

Avascular Necrosis of the Fibular Sesamoid

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Abstract A case report of avascular necrosis of the fibular sesamoid of the right foot in 26-year-old female. The radiographic images demonstrated abnormalities in the contour and bone density of the fibular sesamoid. A magnetic resonance image was ordered. A fractured fibular sesamoid with marrow edema and osseous compression was diagnosed suggesting underlying avascular necrosis. The patient was advised to limit activity and reduce pressure to the area. A dancer's pad was made to relieve pressure to the area.

Introduction The term avascular necrosis (AVN) or osteonecrosis is commonly referred to as the death to a part or all of a bone without signs of inflammation or sepsis, usually as a result of the loss of blood supply to the particular area of the bone.¹ The disruption may be from a surgical procedure or from a trauma sustained to the area. There has been evidence that medications can also predispose the patient to AVN; the most noted is prolonged steroid use.² In the foot, the typical bone to undergo AVN is the talus due to a fracture of the neck or body leading to the disruption of blood flow.² In the body, the femoral head has been reported to also undergo AVN due to the same mechanism. There has been evidence that females are more predisposed to avascular necrosis of the sesamoids in their second and third decades of life.

The sesamoids typically appear during the fifth and eighth week of fetal development. It has been documented that ossification is completed earlier in females than males, being age eight for females and age 12 for males.³ Ossification of the fibular sesamoid precedes that of the tibial sesamoid.⁴

The hallucal sesamoids are present within the flexor hallucis brevis muscle. The tibial (or medial) sesamoid receives the tendon of the medial head of the flexor hallucis brevis and the abductor hallucis muscle. It is attached medially by the medial joint capsule.⁴ The fibular (or lateral) sesamoid receives tendons from the lateral head of the flexor hallucis brevis and of the oblique and transverse heads of the adductor hallucis muscle. The sesamoids are then

supported by the intersesamoid ligament, medial and lateral metatarsosesamoid ligaments, and are embedded within the plantar plate.

The tibial sesamoid is typically the larger of the two with an elliptical appearance and mean dimensions of 13.51 mm and 9.53 mm of the sagittal and transverse axis respectively. The fibular sesamoid has a more cylindrical appearance with an average dimension of 12.3 mm sagittally and 9.81 mm transversely.⁵

A bipartite sesamoid may occur due to osteochondral defects during ossification and may be more prevalent in the tibial sesamoid. Radiographic evidences of bipartite sesamoids have been studied and the prevalence is seen anywhere from 19% to 31%.⁶ Careful examination of the radiographs should be done when identifying a bipartite or a fracture. Typically the bipartite sesamoid is larger than the fracture segment and has smoother edges. The fractured segment will show bony sclerosis and can be flattened with jagged edges. A complete history and physical exam should correlate with the radiographic findings when differentiating between a bipartite or fractured sesamoid. The pain associated with a fractured sesamoid occurs commonly with activity and dissipates with rest. The majority of patients will put more weight-bearing forces on the lateral side of the foot to avoid motion to the sesamoid complex.⁶

Avascular necrosis can be seen as dense sclerotic margin with radiopaque trabeculae surrounded by areas of radiolucency on radiographs.³ Bone scans especially with a fractured sesamoid, have been shown to proceed radiographic findings due to an increased radionuclide uptake to the area. The fracture area shows increased activity especially with callus formation which leads to intense signals on bone scans.⁷ For AVN of a sesamoid the bone scan will reveal a cold spot or decreased or absent uptake. This is due to the loss of blood flow to the area.⁸ Magnetic resonance imaging (MRI) is useful in differentiating an osseous process from soft tissue pathology. With an increased signal to the area the MRI supports avascular necrosis by showing increase marrow pressure. Because of the marrow necrosis, a T-1 image, which is fat weighted, is often very specific for diagnosing avascular necrosis.

The sesamoids function as a shock absorber for the metatarsophalangeal joint, and as a pulley when weight is being transferred during the gait cycle. They also alter the direction of the

muscle pull, diminish friction, and modify pull.⁶ Trauma to the area is typically forced dorsiflexion on the hallux or from repetitive stress to the site. Any increase in force can predispose the sesamoids to inflammation, arthritic changes, and fractures. The tibial sesamoid bears the majority of the weight-bearing forces because of its location plantar to the first metatarsal head thus predisposing it to more trauma. The fibular sesamoid experiences less of these forces due to migration into the first interspace.

Literature Review

Pretterklieber and Wanivenhaus first studied the blood supply to the sesamoids. They conducted a study on twenty-nine cadavers and found three different types of arterial circulation. Accounting for 52% of the cases, type A consists of both the plantar digital arteries branching from the junction between the medial plantar artery and the plantar arch. Type B and C both consist of 24% of the cases. Type B originates from the plantar arch artery, and type C from the medial plantar artery. Pretterklieber et al. also concluded that the proper digital plantar artery ran along the medial aspect of the hallux providing one to three branches to the medial sesamoid. Likewise, the lateral sesamoid received one to three branches from the first plantar metatarsal artery. Additional studies stated that the nutrient arteries of the sesamoids arose more commonly off the plantar arch of the right foot than the left foot.⁵

Pretterklieber stated that the incidence of more than one sesamoid artery is greater in the left foot, leading to the conclusion that avascular necrosis of the sesamoids in the right foot is due to a reduced number of sesamoid arteries.⁵ It was also reported by Pretterklieber that repetitive forces to the area could lead to disturbance of blood flow. Oloff and Schulhofer stated that repetitive stress and fractures to the sesamoid predispose the patient to vascular changes and could possibly cause osteonecrosis.³ The idea that development of avascular necrosis may be acquired directly from trauma or due to a fracture sustained to the site was theorized by Helal and Kliman.⁹ Julsrud stated that patients with a high arch and long first metatarsal and who participate in chronic repetitive stress activities to the forefoot are more prone to fractures of the sesamoid.¹⁰ There is much debate over whether the fracture causes the necrosis or if the fragmentation is a result of the necrosis.

