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Painful Hallux Sesamoid: A Pictorial Review

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Abstract

Sesamoids are small bony structures that are either partially or completely embedded in a tendon. Sesamoid bones are found at multiple places in body but most common sites are in foot, with the most consistent location being the metatarsophalangeal joint of great toe. Various pathologies affecting the sesamoid bones of hallux can be a cause of long-standing forefoot pain and discomfort. Imaging helps in diagnosis of these conditions at an early stage. Imaging also helps in differentiating these pathologies from normal variants like bipartite sesamoid bone.

Keywords

- avascular necrosis
- bipartite
- great toe
- hallux sesamoid
- sesamoiditis

Introduction

The term sesamoid is derived from "sesame seed." Small nodular foci of bone or cartilage or both, resembling a sesame seed is called as sesamoid bone. In humans, variable number of sesamoid bones can be present. The number of sesamoid bones in a person can be as high as 42. Sesamoid bones are found at multiple sites in body but the most common areas are in foot including the metatarsophalangeal joint of great toe, interphalangeal joint of great toe, or lesser metatarsals. The sesamoid bones can also be present within the tendons, for example, posterior tibial and anterior tibial tendons.[1,2]

Most sesamoid bones of foot remain asymptomatic.[1] Sometimes they can be associated with pain because of various pathologies like trauma, infection, inflammation, degenerative changes, or even rare conditions like osteonecrosis.[2]

Sesamoids are small bony structures that are either partially or completely embedded in a tendon. The function of the sesamoid is to reduce the friction and protect the tendon from injury.[3] They can also increase the efficiency of their associated muscle.[3]

The sesamoid bones are covered by cartilage. They can be of two types (►**Fig. 1**). The sesamoid bones, which are in close relation to a joint, are type A sesamoid: where the associated tendon is situated intra-articular. Type B sesamoid: It is situated where there is angulation of tendon and they are separated from underlying bone by a bursa.

Pain in the great toe can be a chronic disabling condition and it can be attributed to various reasons. Identifying the reason of pain in sesamoid can be challenging. Clinical symptoms of various pathologies can be similar and imaging plays a central role in the diagnosis of various conditions.

Imaging of Hallux Sesamoid

Any imaging modality starting from radiograph and ultrasonography to cross-sectional imaging like computed tomography (CT) scan, magnetic resonance imaging (MRI), and even bone scintigraphy[4] can be used for evaluation of sesamoid bones. Most commonly used modalities are radiograph, CT scan, and MRI.[5]

MRI helps in detection of bone marrow edema that can help in differentiating normal variation of a sesamoid from acute pathological condition.[6]

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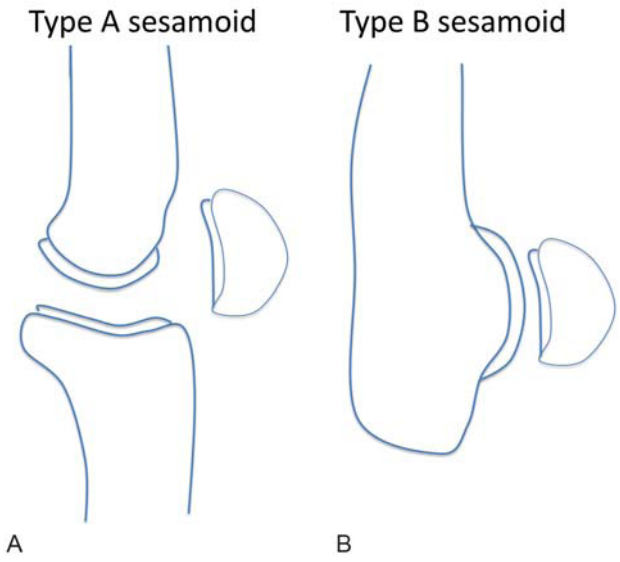

Fig. 1 Schematic showing two types of sesamoid bones. (**A**) Type A sesamoid bones are in close relation to a joint and the associated tendon is situated intra-articularly. (**B**) Type B sesamoid is situated where there is angulation of tendon and they are separated from underlying bone by a bursa.

