Clinical Case Review:

**Ankle Distraction Arthroplasty: MRI Findings**

Small Bone Innovations, Inc. RingFIX™ RAD

**Before**

1 Year Post RingFIX™ RAD Frame Removed
INTRODUCTION

Ankle arthritis and its management remain a challenge. Ankle fusion continues to be a mainstay of treatment for ankle arthritis. However, fusion is not an optimal solution due to the loss of joint motion and subsequent development of degenerative arthritis of adjacent joints. Other disadvantages of arthrodesis include a substantial rate of malunion, non-union, wound healing problems, loss of function, abnormal gait, and increased energy expenditures with ambulation.\(^3\) Ankle arthritis is most commonly seen in patients as a post-traumatic sequelae.\(^4\) Many patients were highly functional prior to their injuries and are reluctant to sacrifice the ankle motion following ankle arthrodesis. With the lack of encouraging long-term results from prosthetic ankle arthroplasty, other treatment modalities are sought.

Joint distraction arthroplasty, using a circular external fixator, is not a new approach in the treatment of arthrosis. Distraction arthroplasty was first implemented in the management of hip arthritis by Judet.\(^1\) Van Valburg, et al.\(^5,6,7\) later applied this concept to the arthritic ankle joint. The theory behind the success of distraction is contingent upon the mechanical unloading of the joint and the intermittent flow of intra-articular synovial fluid. It is thought that mechanical stress upon the joint surface inhibits the ability of articular cartilage to undergo a reparative process. When the mechanical stress is unloaded by means of distraction the cartilage will have the opportunity to undergo a healing phase undisturbed by axial loading and shear forces. The intermittent flow or cyclical changes in joint fluid pressure is facilitated by allowing the patient to weight bear with the frame in place causing fluctuations in intra-articular hydrostatic pressure between swing phase and heel strike. This movement of joint fluid is thought to improve the local environment for cartilage healing.\(^5\) We believe that intermittent flow is further enhanced by incorporating articulated distraction which allows for ankle joint range of motion while in the frame.\(^6\)

INDICATION

Distraction Arthroplasty is indicated for patients with ankle osteoarthritis with preserved tibiotalar joint geometry and preservation of joint mobility. It serves as an alternative to ankle arthrodesis. This surgical protocol describes the application of the RAD articulated external fixator. Often the frame application is preceded by intraarticular surgery to stimulate cartilage healing. This typically involves arthroscopic or open debridement of anterior osteophytes and microfracture of denuded areas of the articular surface. Incisions should be kept small to prevent contamination between areas of dissection and the pin sites.

RingFIX™ RAD FRAME

The RingFIX™ RAD is a new SBi external fixation system solely dedicated to the technique of distraction Arthroplasty. The RingFIX™ RAD is a kit for building an ankle distraction frame with preassembled parts and step by step directions. The RingFIX™ RAD Kit and technique simplifies the process of applying a circular fixator making this tool available to all foot and ankle surgeons.
SURGICAL TECHNIQUE

See SBi RingFIX™ RAD Surgical Technique for details on the procedure.

CLINICAL PRESENTATION: PATIENT A

Patient A is a 38 year old male who had fractured his left ankle 20 years ago. He had a bimalleolar equivalent fracture with disruption of the syndesmotic ligament. He was treated with a plate and screws to fix the oblique fracture of the lateral malleolus and a screw to stabilize the syndesmosis.

Despite good surgical technique, Patient A developed post traumatic ankle arthritis within 5 years of this injury. He had his hardware removed at that time in an attempt to reduce his pain. His pain has continued to increase over time. Upon initial assessment, he was unable to perform any sports and walked with a limp. He was unable to walk more than a few steps without pain and uneven ground was very difficult for him to navigate.

Patient A rated his pain at 6/10 increasing to 8/10 with activities. His ankle motion was impressive at 10 degrees of dorsiflexion to 30 degrees of plantarflexion.

Patient A had failed several nonoperative treatments including bracing, physical therapy, medication and injection of steroid and viscosupplementation. At 6 ft 1 in tall and 270 lbs, he was considered a poor candidate for ankle replacement arthroplasty. Several orthopaedic surgeons had recommended ankle fusion to this patient; however, the loss of mobility to his ankle joint was not an acceptable to him.

An ankle distraction arthroplasty surgery was performed by Dr. Fragomen at the Hospital for Special Surgery. A MRI was obtained prior to the surgery.

