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Five-Year Followup of Ankle Joint Distraction for Post-traumatic Chondrolysis in an Adolescent: A Case Report

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INTRODUCTION

Chondrolysis is a process of progressive destruction of the articular cartilage accompanied by pain and fibrous ankylosis, which may result in premature degenerative arthritis of the affected joint.[6] The mechanism of chondrolysis remains uncertain, although a variety of etiologies including mechanical injury, ischemia, increased intracapsular pressure, abnormal autoimmune response, and abnormalities in chondrocyte metabolism have been proposed.[21] This disease entity is most frequently observed in the hip joint, but has been reported in other joints including the knee, shoulder, and ankle.[2,11,21]

The mainstay of treatment of chondrolysis includes the use of nonsteroidal anti-inflammatory medications, protected weightbearing and maintenance of range of motion of the affected joint.[21] Recently, the application of joint distraction with a hinged external fixator, termed "arthrodiatasis" has been used for the treatment of chondrolysis of the hip.[1,9,16] This method of hinged distraction provides controlled separation of the joint surfaces while allowing uniplanar motion across the affected joint. Healing of the articular cartilage is possibly related to decreasing mechanical load and stimulation of chondrocyte nourishment through motion and constant flow of synovial fluid.[18,21] Articlulated joint distraction appears to be a viable operative alternative in young patients who would otherwise have a high likelihood of poor radiographic and functional outcome. Despite several recent reports of joint distraction for ankle arthritis,[18] we were unable to find a single report of using this technique for treating chondrolysis of the ankle joint.

In this report, an adolescent boy with symptomatic post-traumatic chondrolysis of the ankle joint was treated with arthrodiatasis. Our patient and his family were informed that data concerning the case would be submitted for publication.

CASE REPORT

A 15-year-old boy presented with a 4-month history of increasing left-sided ankle discomfort and a limp. Approximately 8 months before presentation, he had sustained an open Gustilo grade II,[7] displaced Salter-Harris III fracture of the distal tibia with a Salter-Harris I fracture of the distal fibula. He had undergone urgent irrigation and debridement with open reduction and internal fixation of the distal tibia using two intra-epiphyseal cannulated screws (Figure 1) and a 48-hour course of intravenous first generation cephalosporin. Postoperatively, he was mobilized with protected weightbearing precautions. At the time of his current presentation, 8 months later, he was ambulating without any orthoses or walking aids. There were no recent complaints of fever, ankle swelling, or drainage. Physical examination revealed a well-healed, anterolateral scar with mild diffuse tenderness overlying the left ankle and no significant swelling or erythema. His active and passive ankle dorsiflexion was 5 degrees on the left and 15 degrees on the right, and plantarflexion was 10 degrees on the left and 30 degrees on the right. Subtalar motion on the affected left side was approximately 50% of the right side. Radiographs of the ankle demonstrated a significant decrease in the tibiotalar joint space with a mottled appearance of the distal tibial epiphysis (Figure 2). A presumptive diagnosis of chondrolysis of the ankle joint with possible underlying infection was made. Laboratory investigation revealed normal absolute and differential white blood cell count, sedimentation rate, and C-reactive protein analysis. The hardware was removed from the distal tibia with a biopsy and culture of the adjacent bone and synovial tissue. The operative findings did not show any purulence, and intraoperative cultures did not reveal any growth of organisms. The intra-articular fracture had healed. Followup MRI (Figure 3) revealed osteonecrosis of the distal tibia with severe chondrolysis of the ankle joint.