Anatomy of Hallux Sesamoid

A pair of sesamoid bones is consistently present in great toe at the metatarsophalangeal joint. They are seen embedded in tendon of flexor hallucis brevis.[7] The medial (tibial) and lateral (fibular) sesamoid bones articulate with the plantar facet of the head of first metatarsal bone (►**Figs. 2** and **3**). The plantar plate connects the sesamoid bones with the plantar surface of the proximal phalanx. The tibial and fibular sesamoid ligaments extend from the sesamoid to the corresponding aspect of head of metatarsal.[8]

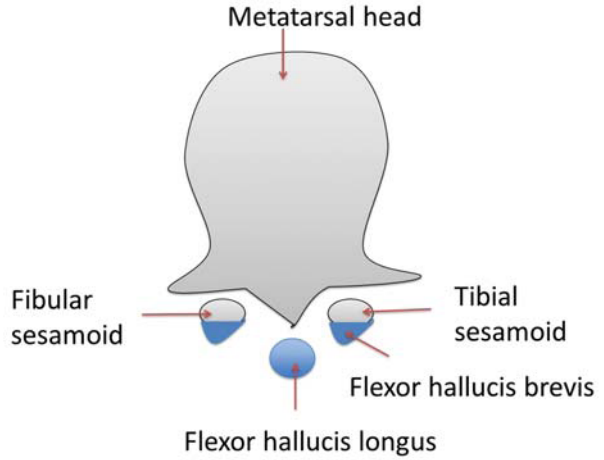

Fig. 2 Schematic diagram showing medial and lateral sesamoid bones articulating with the plantar aspect of first metatarsal head. These are embedded in the tendon of flexor hallucis brevis.

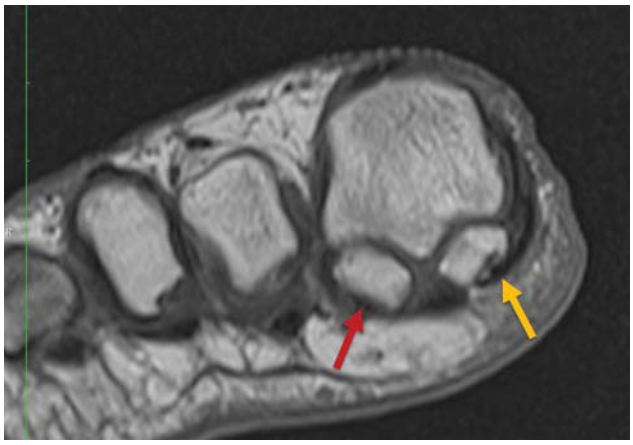

Fig. 3 Normal hallux sesamoid bones: coronal T1-weighted image at the level of first metatarsophalangeal joint showing medial/tibial sesamoid bone (yellow arrow) and lateral/fibular sesamoid bone (red arrow). They are seen embedded in the tendons of flexor hallucis brevis. Flexor hallucis longus tendon is noted coursing in center at the plantar aspect of the sesamoid bones.

Variations of Hallucal Sesamoid

Bipartite Sesamoid

Hallucal sesamoids ossify from multiple centers between the ages of 6 and 7 years. Failure of fusion of these ossification centers results in the anatomical variation of bipartite sesamoid. Various studies have shown the incidence of bipartite sesamoid to be between 7 and 30%. It most commonly involves tibial sesamoid and 80 to 90% are bilateral.[9] Bipartite fibular sesamoids are rare. Bipartite sesamoid bones are larger in size compared with normal sesamoid bone and show smooth rounded borders and thin sclerotic cortex of the divided fragments (►**Fig. 4**).

Congenital Absence

Hallucal sesamoid bones are a constant finding in human beings and their absence is very rare. Congenital absence of medial sesamoid bone is more common than absence of lateral sesamoid of first metatarsophalangeal joint.[10]

Congenital absence of sesamoid bone needs to be differentiated from resorption of the bone due to infection or surgical removal of the bone.[11]

Pathologies of Sesamoid

Sesamoid Fracture

Fracture can be the result of trauma to the great toe. Stress fractures of sesamoid bones are also known to occur. Many times it is difficult to differentiate sesamoid fracture from the bipartite sesamoid. A few points can help in differentiation. In case of sesamoid fracture with displaced fragments, the fragments usually fit with each other to make a single bone while the bipartite sesamoid are well corticated bones

