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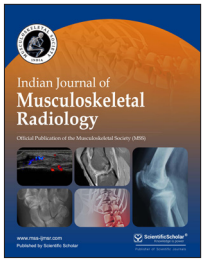

Case Report

Imaging Findings of Bilateral Medial Hallucal Sesamoid Insufficiency in a Marathon Runner

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ABSTRACT

The absence of hallucal sesamoids is an uncommon and incidental entity, bilateral absence is rare, and few cases of symptomatic patients have been reported in literature. Most patients present with metatarsalgia limited to plantar aspect of the great toe, with aggravation of pain on walking and relief at rest. We present a unique case of ipsilateral symptomatic hypoplastic medial hallucal sesamoid and asymptomatic absence of medial sesamoid at the contralateral foot.

Keywords: Tibial sesamoid, Flexor hallucis brevis tear, Painful toe, MRI, Metatarsalgia

INTRODUCTION

The hallucal sesamoids at plantar aspect of first MTP (metatarsophalangeal) joint function to absorb and redistribute weight-bearing forces, reduce friction, protect the FHL (flexor hallucis longus) tendon, and provide dynamic stability during the bipedal gait cycle by acting as a fulcrum for FHB (flexor hallucis brevis) affording more elevation and dorsiflexion at the first MTP joint. The absence of hallucal sesamoids is an uncommon and incidental entity, bilateral absence is rare, and few cases of symptomatic patients have been reported in literature.

CASE REPORT

A 24-year-old male, marathon runner, was investigated for worsening pain at the right metatarsophalangeal (MTP) joint, aggravated on activity, and relieved by rest. He had been suffering from intermittent bilateral MTP joint plantar sided pain for 5 years. He was suspected to have a plantar plate injury, or crystal deposition disease. The patient had no pertinent family history or previous history of any arthropathy.

On examination, he had tenderness overlying the plantar aspect of the first metatarsal head of the right foot and painful dorsiflexion at the first MTP. The plantar arch was normal, and no hallux valgus noted. No tenderness was elicited at the contralateral left foot. On careful inquiry, the patient confessed to repeated interrupted metatarsalgia, more frequent at the right foot, insidious at the first while running and good response to nonsteroidal anti-inflammatory drugs (NSAIDs).

The patient underwent MRI of the right foot. The medial or tibial hallucal sesamoid was indistinct, small, and densely sclerotic on T1- and T2-weighted images, presumed to be hypoplastic [Figure 1]. The medial sesamoidean sulcus was normal, though asymmetrical as

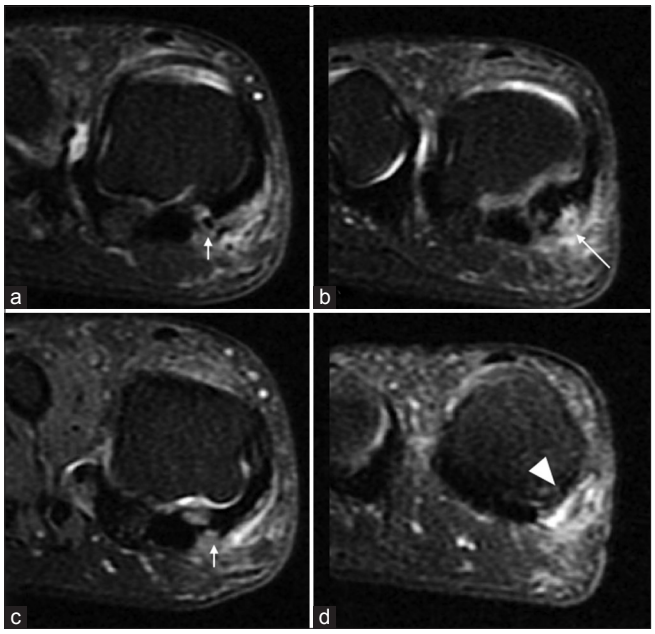

Figure 1: Sequential coronal plane proton density fat-saturated images, level of the first metatarsal head (a) to base of proximal phalanx (d), demonstrate the sclerotic hypoplastic tibial sesamoid (a), and adjoining edema with partial tear at medial metatarsophalangeal ligament (b) marked as short arrow. Medial head flexor hallucis brevis insertional tear (c) and tendinitis (long arrow) and abductor hallucis tendinitis (arrowhead) are shown in Figure 4 (d).

