DEFINITION
- Sesamoiditis is a general term that indicates an injury to the sesamoid bone. There are multiple possible causes, such as trauma (fracture, contusion, repetitive stress), infection, arthrosis, osteonecrosis, and osteochondritis dessicans.3,5,13–15
- There are two sesamoid bones located plantar to the metatarsal head of the hallux: the lateral or fibular and the medial or tibial sesamoid. The tibial sesamoid typically bears more stress than the fibular sesamoid and is more likely to be injured.4

ANATOMY
- The two sesamoid bones are located plantar to the metatarsal head within the tendon of the flexor hallucis brevis (FHB). They are held together by the intersesamoid ligament and plantar plate. The two sesamoids’ dorsal surface articulates with the head of the first metatarsal facets, and they are separated by a crista. The sesamoids function to absorb the weight-bearing stress across the medial ray as well as protecting the flexor hallucis longus (FHL) tendon that passes between them. The tibial sesamoid is typically larger and located slightly more distal than the fibular sesamoid (FIG 1).
- During the stance phase of gait the sesamoids are slightly proximal to the metatarsal head, but with dorsiflexion of the hallux the sesamoids are pulled distally, protecting the exposed surface of the metatarsal head (FIG 2). During the act of toe raising, the sesamoids bear a significant amount of stress. This stress is typically concentrated more medially over the tibial sesamoid, thus accounting for the increased incidence of tibial sesamoid injuries.
- Biomechanically the sesamoids function as a fulcrum to provide a mechanical advantage to the FHB tendon during metatarsal phalangeal joint plantarflexion.7
- Ossification of the sesamoids typically occurs from multiple centers and occurs during the seventh to tenth years of life. The multiple ossification centers may account for the incidence of bipartite and tripartite sesamoids.5
- The tibial sesamoid is bipartite in about 19% of the population and bilateral in 25% of patients (FIG 3).6

PATHOGENESIS
- Symptoms can arise from a single acute traumatic event, or more commonly there is a history of minor or repetitive trauma as the cause of sesamoid pain.
- Acute injuries typically occur with a similar mechanism to a turf toe injury, acute hyperextension to the hallux metatarsophalangeal (MTP) joint, or a direct contusion to the sesamoid region of the forefoot. This can also result in a fracture or an injury to a bipartite sesamoid.
- In nonacute injuries the patient often cannot remember a specific incident or injury and can only initially recall activity-related discomfort to the forefoot. This history is typically noted in cases of repetitive stress, osteochondritis dissecans, and arthrosis. A bipartite sesamoid can similarly be injured in this case.
- Neuritic pain has also been described with compression to the plantar medial cutaneous nerve underlying the tibial sesamoid.

FIG 1 • A. Medial view of relevant anatomy with special note of the adductor hallucis brevis and the relationship to the plantar cutaneous nerve. (continued)
Most sesamoid injuries resolve with appropriate nonoperative treatment.

Sesamoiditis that does not resolve with conservative treatment is unlikely to improve significantly after 3 to 12 months. As a result, patients often have pain that prevents them from participating in athletic activities. Performing everyday activities that involve a dorsiflexed MTP joint such as stair climbing, toe raising, and in women wearing heels also can become bothersome.

PATIENT HISTORY AND PHYSICAL FINDINGS

Most patients cannot remember a specific incident or injury, unless it was acute, and can only recall a gradual onset of discomfort to their forefoot. This pain is often generalized and localized to the great toe region. It is localized more plantarward and is worse with weight-bearing activity. Patients will often prefer cushioned shoe wear versus barefooted activity.

Performing activities that require a dorsiflexed MTP joint such as running, jumping, toe raising, or stair climbing can become very irritating to this region.

Gait can be antalgic, specifically in the toe-off phase, and can also reveal evidence of medial off-loading and lateral foot overload as the patient walks with the foot externally rotated.

Clinical inspection will reveal swelling over the plantar aspect of the hallux MTP joint as well as tenderness to palpation under the tibial sesamoid. This pain can be exacerbated with forced dorsiflexion of the hallux MTP joint. There may be evidence of loss of dorsiflexion and less commonly plantar flexion of the MTP joint. Plantar flexion strength against resistance or with a single-limb toe raise may also be affected due to pain.

