus or valgus deformity have significant improvement in their ankle pain without progression of arthritis. In 2007, Pagenstert et. al. reported on realignment surgery in 35 patients (average age, 43 years) with varus and valgus ankle osteoarthritis with an average follow-up of
five years. AOFAS score increased from 38.5 preoperatively to 85.2 postoperatively. Slight overcorrection of deformity was believed to be optimal, and others have recommended this as well. Whether over-correction is necessary and to what degree is unclear.

COMPLICATIONS

The most common complications of ankle distraction arthroplasty include pin site inflammation or infection, hardware failure, and failure of the procedure to relieve pain. Direct neurovascular injury resulting from pin placement can occur despite operative caution because of post-traumatic distortion of the anatomy and scarring. Other general risks include anesthetic problems, surgical wound problems and infection, and thromboembolic disease.

In patients undergoing ankle distraction with range of motion, the threaded rods attached to the universal hinges or the hinge itself can fail because of the major stresses placed on these portions of the fixator. If a half pin or wire loosens, treatment includes re-tensioning the wires and occasionally replacing a half pin in a new site.

Immediate correction of a deformity (especially varus and equinus) in the distal tibia or foot, especially with concomitant ankle distraction, may be complicated by traction injury of the posterior tibial nerve and tarsal tunnel syndrome. If this occurs, the deformity may be restored and traction released to remove nerve tension, and correction and traction may be reapplied gradually. Prophylactic tarsal tunnel release can limit this complication, and careful postoperative monitoring can enable early recognition and release of traction. Gradual deformity correction and ankle distraction can limit risk of traction injury to the posterior tibial nerve. Furthermore, a postoperative anesthetic nerve block is used with caution because it can mask neuropathic symptoms, and nerve recovery may be optimized by early recognition, release of traction, and tarsal tunnel release.

Tarsal tunnel release may be required in the immediate postoperative period if other measures do not restore nerve function.

Swelling and stiffness can occur after ankle distraction as a result of the underlying arthritic disorder. A period of increased pain and disability after ankle distraction can occur for 3 to 6 months after the frame is removed, occasionally persisting for up to 12 or more months. Nonimpact activities are emphasized during this time, including swimming and bicycling. Gradual improvement up to 12 to 24 months after fixator removal has been observed, and further procedures are usually deferred until this time. Patients may also experience foot pain following ring fixation of the foot. This most commonly is associated with osteopenia and resolves within six months, however, wire positioning issues may lead to prolonged discomfort or arthritic changes.

Other complications that are associated with gradual correction include delayed or premature bony consolidation, malunion, fracture after or associated with frame removal, and ankle and foot stiffness including equinus contracture. In our experience, delayed healing of the distal tibia is the most frequent significant problem encountered during gradual correction of distal tibia deformity. Consideration should be given for bone grafting, our preference is autologous anterior iliac crest, if healing is slow or fails to progress. Also, revision of tibia fixation may be necessary if it becomes loose or inadequate.
References:


