

Painful sesamoid of the great toe

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Abstract

The painful sesamoid can be a chronic and disabling problem and isolating the cause can be far from straightforward. There are a number of forefoot pathologies that can present similarly to sesmoid pathologies and likewise identifying the particular cause of sesamoid pain can be challenging. Modern imaging techniques can be helpful. This article reviews the anatomy, development and morphological variability present in the sesamoids of the great toe. We review evidence on approach to history, diagnosis and investigation of sesamoid pain. Differential diagnoses and management strategies, including conservative and operative are outlined. Our recommendations are that early consideration of magnetic resonance imaging and discussion with a specialist musculoskeletal radiologist may help to identify a cause of pain accurately and quickly. Conservative measures should be first line in most cases. Where fracture and avascular necrosis can be ruled out, injection under fluoroscopic guidance may help to avoid operative intervention.

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Core tip: This paper is a review article examining available evidence on the anatomy, function and common variation in the sesmoids of the great toe. There is discussion of the presentation, history, examination, investigations and subsequent management of the patient with a painful sesamoid. We discuss the role of operative intervention. We recommend early use of magnetic resonance imaging and discussion with a musculoskeletal radiologist to assist in diagnosis. Conservative management should be the first line in most cases.

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INTRODUCTION

Origins

The term sesamoid comes from the Arabic word, *semsem*, meaning sesame seed. Galen named these small rounded bones in reference to their similarity to sesame seeds^[1]. The anatomic locations of some sesamoid bones are constant but others are variable.

Anatomy

The two sesamoid bones of the big toe metatarsophalangeal joint are contained within the tendons of Flexor Hallucis Brevis and forms portion of the plantar plate. There are two sesamoids, tibial (medial) and fibular (lateral) sesamoids. The sesamoids articulate on their dorsal surface with the plantar facets of metatarsal head^[2]. A crista or intersesamoid ridge separates the medial and lateral metatarsal facets. The crista provides intrinsic stability to the complex. In severe cases of hallux valgus the intersesamoid ridge atrophies and can be obliterated. The sesamoids are connected to the plantar aspect of proximal phalanx through plantar plate^[3] which is continuation of the flexor hallucis brevis tendon^[4]. The inferior sur-

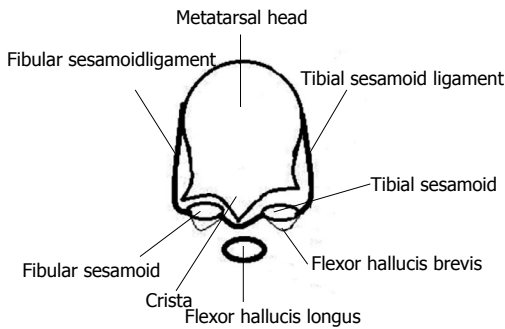


Figure 1 Diagrammatic representation of a cross section through the distal metatarsal and sesamoids.

face of the sesamoid is covered by a thin layer of flexor hallucis brevis tendon and superior surface is articular. The sesamoids are suspended by a sling like mechanism; sesamoid ligaments to the corresponding aspect of metatarsal head (Figure 1). There is no direct connection between sesamoids and flexor hallucis longus tendon that runs between them. The abductor hallucis and adductor hallucis tendons have fibrous insertions into the tibial and fibular sesamoids respectively. The deep transverse metatarsal ligament attaches to the fibular sesamoid^[5].

Function

The function of sesamoids is to distribute weight bearing of first ray, increase mechanical advantage of the pull of short flexor tendon and stabilize the first ray. The tibial sesamoid normally assumes most of the weight bearing forces transmitted to the head of the first metatarsal^[6]. When a person is in standing position sesamoids are proximal to the metatarsal heads. With dorsiflexion of first ray they however move distally thereby protecting the exposed plantar aspect of metatarsal head. When a person rises on to the toes, sesamoids (especially tibial) act as the main weight bearing focus for medial forefoot. Tibial sesamoid is more prone for pathology due to increased loading on this by the first metatarsal head^[7].

Perfusion

Sesamoids have a tenuous blood supply and this is often variable as well. Blood supply to sesamoids enters mostly from proximal part and distal part has more tenuous blood supply. This can lead to delayed or unsuccessful healing following injury^[8].

The bipartite sesamoid

Sesamoids ossify between the ages of 6 and 7. Ossification of sesamoids often occurs from multiple centres and this is the reason for bipartite sesamoids. Bipartite sesamoids are a normal anatomical variant. Studies quote the incidence of bipartite sesamoids to be between 7 and 30^[9-11]. Ninety percent involve tibial sesamoid and 80%-90% are bilateral^[10]. Bipartite sesamoid has narrow and distinct regular edges and also are usually larger than single sesamoid. Some of these divided sesamoids do undergo osseous union with time. The synchondrosis



Figure 2 X-ray to demonstrate a case of sesamoid coalition.

between the sesamoid fragments can also disrupt with injury leading to symptoms and makes it difficult to distinguish whether some of these partite sesamoids are actually ununited fractures^[12]. A Bone scan or magnetic resonance imaging (MRI) scan may help in differentiating between the two^[13]. Bipartite sesamoids can predispose to hallux valgus deformity as twice higher incidence is noted in patients with Hallux Valgus^[14].