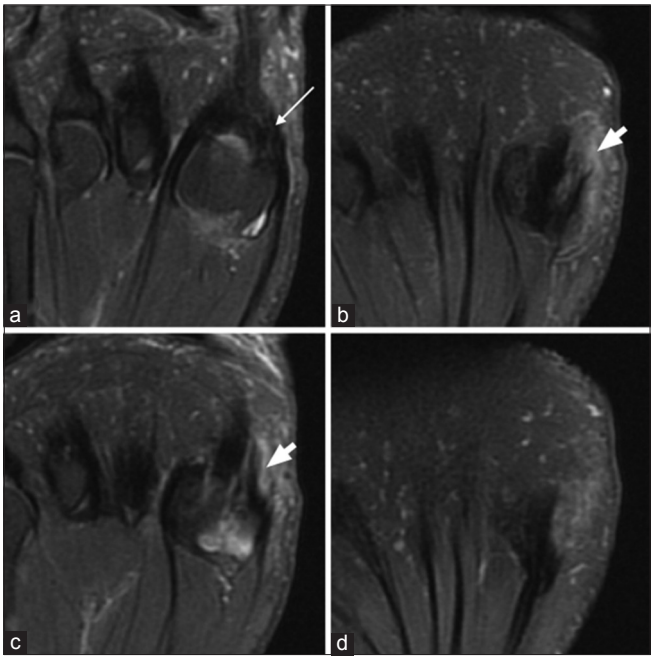

Figure 2: Sequential axial proton density fat-saturated images, level of plantar plate (a) to subcutis (d), demonstrate slumped wavy edematous fibers of the abductor hallucis longus tendon (long arrow) consistent with tendinitis (a), partial tear (short arrows) at medial flexor hallucis brevis (b) with concomitant medial glenosesamoid apparatus ligamentous (c) and subcutaneous edema (d).

compared to lateral sulcus at the plantar aspect of the first metatarsal head, and the intersesamoidean crest (crista) was normal with no bone signal changes or remodeling. Moderate soft tissue edema was noted at the medial glenosesamoid apparatus including the MTP ligaments, collateral ligaments, joint capsule, and the overlying subcutis [Figure 2]. A noticeable partial tear at the medial sesamoid-phalangeal ligament and the insertion of the medial head of flexor hallucis brevis (FHB) was noted. The FHB was seen to attach onto the sesamoid, as expected. Abductor hallucis insertion at the base of proximal phalanx of great toe was edematous. The plantar plate, flexor hallucis longus (FHL), adductor hallucis, and lateral head of FHB showed no abnormality. A diagnosis of medial hallucal sesamoid hypoplasia with partial tear of medial MTP ligament and

Figure 3: Dorsoplantar X-ray view of both feet demonstrates the absence of bilateral medial (tibial) sesamoid bones, a single lateral (fibular) hallucal sesamoid at the right foot (arrowhead) and bipartite lateral sesamoid at the left foot (long arrow).

Figure 4: Sesamoid tangential views show a small sclerotic rudimentary medial hallucal sesamoid at the right foot (arrowhead) and absent medial sesamoid at the left foot. The right medial sesamoidean sulcus is normally notched (long arrow); however, the left sulcus is mildly flattened and remodeled secondary to complete sesamoid aplasia (short arrow).