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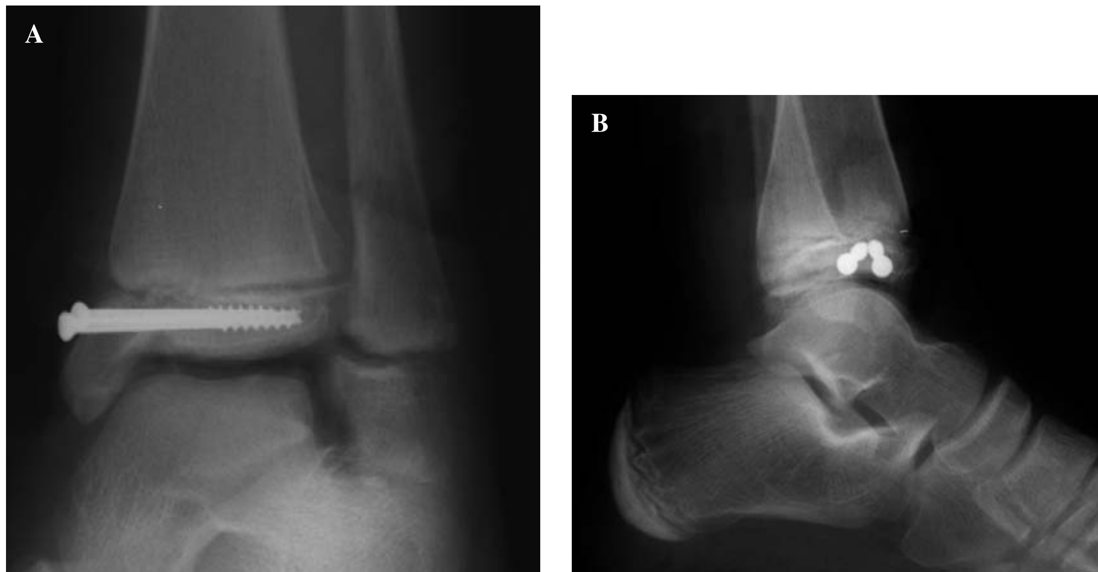

Fig. 1: Anteroposterior **(A)** and lateral **(B)** radiographs after open reduction and internal fixation of a Salter III fracture of the distal tibia.

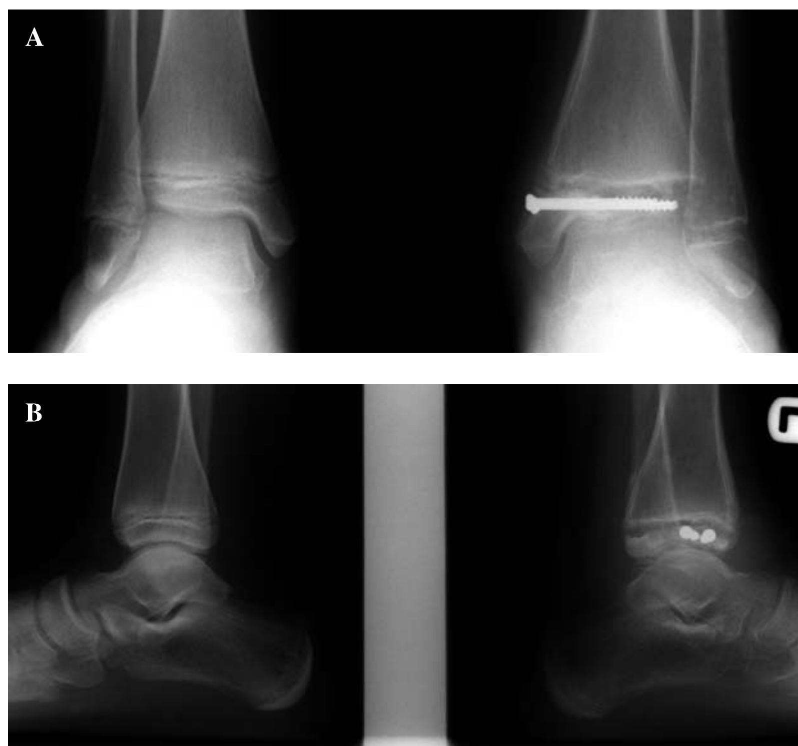

Fig. 2: Standing anteroposterior **(A)** and lateral **(B)** radiographs of both ankles 8 months later, demonstrating chondrolysis of the left ankle with retained hardware.

The patient was prescribed nonsteroidal anti-inflammatory medications, mobilized with an ankle stirrup, and referred to physical therapy for range of motion exercises of the ankle and hindfoot.

Six months after removal of the hardware, his physical findings remained unchanged from the preoperative exam. He had well-healed incisions, minimal swelling, and limited ankle and hindfoot mobility on the left side. Repeat radiographs of his left ankle showed persistent narrowing of the ankle joint space (Figure 3). Laboratory investigation was repeated and once again did not reveal any findings suggestive of an infection. Given his young age and radiographic findings, he underwent ankle joint distraction using an external fixator.