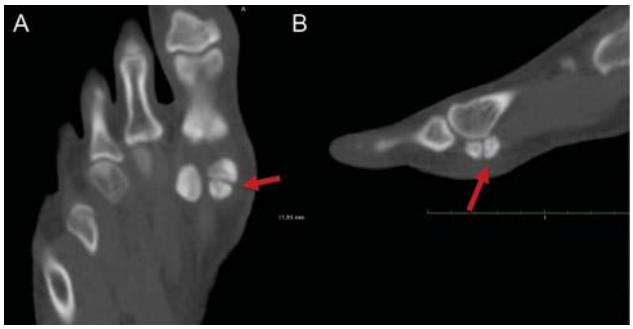

Fig. 4 Bipartite sesamoid bones. (**A**) Axial computed tomography (CT) image and (**B**) sagittal CT image at the level of first metatarsophalangeal (MTP) joint shows medial bipartite sesamoid bone. Normal appearance of lateral sesamoid bone is noted.

which do not fit with each other to make a single bone. Acute fractures of sesamoid bone show marrow edema on MRI (►**Fig. 5**) and tracer uptake on radionuclide scintigraphy, which are absent in case of bipartite sesamoid bone. Sesamoid fracture can be associated with displaced osseous fragments.[11]

Sesamoiditis (►Fig. 6)

Sesamoiditis is a painful sesamoid and many times it is a diagnosis of exclusion. It is seen as bone marrow edematous changes in sesamoid bone. The cause can be inflammation of peritendinous structures or abnormalities of the cartilage. Radiographs usually show normal sesamoid and MRI or nuclear scintigraphy can lead to the diagnosis.[11,12]

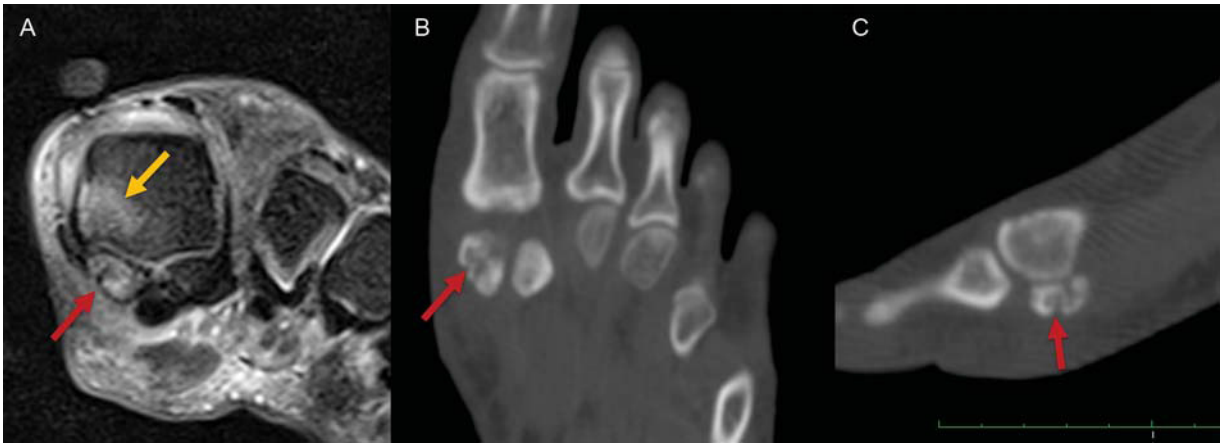

Fig. 5 Medial sesamoid fracture. (**A**) Coronal fat-suppressed T2-weighted image at the level of first metatarsophalangeal (MTP) joint showing diffuse marrow edema involving the medial sesamoid bone. Subtle T2 hypointense linear signal is noted through the medial sesamoid suggesting possibility of fracture (red arrow). Also, note the bone marrow edema or contusion involving inferomedial aspect of head of first metatarsal bone. (**B**) Axial computed tomography (CT) and (**C**) sagittal CT image better delineates the fracture involving the medial sesamoid bone.