In acute injuries or in patients with a bipartite sesamoid a drawer test of the hallux MTP joint may also reveal laxity, indicating a fracture of the sesamoid or disruption of the synchondrosis of a bipartite sesamoid.

Direct palpation over the tibial sesamoid may also reveal a positive Tinel sign or paresthesia distally, indicating a compression over the plantar medial cutaneous nerve.

Assessment of hallux alignment is critical.

Evidence of pre-existing hallux valgus or a cavus foot requires careful planning to identify patients who may require concomitant procedures to prevent further migration after tibial sesamoidectomy.

Augmenting a tibial sesamoidectomy with a lateral capsular release, medial capsular reeving, or metatarsal or phalangeal osteotomy may be considered to prevent progressive deformity.

Methods for examining the tibial sesamoid include:

Direct palpation under the tibial sesamoid with the foot in neutral and with dorsiflexion of the MTP joint

Range of motion (ROM): One hand should be placed on the proximal phalanx with the other stabilizing the metatarsal. Dorsiflexion and plantar flexion ROM should be assessed. Symmetry between the right and left side should be noted.
Drawer test: The examiner grasps the proximal phalanx in one hand and the metatarsal head in the other and performs a dorsal to plantar stress of the MTP joint.

Toe raise: The patient is asked to do double-limb and single-limb toe raises.

IMAGING AND OTHER DIAGNOSTIC STUDIES

- Routine radiographs should consist of standing anteroposterior (AP), lateral, oblique, and axial sesamoid views.
- Plain radiographs will often be diagnostic in cases of arthrosis and osteochondritis dissecans if fragmentation is present (FIG 4).
- A bipartite tibial sesamoid (Fig 3) occurs in up to 19% of the population, and differentiating it from a fracture or injury to the bipartite sesamoid can be difficult.6
  - A fractured sesamoid may have a sharp radiolucent line that may assist in differentiation.
  - AP radiographs in neutral and dorsiflexion may assist in evaluating separation of the sesamoid segments.
- A triple-phase bone scan or MRI is often required to confirm the diagnosis.
- A triple-phase bone scan, with collimated views of the MTP joint, is very sensitive and may demonstrate increased uptake before radiographic changes become present (FIG 5).

MRI is more expensive but allows the examiner to identify most causes of hallux MTP pathology in addition to sesamoiditis (FIG 6).

DIFFERENTIAL DIAGNOSIS

- Infection, sesamoid-metatarsal or MTP arthrosis or chondromalacia, bursitis, flexor tendinosis, fracture, osteochondritis dissecans, intractable plantar keratosis, nerve compression, bipartite sesamoid, turf toe injury

NONOPERATIVE MANAGEMENT

- Most patients will respond to conservative therapy. This consists of rest or immobilization for 2 to 4 weeks, followed by protected weight bearing with an orthotic, walker boot, or cast for an additional 4 to 6 weeks.
Typically a hard-soled shoe will decrease the dorsiflexion stresses across the MTP joint, and a negative-heel shoe will decrease forefoot loading.

An orthosis such as a turf-toe plate or dancer’s pad with a medial longitudinal arch support will decrease the stresses across the sesamoids (FIG 7).

In athletes, taping the MTP joint to prevent dorsiflexion may allow continued participation.

The use of nonsteroidal anti-inflammatory medication may augment treatment.

The judicious use of steroid injections for chronic sesamoiditis is also indicated.

**SURGICAL MANAGEMENT**

Pain under the tibial sesamoid that is not responsive to conservative treatment is the main indication for operative intervention. The presence of hallux MTP malalignment, a cavus foot, or stiffness requires careful evaluation and may require additional surgical procedures to improve clinical results.

Previous excision of the fibular sesamoid or absence of the fibular sesamoid is the main contraindication to a tibial sesamoidectomy. A history of peripheral vascular disease, soft tissue or wound healing problems, diabetes mellitus, and smoking are also relative contraindications that require proper evaluation and discussion with the patient before operative intervention.

**Preoperative Planning**

The initial evaluation of hallux alignment is of utmost importance.