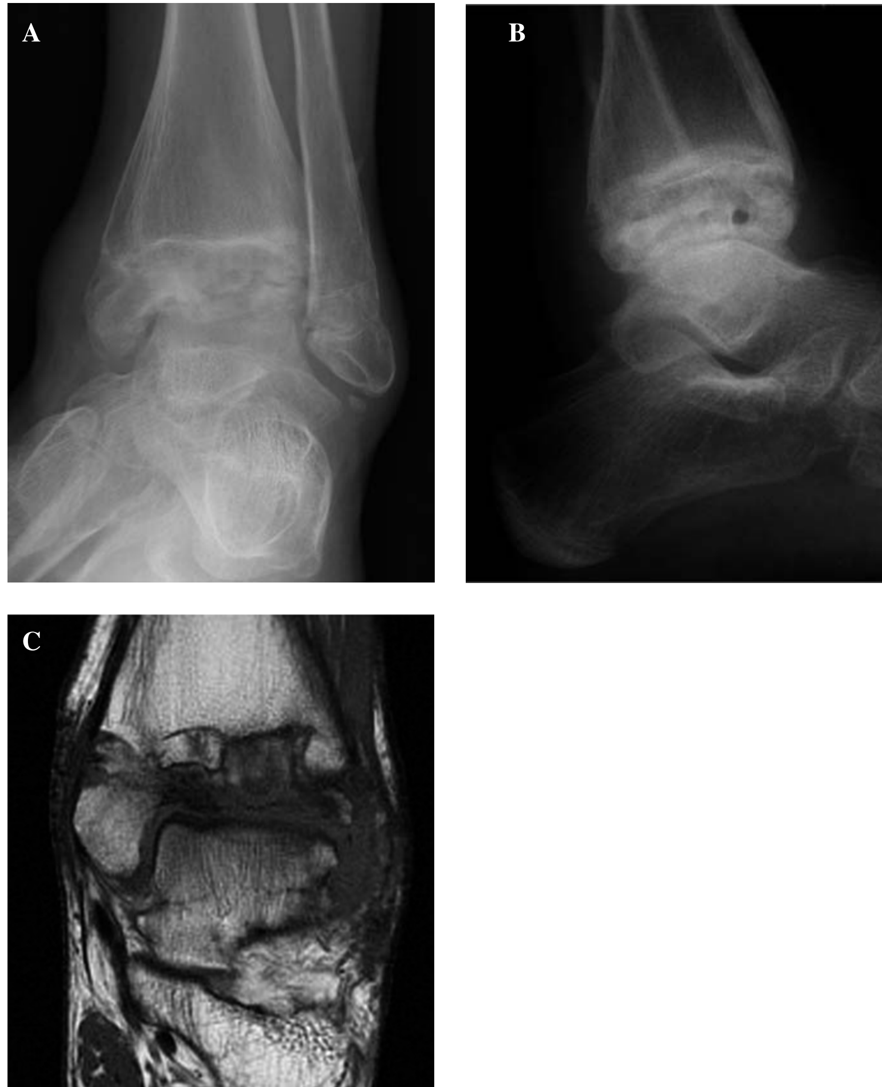

Fig. 3: Anteroposterior **(A)** and lateral **(B)** radiographs and MRI scan **(C)** after removal of the hardware. Changes consistent with osteonecrosis and collapse of the distal tibial epiphyses along with chondrolysis of the tibiotalar joint are seen.

A two-ring Ilizarov (Smith & Nephew, Memphis, TN, USA) external fixator was applied to the tibia, and a footplate was attached parallel to the plantar surface of the hindfoot through two counterposed 1.8-mm beaded Ilizarov wires and an additional smooth axial wire at the calcaneus and one across the talar neck. The tibial and hindfoot rings were connected with universal hinges through medial and lateral threaded rods that were centered at the axis of rotation of the ankle,[14] allowing for range of motion (Figure 4). A third distraction rod was placed posteriorly. No open or arthroscopic procedures were carried out at this time. The patient was mobilized partial weightbearing and distraction initiated two days later at the rate of 0.5 mm, twice a day until the ankle radiographs demonstrated 5-mm distraction at the tibiotalar joint (Figure 5). The posterior rod was removed at that time, and the patient was allowed weightbearing as tolerated with instructions for ankle range of motion exercises at home. He was allowed to start bathing 1 week postoperatively with instructions to clean the pin sites with saline once a day. He was provided with a prescription for a 10-day course of an oral first-generation cephalosporin, to be taken if any erythema or purulence was noted at the pin sites. The patient remained comfortable during his followup and was seen every 3 to 4 weeks with serial radiographs revealing maintenance of the ankle joint space. Three months after its application, the external fixator was removed, and the patient was gradually mobilized to an independent weightbearing status. He was restricted from participating in contact sports for 6 months after the fixator was removed.

