

## PAINFUL SESAMOID OF THE GREAT TOE Dr Vasu Pai

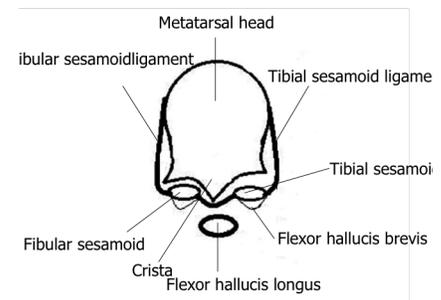
### ANATOMICAL CONSIDERATION

At the big toe MTP joint: Tibial sesamoid (medial) & fibular (lateral)

They are contained within the tendons of Flexor Hallucis Brevis and forms portion of the plantar plate.

There are two sesamoids, sesamoids. The sesamoids articulate on their dorsal surface with the plantar facets of metatarsal head. A crista or intersesamoid ridge separates the medial and lateral metatarsal facets.

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 which is continuation of the flexor hallucis brevis tendon.



The sesamoids are suspended by a sling like mechanism; sesamoid ligaments to the corresponding aspect of metatarsal head. There is no direct connection between sesamoids and flexor hallucis longus tendon that 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.

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. Ninety percent involve tibial sesamoid and 90% are bilateral.

Sometimes 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. A Bone scan or magnetic resonance imaging (MRI) scan may help in differentiating between the two.

## **BIOMECHANICS**

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. 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.

### **Windlass Mechanism**

As part of the plantar plate and its attachments to the plantar fascia, the hallux sesamoids play an important role in the windlass mechanism of the foot. In 1954 Hicks discussed the mechanics of the foot, focusing on the relationship of the plantar aponeurosis to the arch. He believed that functionally there were 2 structures of importance, the plantar plates of the MTPJs and the plantar aponeurosis, which is attached to them through 5 digital processes.

Hicks observed that each plantar plate with its attached process of plantar aponeurosis was seen to constitute a continuous strong band forming a direct connection between the proximal phalanx and the calcaneus, like a tie or bow-string. When the toes are extended the ties pull the plantar plates forward around the heads of the metatarsals, akin to a cable being wound on to a windlass. The longitudinal arch of the foot is induced to rise because the distance between the MT heads and the calcaneus is shortened.

**The biochemical effects of sesamoid excision** on the function of the hallux in cadaver studies. The removal of the distal part of either sesamoid or the whole tibial sesamoid has little effect on

the FHB moment arm, but resection of both bones reduced the moment arm by one-third in dorsiflexion.

## **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 10% and bilateral in 25%. Ninety percent involve tibial sesamoid and 80%-90%. 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.

Sometimes 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. A Bone scan or magnetic resonance imaging (MRI) scan may help in differentiating between the two.

## **EXAMINATION**

1. Pain is typically during toe off phase of gait.
2. 2. examination of footwear
3. leisure activities to identify causation,& occupation
4. The wearing of high heels and a high arched foot type
5. Previous injections
6. Load the lateral aspect of foot causing lateral callosity
7. Restricted and painful range of MTP joint.

8. Localised tenderness
9. Diminished plantar flexion strength.
10. Examination of sensory nerves
11. X ray
12. CT, MRI and Spect scan



## **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

### ***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.

### ***Nerve compression***

Plantar medial and plantar lateral digital nerves travel near Central ray: aim towards the foot midline 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 de- compression may be indicated in the resistant case

### ***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.

### ***Fracture of sesamoid***

An acute fracture of unipartite sesamoid can be differentiated from a congenital bipartite sesamoid using bone scan or MRI. A fractured sesamoid is characterized by an irregular pattern, the presence of sharp fracture edges, comminution, or wide separation and diastasis of fragments



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. 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 displaced into the first intermetatarsal space

### ***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.

### ***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 or inflammation of peritendinous structures.

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. *World J Orthop* 2014 April 18; 5(2): 146-150



## **TREATMENT**

**Conservative methods** work to reduce the weight transmitted through the first MT head. These methods include:

- a. Limitation of activities/weight bearing and activity modification
- b. Orthoses to offload/accommodate the first MTPJ
- c. Avoidance of high heels

d. A rocker-sole shoe designed to reduce the movement at the first MTPJ and especially at the sesamoid-MT articulation

e. Physiotherapy

d. Immobilization for acute fractures

### **Surgical options**

Should be carefully considered and should only be used if the clearly defined indications. Primary surgical treatment, which should treat the underlying condition, can involve tendo-Achilles or gastrocnemius lengthening, dorsiflexion osteotomy at the base of the first MT, or corrective osteotomies or fusions for the fixed pes cavus foot.

### **Indications for sesamoidectomy**

When the correct conservative management (for at least 6–12 months) fails and the patient has ongoing debilitating symptoms, Normal alignment of first ray: no excessive metatarsal plantarflexion, Absence of clawing

### **Complications of sesamoidectomy**

A significant group of complications has been observed and described throughout the last century of orthopedic surgery, including the development of **hallux valgus** (medial sesamoid) or **hallux varus** (lateral sesamoid).

**Claw deformity** of the great toe can develop following removal of both sesamoids if the integrity of the plantar plate attachments is compromised and the FHB tendons are weakened. A meticulous repair and adequate time to heal is necessary after such excision.

Painful scar,

Wound dehiscence

Nerve injury.

Transfer metatarsalgia of the lesser toes

### **How to avoid complications of sesamoidectomy**

Meticulous technique is required.

Injury to the plantar digital nerves leading to neuromas :is more commonly seen with lateral sesamoidectomy. The incidence of neuroma/neuritis is re- ported at 7% to 8%

The integrity of the FHB tendons and capsular structures should be maintained or restored to avoid weakness and instability at the first MTPJ.

Patients should be warned that corrective osteotomies may not offer a total solution to their symptoms whereas a first MTPJ fusion is generally very successful for the relief of pain and could be preceded with a targeted injection.

## **REFERENCES**

1. *World J Orthop* 2014 April 18; 5(2): 146-150
2. *Foot Ankle Clin N Am* 14 (2009) 91–104
3. *Foot Ankle Clin.* 2014 Sep;19(3):425-36.