Dorsolateral Excision of the Fibular Sesamoid: Technique and Results

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Background: Injuries to the hallux sesamoid complex are uncommon, but they can cause significant pain. The medial sesamoid is the most common site of pain, but the fibular sesamoid can also become symptomatic. The most common clinical entities that lead to chronic fibular sesamoid pain are fracture nonunion and osteonecrosis. The purpose of this study was to describe the technique and determine the results of the dorsolateral approach for fibular sesamoid excision.

Methods: During an 11-year span, 8 patients underwent fibular sesamoidectomy using a dorsolateral approach after a minimum of 6 months of nonoperative treatment. The mean age was 33 years (range, 22 to 43 y). The average follow-up was 97 months (range, 24 to 167 mo). Patients were assessed using the AOFAS forefoot grading scale and a subjective rating for walking, pain, and overall satisfaction.

Results: Fibular sesamoidectomy was performed for osteonecrosis in 3 patients and for nonunion in 5 patients. Four patients had work-related injuries. Two injuries were due to trauma and the rest were chronic, without a known cause. The average length of nonoperative care was 107 weeks and included rest, injections, physiotherapy, bracing, casting, NSAIDs, and orthotics. Overall, the patient subjective satisfaction was 5 excellent and 3 good. The mean AOFAS forefoot score was 91 and average time to return to activity was 15 weeks. The mean pain rating was 1.3/5, and the mean subjective walking score was 4.625/5.

Discussion: Compared with previously published reports, our results for isolated fibular sesamoidectomy show similar satisfaction rates with equivalent time to return to activities and a low complication rate while avoiding a plantar incision.

Level of Evidence: Diagnostic Level 3. See Instructions for Authors for a complete description of levels of evidence.

Key Words: dorsolateral fibular sesamoid excision, hallux, sesamoid fractures

After participating in this CME activity, physicians should be better able to:
1. Diagram the anatomy of the great toe MTP joint and sesamoid complex.
2. Evaluate a chronically painful sesamoid clinically as well as radiologically to assess the treatment alternatives.
3. Explain the dorsal surgical approach to removing the lateral sesamoid to improve patient function.

HISTORICAL PERSPECTIVE

The sesamoid bones of the hallux have long been recognized as an essential component of human anatomy. Named after the ancient Greek word for sesame seed, “sesamoedes,” the ancient Hebrews believed the sesamoids were indestructible and thus the center of individual resurrection. More recently it has become apparent that these structures are far from “indestructible,” and, in fact, play an important role in the mechanics of the hallux. The sesamoid complex is centered over the plantar aspect of the metatarsal phalangeal (MTP) joint of the great toe. The ossification of the hallux sesamoids begins in the eighth year of life from multiple ossification centers. Bipartite and tripartite sesamoids form if the ossification process is not completed. Imbedded in the flexor hallucis brevis (FHB) and supported medially and laterally by the abductor and adductor hallucis tendons, the sesamoid complex transmits up to 50% of body weight during stance, and as much as 300% body weight with push off. The larger tibial sesamoid is within the medial head of the FHB and the smaller fibular sesamoid is within the lateral head. The average size of the tibial sesamoid is 12 to 15 mm and fibular is 10 to 12 mm. The tibial and fibular sesamoids are connected by a thick interfosseal ligament, but they can cause significant pain. The medial sesamoid is the most common site of pain, but the fibular sesamoid can also become symptomatic. The most common clinical entities that lead to chronic fibular sesamoid pain are fracture nonunion and osteonecrosis. The purpose of this study was to describe the technique and determine the results of the dorsolateral approach for fibular sesamoid excision.
which is the central component of the plantar plate of the first MTP joint. There are also medial and lateral phalangeosesa-
moid and metatarsosesamoid ligaments which attach to the ti-
bial and sesamoid, respectively, and will form a portion of the plantar plate as well. The flexor hallucis longus (FHL) tendon courses between the sesamoids, dorsal to the inter-
seamoid ligament (Fig. 1). This anatomy can cause confusion when attempting to ascertain the source of hallucal pain. Fortunately, patients with FHL pathology can be dis-
tinguished from those with purely sesamoidal pain using the Passive Axial Compression test as well as clinical findings of pain throughout the entire course of the FHL. This maneuver should be specific for the sesamoids as all soft tissues about the plantar aspect of the first metatarsophalangeal joint are in a relaxed position. The Passive Axial Compression test is performed with the patient in a seated position with the affected leg extended. After the sesamoids are carefully pal-
pated, the hallux is maximally dorsiflexed at the MTP joint, which will cause distal migration of the sesamoids. The index finger of the examiner is then used to apply compression just proximal to the sesamoids. If the test is positive, the patient’s symptoms are reproduced with passive plantar flexion of the MTP joint.