Abnormalities of the sesamoids

Other variations with sesamoids include congenital absence (reported widely in literature)^[15-17] and also changes in shape. Hypertrophy can cause a projection on the plantar surface leading to hyperkeratotic lesion. Exostoses of sesamoids have been reported and these can cause keratosis or ulcerations. Hypertrophied fibular sesamoid can cause pain in the first intermetatarsal space due to local irritation or nerve compression. Coalition of sesamoids can also occur and give rise to symptoms (Figure 2)^[18].

HISTORY AND EXAMINATION

Pain is typically during toe off phase of gait. Careful history taking should include examination of footwear used in past and present, leisure activities to identify causation, occupation and treatment taken so far. Occupational factors include running, ballet dancing and jumping from a height^[19-21]. The wearing of high heels and a high arched foot type also has an aetiological association. Previous injections to the area and smoking status should be asked for. Patients tend to avoid weight bearing on the involved sesamoid and load the lateral aspect of foot.

Findings include restricted and painful range of metatarsophalangeal joint motion, tenderness (Figure 3), and diminished plantar flexion strength. With long standing overloading, an intractable plantar keratotic lesion may develop beneath the affected sesamoid. Any tendency for hallux valgus, varus or clawing should be looked for. Examination of sensory nerves is important to rule out digital nerve compression^[11].

INVESTIGATIONS

Radiographs

Routine AP and lateral radiographs provide limited infor-



Figure 3 Photograph to show surface markings of the tibial (T) and fibular (F) sesamoids.

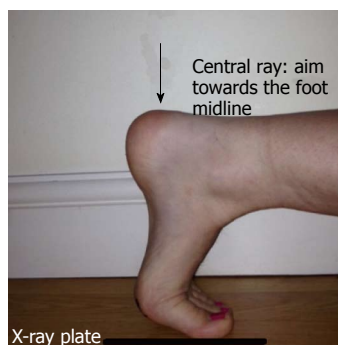


Figure 4 Photograph to show patient positioning to obtain a sesamoid axial view.

mation. The tibial sesamoid can be better imaged with a medial oblique view and the fibular sesamoid can be visualised better with a lateral oblique view. An axial sesamoid view will provide a better profile of both sesamoids with their metatarsal articulations (Figure 4)^[22].

Isotope bone scan

Isotope bone scanning can demonstrate altered uptake before radiographs show changes. It shows increased uptake prior to development of radiological changes such as sclerosis, fragmentation. Bone scanning may be of use in differentiation of the fractured sesamoid from the congenital bipartite sesamoid^[23].

MRI

Pathologies affecting the hallux sesamoids may have overlap of both history and examination. For this reason, imaging is a useful tool that can differentiate causes of sesamoid pain where a diagnosis may not otherwise be easily made^[20]. It can also distinguish between bipartite sesamoids and fracture non-unions. This is currently the investigation of choice for most sesamoid pathology^[20,24].

DIFFERENTIAL DIAGNOSIS

Intractable plantar keratosis

Intractable plantar keratosis may form under the heads of the metatarsals. This can often be as a result of repeated abrasion or increased activity. It is important to differentiate IPK from verruca. Radiographs may help to identify causative osseous abnormality. This may include deformity of an underlying sesamoid. Management may involve activity modification, padding of pressure areas, use of orthosis or shaving of the keratosis. For persistent cases, condylectomy or osteotomy may be required^[25].

Bursitis

Bursitis may affect the intermetatarsal bursae or the adventitial bursae. magnetic resonance imaging may help to diagnose the location of the affected bursa. Should conservative measures fail, bursectomy alone or in combination with sesamoidectomy or metatarsal osteotomy may provide relief^[26].

Nerve compression

Plantar medial and plantar lateral digital nerves travel near

to the corresponding sesamoids and can be a source of pain. Nerve compression at these sites can cause altered sensation, pain and a positive Tinel's sign. Surgical decompression may be indicated in the resistant case^[5].

Osteoarthritis

This may be associated with Hallux rigidus or localized to the sesamoid metatarsal articulation. This can develop secondary to trauma, chondromalacia or sesamoiditis. If conservative treatment fails where disease is restricted to one sesamoid resection of the involved sesamoid may help. When both sesamoids are involved excision can lead to clawing, hence MTP fusion is more appropriate^[18].

Infection

Infection of sesamoids is uncommon. Direct trauma with puncture wound or breakdown of skin in those with peripheral neuropathy are the common mechanisms. Should antibiotic therapy prove ineffective, excision of the sesamoid can be considered. Care should be taken when excising the sesamoids to preserve the surrounding structures to prevent development of intrinsic minus deformity^[11].