The patient was recently evaluated, 5 years and 6 months after ankle joint distraction. At the age of 21 years, he was gainfully employed as a truck driver and denied any symptoms related to the left ankle and lower extremity.

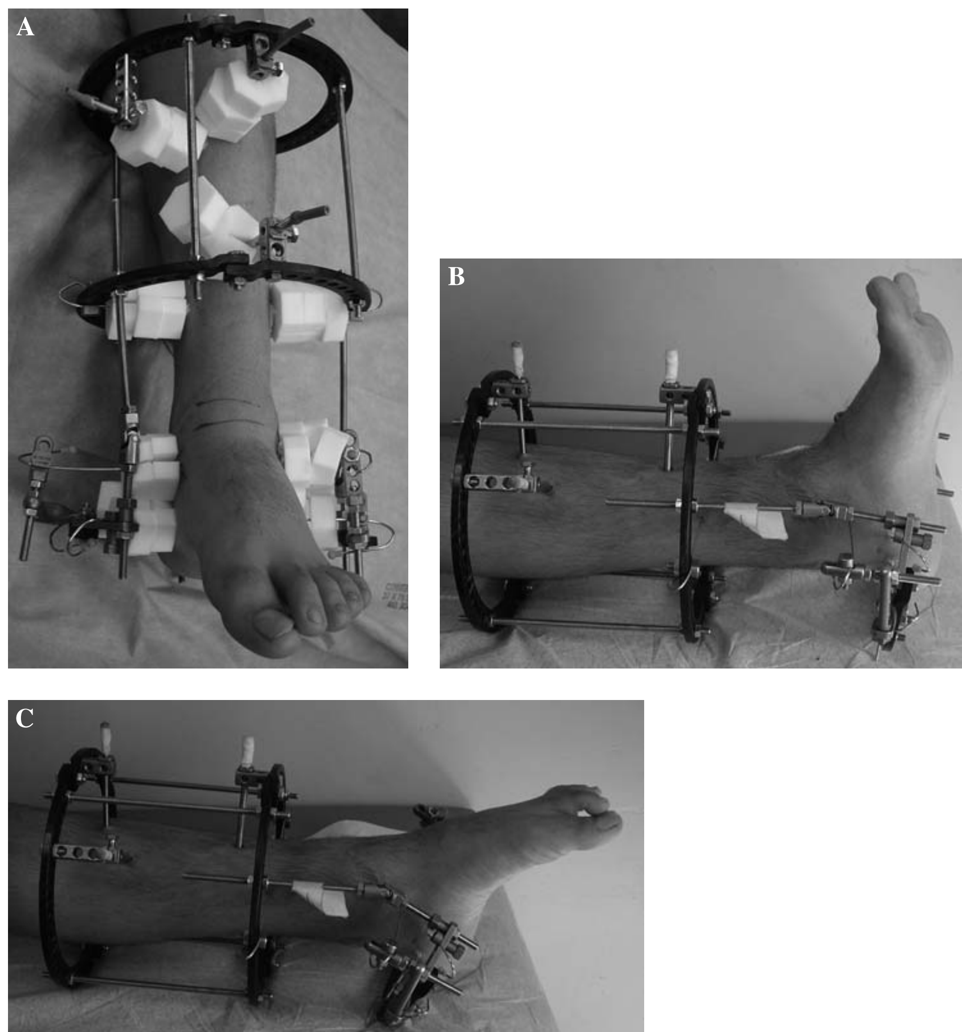

Fig. 4: Clinical photographs of the hinged external fixator **(A)** showing the ability of the patient to actively dorsiflex **(B)** and plantarflex **(C)** his ankle.