The primary extrasosseous blood supply of the sesamoids is derived from the posterior tibial artery. At its distal extent, the posterior tibial artery divides to form the medial plantar artery and a contributing vessel to the plantar arch. The plantar arch directly provides the main blood supply to the sesamoids in 25% of the population. The medial plantar artery is the primary supply in another 25%, whereas 50% receive their supply from both. Regardless of the vessel or vessels that enter the sesamoids, there is further division of the branches after they enter the sesamoid from its proximal pole. The intrasosseous blood supply is 3-fold. The main contribution is from the sesamoid arteries that enter both sesamoids from the proximal pole through a single vessel. Usually, a single ses-
amoid artery supplies each sesamoid, although 2 or 3 have been described in some patients. The second contributors are nonarticular vessels that enter the sesamoids from a plantar direction. Small vessels from the medial and lateral capsular attachments provide the third source of circulation. In summary, the majority of the blood supply comes from a proximal plantar direction, with little collateral flow, potentially leading to chronic nonunion or osteonecrosis if this system is disrupted.

The medial plantar digital nerve courses over the medial border of the tibial sesamoid and the common digital nerve of the first web space lies beneath the transverse inter-
metatarsal ligament, near the fibular sesamoid. Both of these structures can be involved in pain-generating nerve impinge-
ments and must be avoided during surgery involving the sesamoids.

The sesamoids function to increase the moment arm of the great toe flexors and cushion the MTP joint, dispersing the impact on the metatarsal head. The majority of the impact seems to be taken by the larger tibial sesamoid as it is more often injured. Because of their function as a “shock absorber” as well as a force transducer, they are prone to both impact and chronic overuse injury. The hallucal sesamoid complex is involved in 9% of foot injuries and 1.2% of all running injuries.

Indications and Contraindications
Disorders of the sesamoid include: congenital variations, pathology involving hallux valgus and metatarsus primus varus, systemic disorders, infection, trauma (acute fracture and chronic nonunion), osteochondritis, and osteonecrosis.

Partition of the sesamoid occurs in 7.8% to 33.5% of the population (medial 10% more common than lateral). Eighty-five percent are bilateral. Fracture of a bipartite sesamoid can go unnoticed and lead to chronic pain/nonunion. Fractures can be caused by a fall from a height or forceful dorsiflexion of the MTP joint resulting in a transverse fracture pattern. Most fractures/ chronic overuse injuries are treated conservatively, but chronic, painful, nonunion/osteonecrosis can occur, leading to the need for excision versus open reduction internal fixation.

Preoperative Planning
Confirming the sesamoid as the source of pain requires a complete history, physical examination, x-ray, and often other modalities to include magnetic resonance imaging (MRI), computed tomography (CT), or bone scan (Fig. 2).

As the majority of pathology is in the tibial sesamoid, there are few series of fibular sesamoidectomies, the largest of which involves 10 cases. Many of these are in combi-
nation with tibial sesamoidectomies. In addition, some authors advocate a plantar approach for lateral sesamoid excision, but Coughlin et al cautioned about a painful scar. Because of our concern for a persistently painful postoperative scar, we have used the dorsolateral approach. The purpose of this study was to describe the technique and determine the results of the dorsolateral approach for lateral sesamoid excision.

Our hypothesis was that the dorsal approach for excision of a lateral sesamoid provided excellent results with few complications.

MATERIALS AND METHODS
During an 11-year span, 8 patients underwent fibular sesamoidectomy by a single surgeon through a dorsolateral approach. All patients failed a prolonged period of nonoperative treatment (at least 6 mo) including rest, injections, bracing, casting, physical therapy, NSAIDs, and orthoses. The mean age at surgery was 33 years (range, 22 to 43 y). There were 4 females.
and 4 males (mean age 32 and 34 y, respectively). The mean follow-up range was 97 months (range, 24 to 167 mo). The incidence of pain and neurological symptoms as well as MTP flexion strength loss was noted before surgery.

At a minimum of 24 months postoperatively, all patients were evaluated using 3 subjective rating scores including subjective evaluations of: pain, walking ability, and overall satisfaction. Pain was rated on a 1 to 5 scale; 1 being no pain.

TABLE 1. Overall Patient Subjective Satisfaction

<table>
<thead>
<tr>
<th>Rating (Points)</th>
<th>Specifications</th>
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<tbody>
<tr>
<td>Excellent (5)</td>
<td>Without problems, very satisfied, mild or no pain, walk without difficulty</td>
</tr>
<tr>
<td>Good (4)</td>
<td>A few problems, satisfied, mild pain, walks without difficulty, would still have had surgery</td>
</tr>
<tr>
<td>Fair (3)</td>
<td>Moderate pain, limited walking, reservations about success of surgery</td>
</tr>
<tr>
<td>Poor (2)</td>
<td>Continued pain, little improvement in walking ability, regrets surgery</td>
</tr>
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</table>

Patients were asked to evaluate their overall satisfaction as: poor, fair, good, or excellent based on the criteria in the table. Points were assigned as indicated in parentheses.
and 5 being severe pain. Walking ability was also rated on a 1 to 5 scale. A patient that was housebound was awarded 1 point, whereas patients with significant, moderate, mild, and no limitation were given 2, 3, 4, and 5 points, respectively. The subjective overall satisfaction rating is outlined in Table 1.