Fracture of sesamoid

An acute fracture of unipartite sesamoid can be differentiated from a congenital bipartite sesamoid using bone scan or MRI. Bipartite sesamoids can also fracture following trauma when the synchondrosis between the two sesamoid fragments prevents healing. Rest in a non-weight bearing cast for 6 to 8 wk is the first line of treatment. Symptomatic non-union may be treated with percutaneous screw fixation, open fixation or open bone grafting (Figure 5)^[27]. Surgical excision may be reserved for revision surgery.

Subluxation/dislocation of sesamoids

As hallux valgus develops, first metatarsal drifts medially. The sesamoids maintain their relationship to the second metatarsal due to tethering by transverse metatarsal ligament and adductor hallucis tendon. There is often erosion of the crista and increased weight bearing by the tibial sesamoid. Fibular sesamoid is spared as it is dis-



Figure 5 Symptomatic non-union may be treated with percutaneous screw fixation, open fixation or open bone grafting. A: X-ray to show a symptomatic non-union of a sesamoid fracture; B: Magnetic resonance imaging scan demonstrating fracture of the sesamoid; C: Post-operative X-ray following fixation of a non-union sesamoid fracture.

placed into the first intermetatarsal space^[28].

Osteochondritis/avascular necrosis

Sesamoids have a tenuous circulation making them vulnerable to avascular necrosis. In cases of avascular necrosis trauma may be an aetiological factor. Radiographs may show fragmentation with areas of increased bone density. MRI is also helpful in diagnosis. Excision of the sesamoid is reserved for cases where conservative management is ineffective^[11].

Sesamoiditis

Sesamoiditis is a diagnosis of exclusion once other causes of sesamoid pain have been excluded. Sesamoiditis is a painful condition affecting the sesamoids and can occur with or without trauma. This may be due to cartilage abnormalities similar to chondromalacia of patellofemoral joint^[29] or inflammation of peritendinous structures. This condition is typically seen in younger women. The tibial sesamoid is more often involved. Radiographs are usually normal and bone scan and MRI may help in diagnosis. Conservative treatment involves decrease in activity. Low heels reduce pressure on sesamoids. Offloading custom made insoles are often helpful. Injections can be helpful and when everything fails excision is treatment of choice.

MANAGEMENT

Conservative management

Initial attempts at management include a period of non- or reduced weight bearing, providing wide shoes with a reduced heel height, orthotics or padding^[30]. The toes may be taped in plantar flexion or neutral to avoid excessive dorsi-flexion. Clinical evidence confirming resolution of symptoms with simple, conservative measures is often possible^[31]. Non-steroidal anti-inflammatory drugs may also help to provide relief.

Injection

Steroid and local anaesthetic injections can be both diagnostic and therapeutic. Injections are usually done under radiological guidance to improve accuracy of needle placement. Steroid injections should not be used in presence of a sesamoid fracture or avascular necrosis^[3].

SURGERY

Sesamoid shaving

In the presence of an intractable plantar keratosis due to prominence of a tibial sesamoid, shaving of the plantar half of the sesamoid may provide relief without excision of the complete sesamoid. This should only be attempted in the presence of normal mobility at the first metatarsal^[32].

Sesamoidectomy

Surgical excision of a sesamoid should be considered only when other treatment modalities have failed. Only one sesamoid may be excised, excision of both is likely to lead to a cock-up deformity or a claw toes deformity^[30]. The sesamoid to be excised will dictate the surgical approach. For tibial sesamoidectomy a medial approach is preferred to avoid injury to plantar medial nerves. In one study, ninety-percent of patients were able to return to normal pre-morbid levels of activity following tibial sesamoidectomy^[33]. A dorsolateral approach is preferred for fibular sesamoidectomy as a plantar approach is likely to encounter the neurovascular bundle and flexor hallucis longus tendon, making access difficult^[11]. Painful plantar scar is a difficult problem to resolve and should be avoided.

Percutaneous screw fixation

In cases of fracture of the sesamoid unresponsive to conservative management, percutaneous fixation of the sesamoid may provide improvement of symptoms. In one study of nine patients managed this way, all patients had dramatic relief from pain at three months post-operatively^[27].

CONCLUSION

A range of conditions can lead to sesamoid pain. Careful history examining occupation and hobbies alongside a thorough examination and use of appropriate imaging modalities are likely to identify aetiology. Our recommendations are that early consideration of MRI and discussion with a specialist musculoskeletal radiologist may help to identify a cause of pain accurately and quickly. Conservative measures should in most cases be first line. Where fracture and avascular necrosis can be ruled out, injection under fluoroscopic guidance may help to avoid operative

intervention. Operative intervention used only in resistant cases operative morbidity should be considered and explained to patients.

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