Case Study:

A twenty-six year old female presented to clinic with a shooting pain on the ball of the right foot. The pain radiated into the toes and medial side of the hallux. The patient indicated that the pain began approximately one year earlier and increased with wearing high-heeled shoes, and with walking or any activity placing additional pressure to the ball of the foot. She could not participate in exercise or sports, which required days of recovery following athletics. She admitted buying sport insoles and new tennis shoes without relief. Her medical history was unremarkable. A physical exam demonstrated pain on palpation to the plantar aspect of the foot just proximal to the first metatarsal head. Radiographs were taken with the forefoot axial view showing abnormalities in the contour and bone stock of the fibular sesamoid. To rule out a bipartite sesamoid or a fracture, a MRI was ordered. The MRI showed a fractured fibular sesamoid with cancellous marrow edema. There was joint effusion at the first metatarsophalangeal joint without capsulitis or capsular distention. The diagnosis was a fractured sesamoid with underlying avascular necrosis.

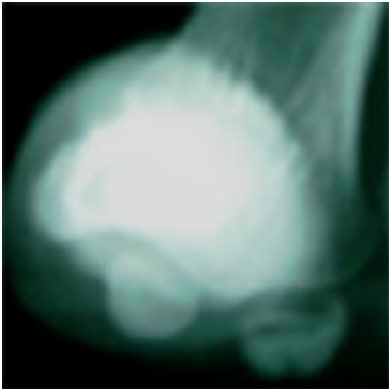


Figure 1a) Forefoot Axial view displaying the fractured fibular sesamoid.



1b) AP view of the 1st metatarsophalangeal joint and the sesamoids

Treatment:

Avascular necrosis of the hallucal sesamoid is treated conservatively. Jahss has recommended principles to follow when treating a patient with sesamoidal pain. The patient should cease activity that creates the pain and should be encouraged to wear low-heeled and thicker soled shoes. He also suggests placing an arch support with a cut out into the patient's shoe to decrease weight bearing to the area.⁴ Another thought of conservative treatment is to place the patient in a weight bearing cast, padding the area, or using a device to dissipate the plantar pressure and pain.¹⁰ A metatarsal pad that would extend just proximal to the sesamoids has shown success.⁶ The use of nonsteroidal anti-inflammatory agents has shown good results when used over a couple of weeks. With the patient presented in the case, a dancer's pad made out of 3/16 inch firm pelite was fabricated and inserted in her right athletic shoe. This pad is made to fit the patient's foot from the midfoot to the metatarsophalangeal joints. There is a cut out made at the first metatarsophalangeal joint. This is to relieve the pressure to the area. The use of intra-articular injections has been discussed as another way to decrease pain and inflammation.

Literature concludes that surgery is indicated if conservative treatment offers no relief. Though the best surgical approach has been debated, excision of the involved sesamoid is most common. The typical approach for a tibial sesamoidectomy is through a medial incision just proximal to the first metatarsal head and extending to the base of the proximal phalanx.⁶ Though

there have been successful surgeries with a plantar longitudinal incision, more complications are seen utilizing a weight bearing surface.¹¹ A common complication seen with a tibial sesamoidectomy is the mechanical weakness of the flexor hallucis brevis, due to the disruption of the tendinous insertions to the sesamoid. The fibular sesamoidectomy takes a more dorsal approach through the first intermetatarsal space.⁶ There are some who believe that excision of both sesamoids should be performed so that balance would be preserved, but this is not a popular surgical option. The common post-operative management is to place the patient in a non-weight bearing cast for three weeks.

Discussion:

Avascular necrosis is not commonly associated with the sesamoids and is usually the last diagnosis of plantar pain to the first metatarsophalangeal joint. Typically the patient will complain of pain on the plantar aspect of the first metatarsophalangeal joint. A pedal exam can show edema and erythema to the involved area. Pain will be elicited with palpation of the area and with passive range of motion. Aggravating factors include the use of high-heeled shoes and repetitive stresses to the sesamoid complex.

Radiographic evaluation can show no evidence of injury, but may reveal either a bipartite or a fractured sesamoid. Typically the radiographic evidence lags behind the clinical symptoms. The use of ancillary modalities such as computed tomography, bone scans, and magnetic resonance imaging have been useful in early diagnosis of avascular necrosis.

The treatment of choice is conservative therapy, usually the use of padding to the area to decrease the weight bearing forces. Casting has also been considered to lessen the stresses on the complex. Nonsteroidal anti-inflammatory agents have helped control the amount of pain and inflammation to the area. When conservative treatment has been exhausted surgical approaches have been considered. The approach commonly taken is a sesamoidectomy of the involved sesamoid.

Acknowledgement

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