He denied using any analgesics, need for activity modification, or use of ambulatory aids. He was walking without a limp, and could toe- and heel-walk without difficulty. Range of motion of the left ankle joint had slightly improved with dorsiflexion of 10 degrees and plantarflexion of 20 degrees. Subtalar motion was normal and equal to the unaffected right side (Figure 6). Standing radiographs of the left ankle revealed reconstitution of the distal tibia with minimal subchondral sclerosis, normal alignment, and reconstitution of the tibiotalar joint space (Figure 7).

DISCUSSION

Complications resulting from physeal fractures of the distal tibia typically involve angular deformities secondary to asymmetric growth, nonunion, and intraarticular step-off with the possibility of post-traumatic arthritis of the ankle joint.[3] Rarely, a distal tibial physeal injury can lead to osteonecrosis of the adjacent tibial epiphyses.[8,15] There is a report of chondrolysis of the ankle joint in a young adult who had uneventful arthroscopic surgery and ligament reconstruction for post-traumatic instability.[2] However, we are not aware of a reported case of chondrolysis after a distal tibial physeal fracture in an adolescent.

The use of an external fixator for joint distraction has evolved as a viable alternative to arthrodesis and joint replacement in a select group of patients with degenerative arthritis. This technique was first reported for the knee and elbow joints by Volkov in 1975.[20] Aldegheri et al.[1] used a similar technique for the hip joint and coined the term “arthrodiatasis,” derived from the Greek language, meaning “to stretch out through a joint.” The rationale for using joint distraction for ankle arthritis has been elaborated by Von Roermund et al.[18] They proposed that controlled distraction across the affected joint provides a low-pressure environment that allows the osteathritic cartilage to repair itself. This

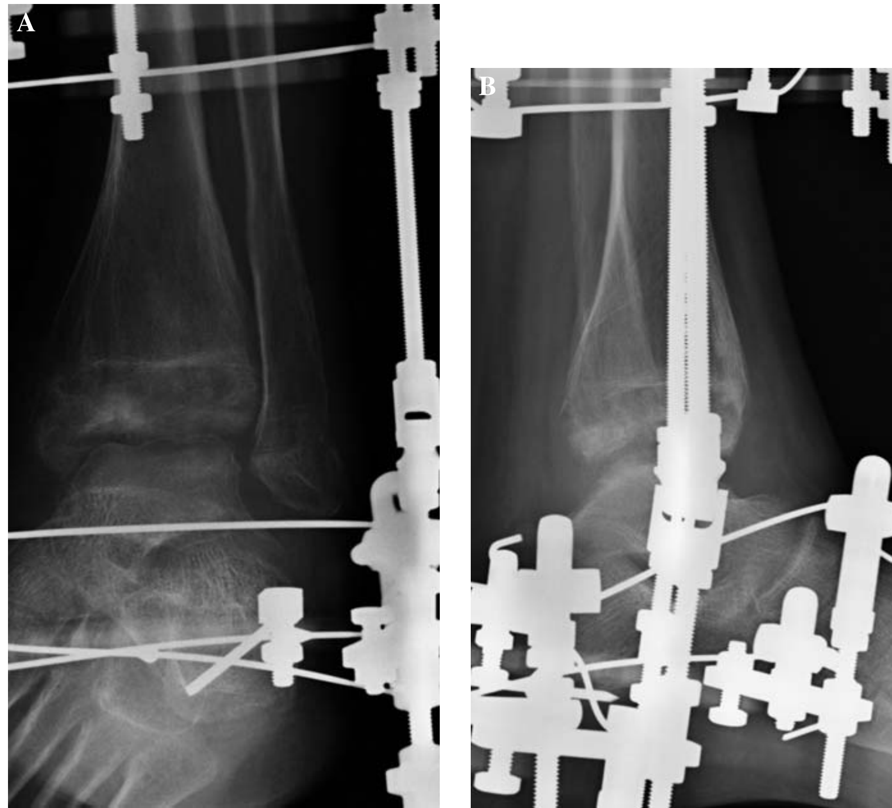

Fig. 5: Anteroposterior **(A),** and lateral **(B),** radiographs of the left ankle demonstrating distraction across the tibiotalar joint using a hinged external fixator.