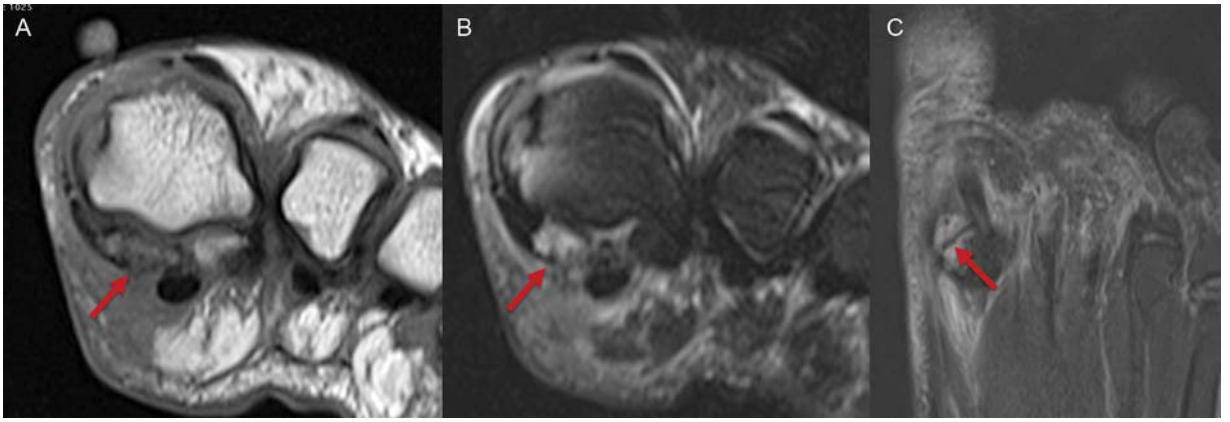

Fig. 6 Sesamoiditis. (**A**) Coronal T1-weighted and (**B**) fat-suppressed proton density (PD)-weighted images and (**C**) axial fat-suppressed T2-weighted images show marrow edematous changes involving the medial sesamoid bone. No history of trauma was noted.