Surgery included an anterior arthrotomy, osteophyte excision, and microfracture of both tibial and talar articular surfaces. A SBi RingFIX™ RAD articulated circular external fixator was mounted to the left ankle and 5mm of distraction was applied across the joint in the operating room. (Figure 1)

The patient was allowed to weight bear as tolerated with ambulation beginning immediately post operatively. Weight bearing x-rays were obtained in the hospital and 2mm of additional distraction was applied to the joint to ensure adequate joint separation.

Sutures were removed from the wound at the patient's two week post operative follow up visit.

At this point, the frames hinges were unlocked and the patient began range of motion exercises as tolerated.

The RAD frame was removed after 3 months. Patient A was placed into a walking boot and allowed to weight bear as tolerated. Ankle mobility exercises were started immediately.

Figure 1. Example of Patient in RAD Frame
One year after the removal of the external fixator, the patient was assessed in the office and a new MRI was obtained. The patient states that he felt “20 times better” than before the surgery. He is currently able to walk 4 miles on uneven cobblestone with no more than 2/10 pain. He is also taking 2 hours walks in the woods with his dogs while wearing normal shoes. Patient A is not taking any pain medication regularly. He is very pleased with the outcome of the ankle distraction and especially glad to have maintained the mobility in his ankle. His 1 year ankle range of motion is 5 degrees of dorsiflexion to 30 degrees of plantarflexion.

His latest MRI shows significant improvement in the articular surface depth of the ankle joint. This new articular tissue is presumed to fibrocartilage. Also note the reduction in the subchondral edema and reduction of subchondral cysts.

We have been able to compare the pre operative and 1 year post frame removal MRI images (all performed at the same center using the same techniques).

The below images are Patient A’s before and after MRI’s.

**BEFORE / AFTER MRI’s**

**Before**

**1 Year Post RingFIX™ RAD Frame Removed**

Medial View
- Subchondral Edema
- Bone on bone

Medial View
- Decreased Subchondral Edema
- Increased Joint Space
Before 1 Year Post RingFIX™ RAD
Frame Removed

Central Ankle
- Subchondral Edema
- Bone on bone

Central Ankle
- Decreased Subchondral Edema
- Increased Joint Space

Lateral Ankle
- Subchondral Edema
- Bone on bone

Lateral Ankle
- Decreased Subchondral Edema
- Increased Joint Space
Patient B is a 40 year old active female who fractured her right ankle 15 years ago while playing sports. She had a lateral malleolus fracture that was treated with a plate and screws.

Despite good internal fixation technique, Patient B developed post traumatic arthritis. Upon her initial assessment the patient complained that she was unable to run and play sports without immediate pain. It would take her several days to recover from strenuous events.

Patient B had no long term benefit from several nonoperative treatments including bracing, non steroidal anti inflammatory drugs, and injection of viscosupplementation. Patient B also had undergone two orthroscopic debride-ments.

An ankle distraction arthroplasty surgery was performed by Dr. Kennedy and Dr. Fragomen at the hospital for Special Surgery. A MRI was obtained prior to this surgery.

Surgery included osteophyte excision, percutaneous tendo-achilles lengthening, and an injection of stem cells into the joint. A SBI RingFIX™ RAD articulated circular external fixator was mounted to the right ankle and 5mm of distraction was applied across the joint in the operating room.

The patient was allowed weight bearing as tolerated with ambulation beginning immediately postoperatively. Weight bearing x-rays were obtained upon the 1st office visit (2 weeks post op). An additional 1mm of distraction was applied to the joint to ensure adequate joint separation.

The frames hinges were unlocked and the patient began range of motion exercises as tolerated at week two.

The RAD frame was removed after 3 months. Patient B was placed in a walking boot and allowed to weight bear as tolerated. Ankle mobility exercises were started immediately.

18 months after the removal of the external fixator, the patient was assessed in the office and a new MRI was obtained. The patient states that her day to day pain level is a 1/10. She does become “sore” after a lot of walking, but recovers completely the next day.

She was able to play softball all summer – including sprinting in between bases with complete recovery the following day. Her post operative range of motion is 0 degrees of dorsiflexion to 30 degrees plantarflexion.

Her latest MRI shows a decrease in subchondral edema and a restoration of joint space.
Before 1 Year Post RingFIX™ RAD Frame Removed

Sagittal View of the Medial Ankle
- Bone on bone

Coronal View
- Medial Joint Space Narrowing
- Subchondral Edema

Coronal View
- Restoration of the Joint Space
- Decreased Subchondral Edema

Sagittal View of the Medial Ankle
- Increased Joint Space
- Partial Absorption of Subchondral Cysts
REFERENCES


