CHAPTER **35**

CORTICOSTEROID INDUCED AVASCULAR NECROSIS OF THE RIGHT MEDIAL CUNEIFORM TREATED WITH TRINITY EVOLUTION BONE GRAFT AND ARTHRODESIS: Case Report and Review of the Literature

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INTRODUCTION

Avascular necrosis (AVN) is a process that is due to the temporary or permanent loss of the blood supply to an area of bone. As a result, the bone tissue dies and the bone collapses. If the AVN involves a joint, it can lead to destruction of cartilage, resulting in arthritis and pain.

AVN can be classified into 2 general categories, traumatic and nontraumatic. In the case of trauma, a fracture disrupts the blood supply to the bone leading to AVN. In the case of nontraumatic AVN, some other pathology disrupts the blood vessels. These include idiopathic (no cause is ever found), steroids (e.g., anabolic and high dose-corticosteroids [prednisone] given for rheumatoid arthritis, lupus, or cancer), excess alcohol consumption, sickle cell anemia, or radiation treatments (1).

The case presentation is a patient with chronic pain at the first metatarsal-medial cuneiform joint and medial cuneiform bone, treated with multiple corticosteroid injections. The patient developed AVN of the medial cuneiform bone with subsequent arthritis of the first metatarsomedial cuneiform and medial cuneiform-navicular joints. The diagnosis was made by physical examination, plain radiographs, and magnetic resonance imaging (MRI). The symptoms were alleviated with arthrodesis of these joints using external fixation, and hemopoietic autologous bone graft combined with allogenous bone graft.

CASE REPORT

A 62-year-old man presented with a report of a dull, aching pain in the medial aspect of his right midfoot and right first ray of 1 year of duration. The pain was noted to increase after strenuous walking, and when he wears any type of shoe. The patient stated that the pain was persistent and ranked 10 out of 10 on a pain scale. There was associated swelling observed in the right foot. The patient reported receiving multiple corticosteroid injections in the right medial cuneiform area by different doctors due to the chronic pain. There was no other past medical history that would increase the likelihood of bone infarction, such as rheumatoid arthritis, lupus, cancer, excess alcohol consumption, sickle cell anemia, or radiation treatments (1).

Antalgic gait was noted on gross examination, mild swelling and pain on palpation were noted over the medial cuneiform area with painful and limited range of motion of the right first ray. Motion of the right ankle and subtalar joint were normal. Preoperative radiographs (Figure 1) and MRI of the right foot with and without contrast (Figure 2) were obtained. The patient had been treated by different doctors with limited weightbearing on the right lower extremity and corticosteroid injections. The patient continued to have severe pain to his right midfoot after weightbearing restrictions and steroid injections for about 1 year. Based on the clinical evaluation and diagnostic image findings, AVN of the right medial cuneiform was diagnosed.

An evacuation and curettage of the cuneiform was planned with arthrodesis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints. Bone graft application was Trinity Evolution bone allograft combined with hemopoietic autologous bone graft. The arthrodesis was planned to be performed using 2 mini-rail external fixators from Orthofix.

All benefits and risks about the procedure were discussed with the patient and the patient gave consent for the surgical procedure.

After anesthesia was obtained, an incision was made over the right first metatarsal-medial cuneiform joint and extended to the right medial cuneiform-navicular joint. Using mild distraction at the level of the medial cuneiform-first metatarsal joint, the cartilage from the base of the first metatarsal base and from the distal aspect of the medial cuneiform were removed in total. It was noted that the medial cuneiform had an appearance

Figure 1A. Plain radiographs of the right, anterior posterior view revealed the presence of diffuse sclerosis areas with a possible nondisplaced subcortical fracture along the distal margin of the medial cuneiform, and narrowing of the first metatarsal medial cuneiform joint with diffuse arthritic changes at the midfoot joints.

Figure 1B. Medial oblique view.

Figure 1C. Lateral oblique view.

Figure 1D. Lateral view.

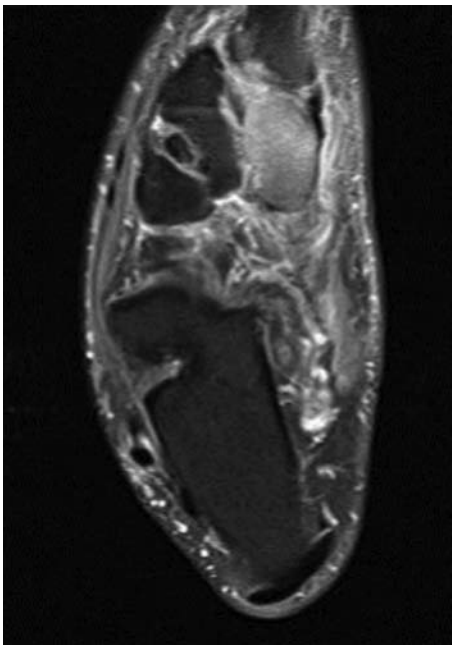

Figure 2A. Preoperative axial T2 magnetic resonance image of the right foot revealed the presence of moderate marrow edema within the medial cuneiform emanating from a probable non-displaced sub-cortical fracture along the distal margin. Additional mild marrow edema in the proximal and lateral margin of the first metatarsal base, which may represent an additional stress reaction or contusion, if there has been recent trauma. The nearby Lisfranc ligament is intact.