Although there is little literature in regard to the appropriate criteria for the addition of a hallux realignment procedure in an isolated tibial sesamoidectomy, the surgeon needs to keep in mind that any failure of reconstruction of the tibial FHB complex or failure to address pre-existing hallux malalignment will compromise patient outcome.

In general, any patient whose hallux alignment would be considered for surgical realignment without tibial sesamoiditis should have the malalignment corrected during the tibial sesamoidectomy.

**Positioning**

Anesthesia should be similar to a bunion procedure.

An ankle block with some mild sedation is typically well tolerated.

A well-padded supramalleolar Esmarch tourniquet is also used and is well tolerated.

The patient should be placed on the operating table in a supine position.

The natural external rotation of the lower extremity allows excellent exposure to the medial aspect of the forefoot (FIG 8).

**Approach**

Dorsomedial, straight medial, and plantar medial incisions to approach the tibial sesamoid have all been described. The most commonly used incision is a longitudinal medial skin incision that is slightly plantar to the standard incision for a bunion excision (FIG 9). With the dorsomedial incision, it is very difficult to obtain adequate exposure of the plantar aspect of the foot, while the plantar medial incision is typically directly over the plantar cutaneous nerve and near the weight-bearing surface of the foot, increasing wound complications.
TIBIAL SESAMOIDECTOMY

- The most commonly used incision is a longitudinal medial skin incision that is slightly plantar to the standard incision for a bunion excision.
- The plantar cutaneous nerve must be identified and mobilized for protection during the procedure (TECH FIG 1).
  - The nerve can usually be found along the inferior border of the abductor hallucis brevis tendon alongside the MTP joint.
  - Typically the nerve is mobilized inferior to the surgical dissection, although dorsal retraction has been described as well.
  - A vessel loop can also be placed around the nerve to protect it.
- Perform initial evaluation of the tibial sesamoid and metatarsal head articulation through an intra-articular exposure.
- Make a longitudinal incision in the capsule in line with the skin incision.
  - This incision is usually dorsal to the fibers of the insertion of the abductor hallucis tendon.
- Assess the sesamoid articular surface for significant displacement or step-off in acute fractures or bipartite sesamoids. In chronic cases, assess the resultant articular cartilage injury to the sesamoid or metatarsal head articulation of the hallux from osteonecrosis, osteochondritis dissecans, or arthrosis (TECH FIG 2).
- At this stage, when the decision is made to remove the sesamoid, the use of a Beaver mini-blade to outline the tibial sesamoid from the intra-articular approach will assist in its later removal.
- In an acute fracture or a bipartite sesamoid without articular damage, consider using bone grafting of the defect as opposed to performing a sesamoidectomy.
- Repair the capsulotomy with a 2-0 nonabsorbable suture before proceeding with the sesamoidectomy exposure (TECH FIG 3).
- Expose the sesamoid through an extra-articular plantar medial incision in line with the FHB fibers.
  - The sesamoid is embedded within a dense fibrous sheath, and careful dissection out of the FHB and its soft tissue attachments is required (TECH FIG 4).
- This can be facilitated by the use of a Beaver mini-blade, using a pushing technique rather than a cutting motion, as well as grasping the sesamoid with a small towel clamp or Kocher clamp for stability.
- Take utmost care to protect the nerve medially as well as the FHL laterally to prevent injury.
- Once the sesamoid is removed, carefully assess the continuity of the FHB complex. Typically there are some remaining fibers of the FHB complex.

TECH FIG 1 • Intraoperative picture; the Freer elevator is underneath the plantar cutaneous nerve.

TECH FIG 2 • Intracapsular view showing the articulation of the tibial sesamoid and the metatarsal head. (From Lee S. Technique of isolated tibial sesamoidectomy. Techn Foot Ankle Surg 2004;3:85–90, with permission.)

TECH FIG 3 • The tip of the Freer elevator is underneath the plantar cutaneous nerve.