release of mechanical stress on the articular cartilage while maintaining intra-articular intermittent fluid pressure allows for the reparative activity. Intermittent hydrostatic compressive force of low physiologic magnitude also was found to stimulate synthesis of proteoglycans in human osteoarthritic cartilage.[10] This hypothesis is supported by clinical[13,19] and basic science[10,12] studies, demonstrating the effectiveness of joint distraction, especially when combined with intermittent motion across the osteoarthritic joint. Significant reduction in pain along with improvement in function and radiographic appearance of the ankle was noted in most adults with post-traumatic arthritis undergoing ankle joint distraction.[13]

Although we were unable to find any reports on joint distraction for chondrolysis of the ankle joint, several authors have successfully used this technique for symptomatic chondrolysis of the hip joint.[1,4,9,16] Aldegheri et al.[1] performed arthrodiatasis of the hip in 80 patients with various disorders. Of the 15 patients with chondrolysis secondary to different etiologies, 93% had satisfactory outcomes. Kitakoji et al.[9] successfully treated a 13-year-old with arthrodiatasis for chondrolysis of the hip after subcapital osteotomy for slipped capital femoral epiphysis. Thacker et al.[16] reported their experience in 11 adolescents with a range of hip pathologies, three of whom had idiopathic chondrolysis. Articulated hip distraction for a mean of 4 months was found to be effective in relieving pain and improving function with no deterioration of joint space at an average of 5 years after surgery.

The reason for chondrolysis of the ankle joint in our patient remains unresolved. While the blood work and intra-operative culture results were not consistent with an underlying infection, given the history of an open fracture, a septic etiology cannot be ruled out. The other possibility is that osteonecrosis of the distal tibial epiphysis led to chondrolysis. Irrespective of the etiology, this otherwise healthy young patient had substantial loss of ankle joint space and associated symptoms necessitating operative intervention. Although one could consider ankle joint arthrodesis for pain relief, concerns of long-term sequelae with arthritis of adjacent joints of the midfoot and hindfoot along with functional limitations related to loss of ankle mobility are potential disadvantages of an ankle fusion.[5,17] While ankle joint replacement is another salvage procedure for severe arthritis,[17] given our patient's young age, active life style, and possibility of underlying infection, arthroplasty was not recommended. Based on the limited options available, arthrodiatasis was offered as a viable alternative for the treatment of symptomatic post-traumatic chondrolysis.