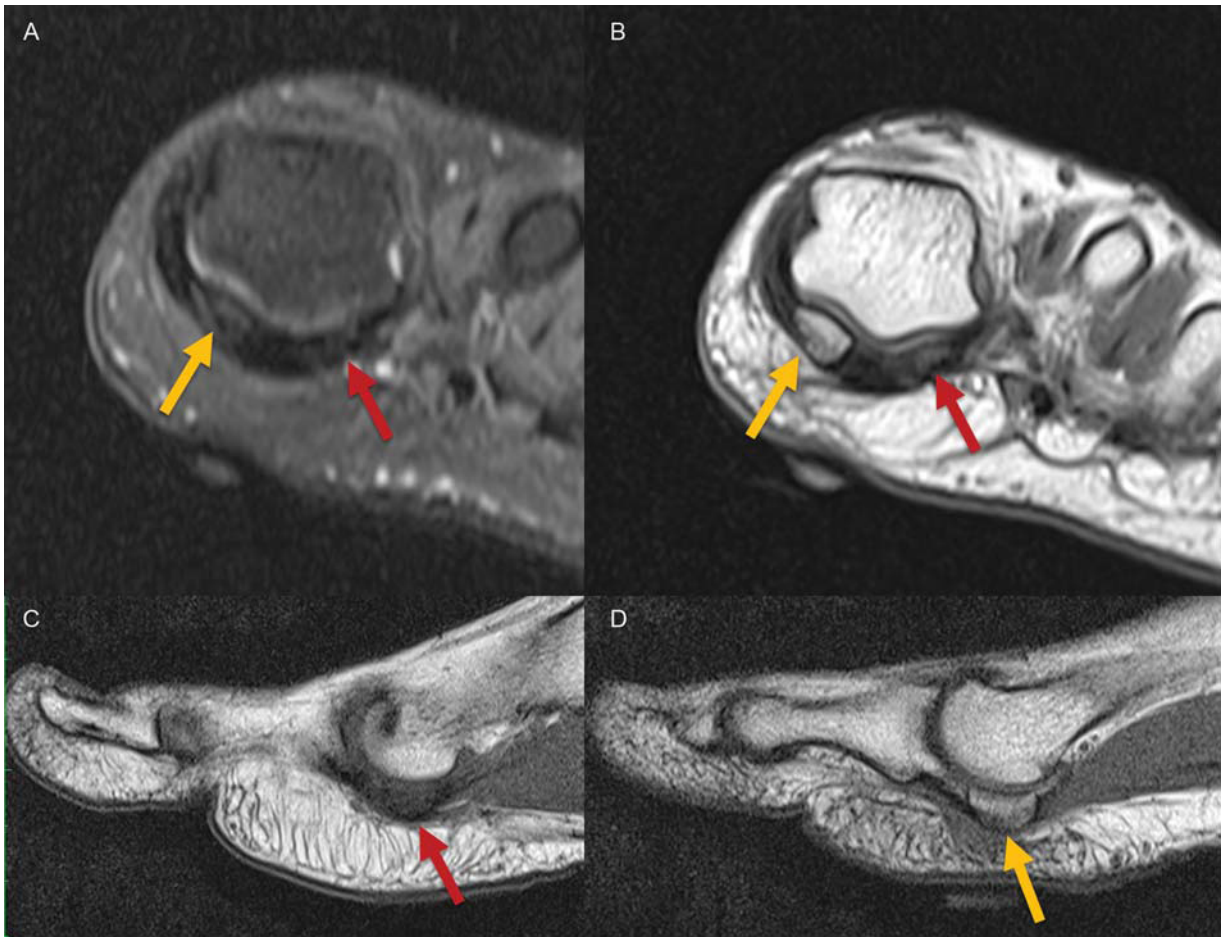

Fig. 7 Avascular necrosis of lateral sesamoid bone. (**A**) Coronal fat-suppressed T2-weighted and (**B**) T1-weighted images at the level of first metatarsophalangeal (MTP) joint shows sclerosis of lateral sesamoid bone (red arrow) showing collapsed flattened morphology of the bone suggestive of avascular necrosis. No evident abnormal marrow edema was noted. (**C**, **D**) Sagittal T1-weighted images show flattened sclerotic lateral sesamoid (red arrow) and normal appearing medial sesamoid bone (yellow arrow).

Avascular Necrosis (►Figs. 7 and 8)

This painful condition of sesamoid bone is most commonly seen in adolescents or adults with female getting affected more commonly than male. The pain is more severe while walking. Radiographs do not help in diagnosis in initial phase. Advanced cases can show presence of increased bone density with fragmentation. MRI shows loss of normal marrow signals with presence of low signal intensity of affected sesamoid bone on T1-weighted (T1W) and T2W images even in early stage of the disease. CT scan can be used as an additional imaging modality, which shows areas of sclerosis in the affected bone. Bone scintigraphy shows high uptake specifically in the affected sesamoid bone without involvement of the metatarsophalangeal joint.[11,13,14]

Infection

Osteomyelitis of sesamoid bone is uncommon. It can occur due to direct trauma with open would or in patients who have peripheral neuropathy leading to ulcers and infection of toe. Sesamoid is more commonly affected due to spread of adjacent osteomyelitis or septic arthritis with secondary involvement. The affected sesamoid shows marrow edema on MRI in early stages while advanced stages show presence of erosion, fragmentation, and resorption of bone. The postcontrast study after intravenous injection of gadolinium shows enhancement of the affected sesamoid bone.[11]

Osteoarthritis (►Fig. 9)

Osteoarthritis of sesamoid bones is common. It can be associated with hallux rigidus due to osteoarthritis of first metatarsophalangeal joint or limited to the articulation of sesamoid with metatarsal bone. It can be secondary to trauma or sesamoiditis. Imaging findings include reduction in the joint space with osteophytes formation and irregularity of the articular margin of the sesamoid.[11,15]

Conclusion

Various abnormalities of the hallucal sesamoid bone can result in painful great toe. Imaging helps in diagnosis and differentiation of these abnormalities. It is important to keep