TECH FIG 4 • After the initial incision to separate the flexor hallucis brevis complex. Also note the longitudinal capsulotomy and repair.
Part 2 FOOT AND ANKLE • Section X TITLE

POSTOPERATIVE CARE

- Patients are limited to heel weight bearing for 2 weeks.
- At the 2-week follow-up visit stitches are removed, a toe spacer is placed, and patients are allowed to bear weight as tolerated in a postoperative shoe or a short walker boot.
- Standing radiographs should be performed to confirm maintenance of hallux alignment.
- The toe spacer should remain in place for 6 to 8 weeks postoperatively to prevent hallux valgus deformity.
- If a hallux realignment procedure was also performed, use a taping technique for 4 to 6 weeks similar to a bunion procedure.
- Reapproximate the skin edges with a 3-0 nylon suture and dress the wound with a bunion dressing, with the hallux protected in plantarflexion and in mild varus.
- The patient is provided with a firm-soled postoperative shoe and allowed immediate heel weight bearing.

OUTCOMES

- Hallux malalignment with resultant claw toe and cock-up deformity after tibial sesamoid excision have been described.
- Historical studies have found that a 10% to 42% incidence of hallux valgus and a 33% to 60% incidence of loss of motion on follow-up.
- Kaiman and Piccora also reviewed tibial sesamoidectomies and concluded that assessment of the osseous relationship was crucial to prevent hallux valgus deformity. Their average follow-up was only 13.2 months and they found no evidence of valgus drift, but they recommended tendon balancing or capsulorrhaphy in conjunction with the tibial sesamoidectomy.
- Van Hal et al found no evidence of deformity or diminished range of motion.
- Lee et al reported on 20 patients without preoperative malalignment and noted no significant difference in postoperative ROM or the development of subsequent hallux malalignment.
- Saxena and Krisdakumtorn reported on active individuals who had isolated tibial sesamoidectomies.
- One patient developed loss of hallux flexion after surgery. Two patients with hallux valgus deformity were identified before surgery. One patient had a concomitant distal metatarsal osteotomy with no further drift, while the other patient did not have a concomitant procedure at the same time and went on to a bunion correction at a later date.
- Inge and Ferguson and Mann et al found that 41% to 50% of their patients continued to have mild to severe pain after a tibial sesamoidectomy. More recently, however, Van Hal et al, Saxena and Krisdakumtorn, and Lee et al have reported excellent pain relief in the majority of their patients with tibial sesamoidectomies in their athletic population.
- Aper et al showed in two cadaveric studies that the FHB effective tendon moment arms are significantly decreased with...
the excision of both hallux sesamoids. However, FHL effective tendon moment arms are noted to be diminished with isolated sesamoid excisions as well.² These studies may help to explain the functional weakness reported by Mann et al.¹¹ However, Van Hal et al.¹⁵ and Saxena and Krisdakumtorn¹⁴ have not found any functional weakness of plantarflexion in any of their patients. Their patients were also able to return to their previous level of athletic participation with no functional deficit. Lee et al.¹⁰ also reported that 30% of their patients could not do a single-limb toe raise, indicating some plantarflexion weakness, but this did not affect any subsequent athletic activity.

COMPLICATIONS

- Complications related to tibial sesamoid excisions can be separated into intraoperative complications, insufficient pain relief, functional weakness, and hallux malalignment.
- The most common intraoperative complication reported is injury to the plantar digital nerve. Patients typically complain of nerve irritation postoperatively. This generally responds well to observation or localized steroid injections. It occurs more commonly with fibular sesamoid excisions.
- Complete laceration of the nerve has never been reported, and this nerve irritation appears to be the result of aggressive retraction during surgery. This can be avoided by using meticulous technique with identification and protection of the plantar digital nerve during surgery.
- Isolated complete sesamoidectomies are thought to alter the mechanical balance of the hallux MTP joint. Clinical studies have described stiffness, functional loss, cock-up deformity, claw toe deformity, and the development of a hallux valgus deformity after isolated tibial sesamoidectomies.⁸,⁹,¹¹,¹²
- As noted earlier, identifying and addressing any significant malalignment of the hallux MTP can decrease the rate of future deformities.

- The loss of single-limb toe raise has also been reported and may be related to the decreased moment arm and inadequate repair of the FHB complex.¹⁰

REFERENCES

AUTHOR’S QUERY

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