Figure 2B. Preoperative aixal T2 images after contrast material with fat saturation sequences.

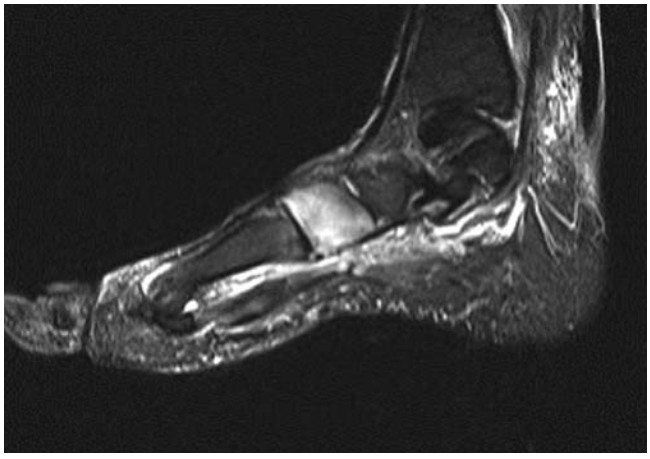

Figure 2C. Sagittal T2 image after contrast material injection.

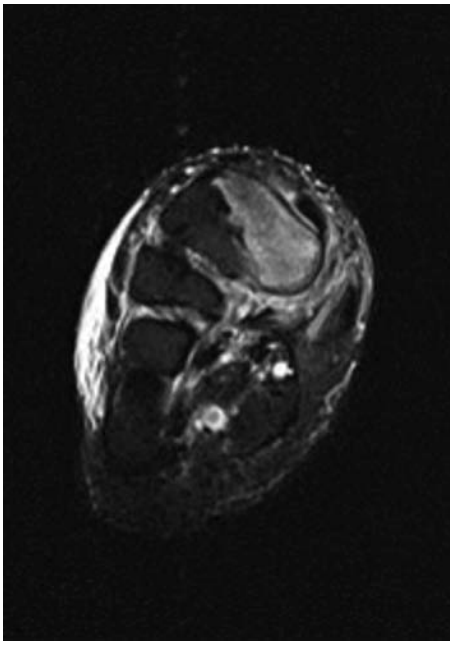

Figure 2D. Axial T2 images after contrast material injection.

of osteoporotic bone and had a low vascular nature. Then attention was directed to the right navicular-medial cuneiform joint, where all the cartilage from the joint surface were removed in total using distraction techniques. The articular surfaces of the joints were partially eburnated, and all the articular surfaces were drilled to obtain good bone bleeding. The joint spaces were filled with Trinity Evolution bone allograft combined with hemopoietic autologous bone graft and the arthrodesis was performed using 2 mini-rail external fixators from Orthofix (Figure 3). The surgical wound was closed in anatomic layers and a sterile dressing applied. The patient was discharged to his home with verbal and written instructions regarding non-weight bearing to the right foot and pain medications to be taken until the next postoperative appointment.

Subsequent histopathologic analysis revealed fragments of necrotic bone and bone with degenerative osteoarthritic changes consistent with the diagnosis of AVN and osteoarthritis. The patient's midfoot pain subsided almost immediately after the operation, with the exception of surgical wound pain, which subsided in a normal fashion.

Figure 3A. Intra-operative anterior posterior view of arthrodesis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints with application of Trinity Evolution bone allograft combined with hemopoietic autologous bone graft using 2 mini-rail external fixators from Orthofix Company.

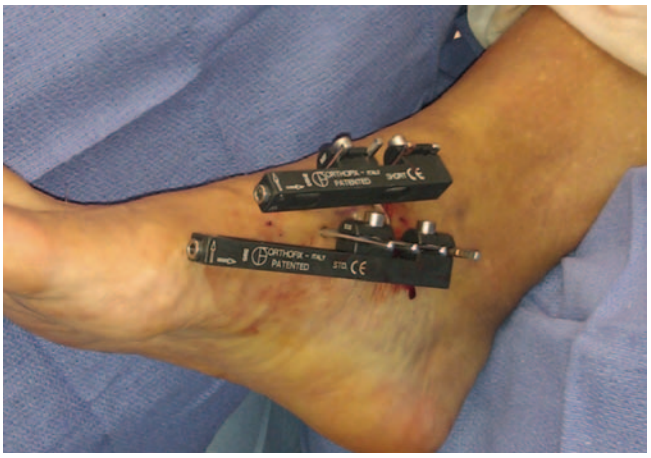

Figure 3B. Lateral view.

Figure 4A. Lateral radiograph of the right foot was taken as part of the postoperative evaluation showing good position of the 2 mini-rails external fixators and good alignment of the arthrodesis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints.

Figure 4B. Postoperative view.