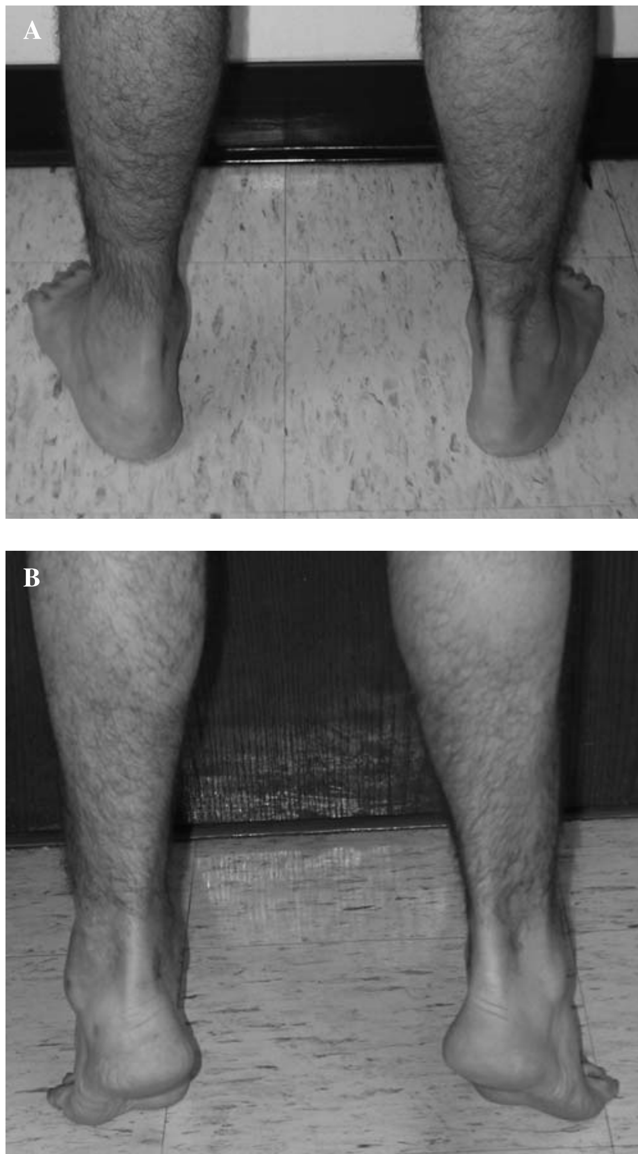

Fig. 6: Recent clinical photographs demonstrating symmetric appearance **(A)** and mobility **(B)** of the hindfoot.

CONCLUSION

At 5.5-year followup, our patient has remained asymptomatic and is gainfully employed as a truck driver. Although his ankle joint mobility and radiographic appearance have not deteriorated thus far, the possibility of progressive worsening of symptoms necessitating operative intervention in the future does exist. Nevertheless, unlike arthrodesis and arthroplasty, joint distraction treatment does not "burn bridges" and allows for such intervention, if needed, at a later time. Potential drawbacks of arthrodiatasis include pin track infections, the inconvenience of wearing a bulky external fixator, and the need for the surgeon to be familiar with the instrumentation and technique of safely placing the external fixator. Based on our early experience, hinged distraction with the use of an articulated external fixator is a viable alternative for the treatment of symptomatic chondrolysis of the ankle joint in a young patient.

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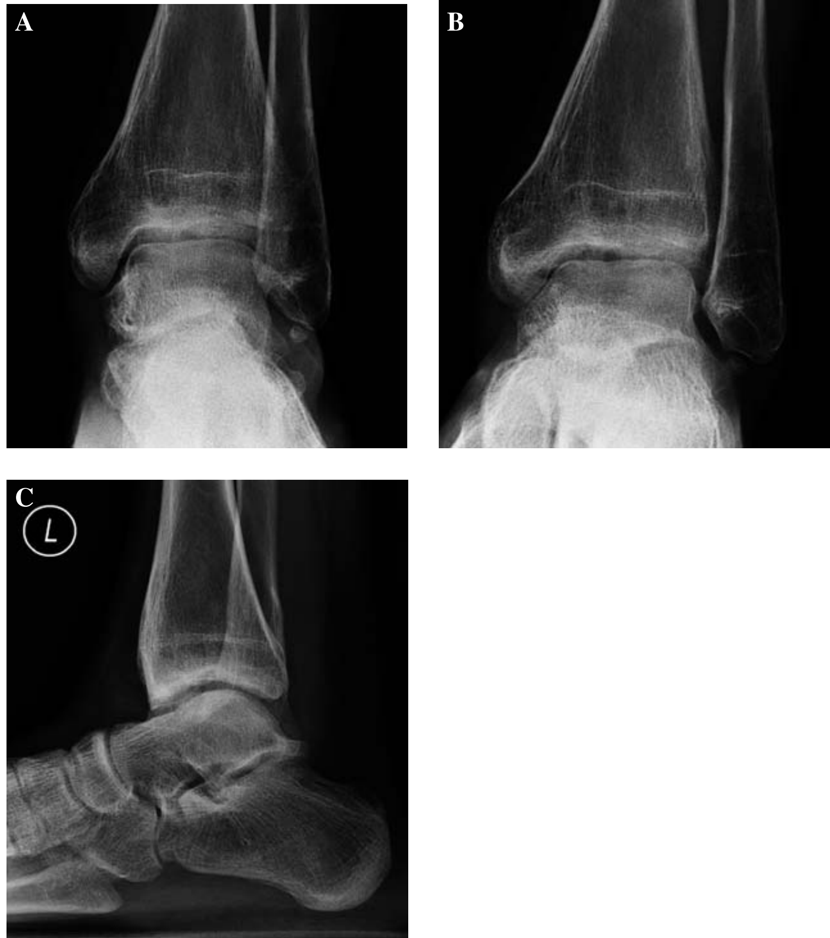

Fig. 7: Weightbearing anteroposterior **(A)**, mortise **(B)** and lateral **(C)** radiographic views of the left ankle, 5.5 years after articulated distraction showing reconstitution of the joint space with mild subchondral sclerosis of the distal tibia.

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