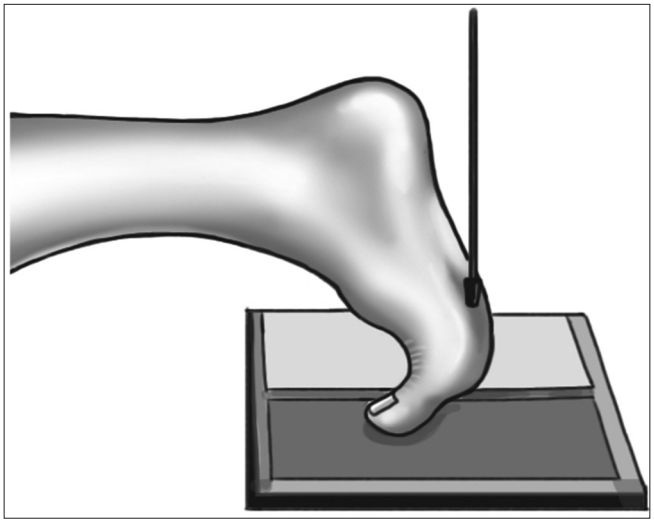

Figure 5: Drawing demonstrates that metatarsal tangential X-ray technique was by Lewis method, the patient placed prone, foot in dorsiflexion till the plantar surface forms a 15–20° angle to the vertical, X-ray beam directed skyline and collimated closely to the metatarsal heads, with central ray at the first metatarsophalangeal.

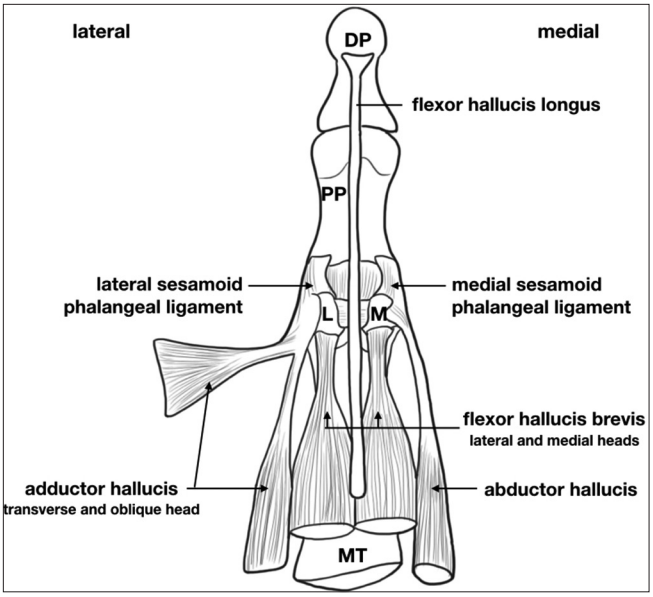

Figure 6: The illustration demonstrates the anatomy at plantar aspect of the first metatarsophalangeal joint. DP = Distal phalanx, PP = Proximal phalanx, MT = Metatarsal, M = Medial/tibial sesamoid, L= Lateral/fibular sesamoid.

medial head of FHB, and tendinitis at the abductor hallucis insertion, was concluded.

Bilateral foot radiographs were obtained in the dorsoplantar (DP), medial oblique, and tangential sesamoid/metatarsal view [Figures 3 and 4]. The metatarsal tangential X-rays were acquired by Lewis method [Figure 5], the patient placed prone, foot in dorsiflexion till the plantar surface forms a 15–20° angle to the vertical, and the X-ray beam directed skyline to and collimated closely to the metatarsal heads, with central ray at the first MTP.

The right foot sesamoid view X-ray showed a hypoplastic sclerotic medial sesamoid and the left foot corresponding X-ray revealed aplasia/absence of the medial sesamoid. The patient was advised short-term NSAID with rest, ice, compression, and elevation protocol, and long-term metatarsal pad with orthotic customized shoe support during long-distance running for both feet.