One week following suture removal, the patient was mobilized with partial weightbearing for 3 weeks, followed by weightbearing as tolerated for the next few postoperative weeks. Clinical and radiologic examinations were done on the first postoperative day (Figure 4), at 6 weeks, at 9 weeks, and every other month thereafter, until radiologic confirmation of graft consolidation. External fixation was removed 9 weeks after surgery. Radiographs showed that the right first metatarsal-medial cuneiform and navicular-medial cuneiform joints were fully fused (Figure 5).

DISCUSION

Aside from injury, one of the most common causes of osteonecrosis is the use of corticosteroid medications such as prednisone. Corticosteroids are commonly used to treat inflammatory diseases such as lupus, rheumatoid arthritis, inflammatory bowel disease, severe asthma, and vasculitis. Studies suggest that long-term use of oral or intravenous corticosteroids is associated with nontraumatic osteonecrosis (2). Isolated steroid injection induced osteonecrosis of the medial cuneiform bone is extremely rare. Researchers are not sure why the use of corticosteroids sometimes leads to osteonecrosis. They speculate that the drugs may interfere with the body's ability to break down fatty substances called lipids. These substances then build up in and clog the blood vessels, causing them to narrow and to reduce the amount of blood that gets to the bone. Some studies suggest that corticosteroid-related osteonecrosis is more severe than osteonecrosis resulting from other causes (3-5).

There are several pathophysiological causes for the ischemia that have been postulated as the etiological basis for AVN. One involves an acceleration of the bone degradation versus synthesis. In the course of AVN, however, the healing process is usually ineffective and the bone and subsequent soft tissues break down faster than the body can repair them. If left untreated, the disease progresses, the bone collapses and the joint surface breaks down, leading to pain and arthritis (6). Bone infarct refers to ischemic death of the cellular elements of the bone and marrow. A considerable lack of uniformity exists in the use of terminology for bone infarct. At present, the term osteonecrosis is accepted and used widely (5).

Radiographs, computed tomography scans, MRI, and bone scans play a significant role in diagnosing the disease at an early stage and thereby reducing the number and/or severity of complications and morbidity associated with the disease (7). Our patient's AVN was diagnosed by patient history and physical examination, radiographs, and MRI, and the diagnosis was confirmed with biopsy and pathology. Plain radiography is not sensitive in the detection of bone infarction. However, plain radiography has a role in the differential diagnosis. Radionuclide imaging and MRI are much more sensitive than plain radiography and may show changes caused by altered hemodynamics early in the course of disease. CT scanning is complementary to the other techniques, but it is not as sensitive as radionuclide imaging or MRI. CT scans may demonstrate subtle trabecular irregularity with bone necrosis when plain radiographic findings are normal. MRI has become the standard diagnostic method for diagnosing AVN (8-10).

In our case, the patient had chronic midfoot pain treated by multiple steroid injections, which developed into AVN of the medial cuneiform bone. Images revealed

Figure 5A. Postoperative anterior-posterior radiograph 3 months after surgery showing full fusion of the right medial cuneiform-first metatarsal and right navicular-medial cuneiform joints.

Figure 5B. Lateral view.

aspects of osteoarthritis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints and osteonecrosis of the medial cuneiform bone.

AVN can be treated in a number of ways. The normal course of treatment begins with limiting weightbearing on the extremity. The amount of time that a person spends non-weightbearing or limited weightbearing depends on the stage of injury. It has also been found that the desirable time and degree of weightbearing is typically dictated by the degree of osteonecrosis (4, 6).

The patient continued with severe pain in his right midfoot after weightbearing restrictions and then was offered surgical approaches to AVN with arthritic changes. While multiple surgical options are available including debridement, osteotomy, and bone grafts to treat AVN, their efficacy remains controversial. Therefore, we thought the mid-foot pain was caused by osteoarthritis, pseudarthrosis, and osteonecrosis. We planned to perform arthrodesis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints. The articular surfaces of the joints were partially eburnated, and all the articular surfaces were drilled to obtain good bone bleeding. The joint spaces were filled with Trinity Evolution bone allograft combined with hemopoietic autologous bone graft and the arthrodesis was performed using 2 mini-rail external fixators from Orthofix.

We concluded that the mid-foot pain was derived from osteoarthritis of the first metatarsal-medial cuneiform joint and pseudarthrosis with corticosteroid induced AVN of the medial cuneiform bone, and performed arthrodesis of these joints using external fixation. Application of Trinity Evolution bone Allograft combined with hemopoietic autologous bone graft reduced the mobility that existed between the 2 joints around the medial cuneiform, preventing more damage to the medial cuneiform bone. As a result, almost immediately after the surgery, the patient felt no mid-foot pain and was able to return to his normal activities after external fixation was removed 9 weeks after surgery. At this time, radiography showed that the right first metatarsal-medial cuneiform and navicular-medial cuneiform joints were fully fused.

Arthritis of the first metatarsal-medial cuneiform and medial cuneiform-navicular bone joints accompanied by corticosteroid induced osteonecrosis of the medial cuneiform bone is an extremely rare case, and to the best of our knowledge, arthrodesis of these joints using external fixation, and application of Trinity Evolution bone Allograft combined with hemopoietic autologous bone graft for this situation has not been previously described.

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