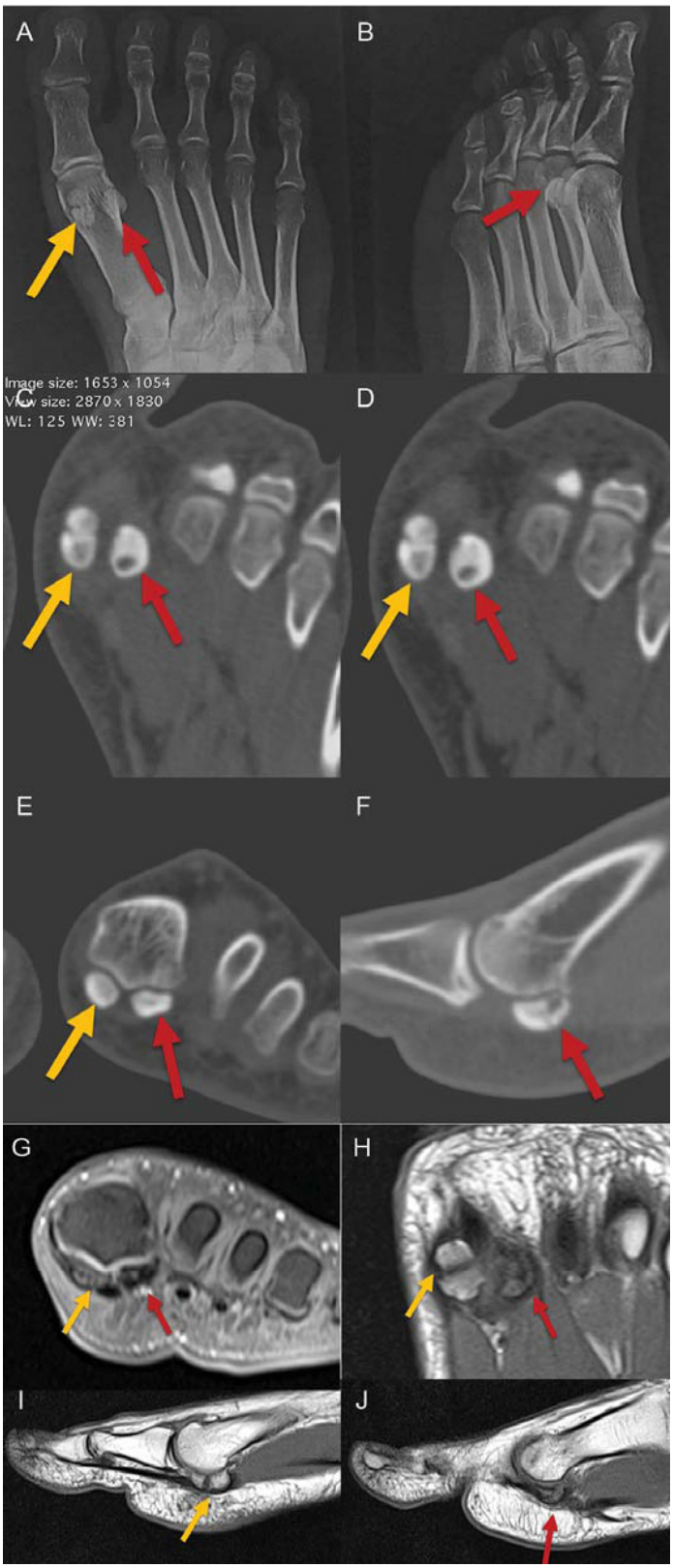

Fig. 8 Avascular necrosis of lateral sesamoid bone and bipartite medial sesamoid bone. (**A**) Radiograph anteroposterior (AP) and (**B**) oblique view of forefoot showing bipartite medial sesamoid bone (yellow arrow) and sclerotic lateral sesamoid bone (red arrow). (**C**, **D**) Computed tomography (CT) axial, (**E**) coronal, and (**F**) sagittal images showing bipartite medial sesamoid bone (yellow arrow) and sclerotic lateral sesamoid bone (red arrow) with mild flattening and cystic changes at its proximal end suggesting possibility of avascular necrosis. Avascular necrosis of lateral sesamoid bone and bipartite medial sesamoid bone. (**G**) Coronal fat-suppressed proton density (PD)-weighted image and (**H**) T1-weighted axial image showing bipartite medial sesamoid bone (yellow arrow) and sclerotic flattened lateral sesamoid bone (red arrow) suggesting avascular necrosis. Note absence of any bone marrow edema in lateral sesamoid bone. (**I**, **J**) Sagittal T1-weighted images show bipartite medial sesamoid bone (yellow arrow) and sclerotic lateral sesamoid bone (red arrow).

Fig. 9 Osteoarthritis. (**A**, **B**) Computed tomography (CT) sagittal images and (**C**) CT coronal images show marked reduction in joint space between the first metatarsal head and medial sesamoid bone with marginal osteophytes and irregularity of the articular margin of sesamoid suggesting degenerative osteoarthritic changes.

in mind that normal variation like bipartite sesamoid can mimic a pathology and should not be misinterpreted.

Conflict of Interest
None declared.

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