DISCUSSION

Hallucal sesamoids are two oval-shaped pea-sized embedded bones that form an integral component of the hallux MTP joint complex [Figure 6]. The name is derived from its resemblance to sesame seeds. The sesamoids function to absorb and redistribute weight-bearing forces, reduce friction, protect the FHL tendon, and provide dynamic stability during the bipedal gait cycle by acting as a fulcrum for FHB affording more elevation and dorsiflexion at the first MTP joint.[1]

Embryologically, the hallucal sesamoids first appear in the 5th week of fetal life as islands of undifferentiated mesenchyme with multiple ossification centers.[2] Ossification of hallucal sesamoids occurs at 10 years of age in boys and at 8 years in girls, lateral sesamoid ossifies earlier than its medial counterpart.[3] There are multiple etiologies for the insufficient development of hallucal sesamoids.[4] Various hypotheses have been postulated for congenital absence or hypoplasia, most widely accepted being vascular insults to ossification centers,[5] excessive hydrostatic compression of tendons hampering the development of fibrocartilaginous regions, and late-stage immobilization predicting failure of plantar tarsal sesamoid development.[6] Surgical exploration studies on a patient with a congenitally absent sesamoid revealed a small cartilaginous nodule-like precursor at the site of absent medial sesamoid supporting the previous theory.[7] Incomplete fusion of ossification centers leads to the formation of bipartite and tripartite sesamoids.[3]

The absence of hallucal sesamoids is an uncommon and incidental entity, bilateral absence is rare, and few cases of symptomatic patients have been reported in literature.[8,9-11] Standard X-ray views are insufficient to assess complete plantar sesamoid absence versus its hypoplastic cartilaginous nodule variety. DP views [Figure 3] allow assessment of axis and angles in reliable and reproducible manner, to rule out hallux valgus. Sesamoidal axial radiographs are best to assess their anatomy.[12,13] Absent medial sesamoids are associated with flattening of the sesamoidean sulcus and rudimentary intersesamoidean crest.[13] Densely sclerotic and small medial sesamoids are

observed in patients with chronic repetitive sesamoiditis with or without avascular necrosis; this occurs due to excessive plantar compressive forces, leading to vascular insult, and is the closest radiological differential.

MRI adequately demonstrates the sesamoid anatomy, plantar glenosesamoid apparatus, and the adjoining flexor, abductor, and adductor tendons and is the investigation of choice for metatarsalgia [Figure 6]. Even when the radiological findings favor the diagnosis, it is important to carefully ascertain whether sesamoid aplasia or hypoplasia is the actual cause of patients symptoms based on intent history and clinical examination.[14] Pedobarographic studies can confirm a shift in the gait line of highest pressure during the stance phase of the gait cycle from heel strike to push-off for the symptomatic patient.[12]

Unchecked, these patients develop FHB tendinitis, tears, medial sesamoid-phalangeal ligament tears, abductor hallucis insertional tears, and plantar plate dysfunction. Long-term hallux abducto valgus deformity may occur. As the hallucal sesamoid bones are tightly linked to the proximal phalanx by the short flexor tendons, the absence of medial sesamoid causes first metatarsal head to move medially off the sesamoid, the crista becomes eroded, reducing sesamoid-metatarsal stability and causing great toe rotation. This rotation disrupts the equal bipolar muscle balance at the metatarsal head of the big toe, causing the abductor hallucis muscle to become flexor rather than abductor and leaving the two heads of adductor hallucis unopposed into pulling the phalanx laterally with perpetuation of further valgus.[14] Surgical corrections such as extended Chevron osteotomy and proximal phalanx osteotomy (Akins procedure) have been described with good clinical outcomes.

CONCLUSION

With increasing popularity of running in the recent decade, many more cases of symptomatic sesamoid insufficiency are reporting to foot surgeons and podiatrists. Awareness of anatomical sesamoid variations, clinically relevant interpretation of its attribution in symptomatic patients, instituting early treatment in the form of metatarsal support, orthotic modifications, and athletic training alteration are imperative to redistribute the biomechanical forces offloading the sesamoid apparatus and to prevent long-term complications and surgical interventions.

Acknowledgment

Illustrations by Madhumangal Singh.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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