Patients were also evaluated postoperatively with the AOFAS hallux/great toe rating system. Mean scores for all 3 subjective scoring systems and the AOFAS rating system for all patients were calculated using a 2-tailed Student t test. The workers’ compensation and nonworkers’ compensation for the 3 subjective ratings were then compared. Postoperative radiographs (AP and lateral weight bearing, oblique, and sesamoid views) were also obtained at this time to ascertain overall hallux alignment and alignment of the sesamoid complex.

**Surgical Technique**

A 3 cm incision was made dorsally in the first intermetatarsal web space. Soft-tissue retraction was provided using sutures and hemostats to avoid excessive force on the fragile dorsal skin of the foot (Fig. 3). After careful dissection through the subcutaneous tissue, a laminar spreader was placed to spread the first and second metatarsals. Care was taken to avoid damage to the common digital nerve below the intermetatarsal ligament. The adductor tendon/joint capsule complex was detached subperiosteally from the metatarsal and the base of the proximal phalanx (midway between the dorsal and plantar aspects of the MTP joint) exposing the MTP joint and fibular sesamoid (Fig. 4). A cuff of tissue was left on the metatarsal and the proximal phalanx for later reattachment.

A stitch was then placed in the lateral capsule to retract it laterally to assist in exposure of the fibular sesamoid. A Beaver blade (ref. 376900) was used to first release the intersesamoid ligament from the medial side of the fibular sesamoid before releasing the lateral proximal and distal attachments (Fig. 5). It is critical to avoid releasing the lateral attachment first to prevent retraction of the lateral sesamoid under the metatarsal head.

The sesamoid was fully excised using extreme caution to avoid injuring the FHL. Often this requires a “shelling out” of the bed in which the sesamoid lays as it may be crushed into several pieces (Fig. 6). An x-ray was then taken to verify toe alignment and complete excision of the fibular sesamoid. The image intensifier was brought in from the contralateral side and 25 degrees of axial tilt toward the foot was used to recreate the sesamoid view. The surgeon used a freer elevator to dorsiflex the great toe while leaving the foot in approximately 30 degrees of plantar flexion (Fig. 7). This axial view (Walter-Muller view), in conjunction with standard AP and oblique views of the foot, was used to confirm complete excision of the sesamoid. Following resection, the deep, plantar portion of the wound must be inspected to ensure the FHL has not been damaged. A stitch was used to close the fibular sesamoid defect if possible, with 3-0 absorbable suture. The adductor hallucis tendon/joint capsule complex was then

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**FIGURE 3.** The dorsolateral incision is made in the first web space of a right foot. Notice sutures and hemostats are used for soft-tissue retraction to avoid excessive force on the skin and soft tissues.

**FIGURE 4.** Dorsal approach for a fibular sesamoid excision in a right great toe. A, Care must be taken during dissection to avoid damage to the common digital nerve below the intermetatarsal ligament. B, The adductor tendon/joint capsule complex is detached subperiosteally exposing the MTP joint and fibular sesamoid (Copyright, Richard D. Ferkel).
reapproximated to the previously left cuff of tissue at the base of the proximal phalanx and distal metatarsal with 2-0 absorbable suture. Skin closure was accomplished with 5-0 interrupted nylon suture.

**Postoperative Management**

The foot was bandaged carefully to provide good compression and to prevent varus drift. Postoperatively, the patients were immobilized in a short leg cast that completely covered the great toe, with limited weight bearing for the first 2 weeks and then placed in a walking cast for an additional 2 weeks. At 4 weeks, they were placed into a controlled active motion walking boot. At 6 weeks, they were placed into a stiff-soled shoe with a full-length semirigid orthotic with a Morton extension, and began physical therapy. All activities, including sports, are resumed after the patient completes phases 1 to 4 rehabilitation and the orthotic is worn at all times. Phase 1 includes immediate postoperative care, phase 2 is direct foot and ankle intervention, phase 3 is restoration of activities of daily living, and phase 4 is sports-specific or work-specific training.

**RESULTS**

Our patient population included 4 males and 4 females. Fibular sesamoidectomy was performed for osteonecrosis in 3 patients and fracture nonunion in 5 patients. Four patients (2 male and 2 female) had work-related injuries. Two injuries were due to trauma and all others were chronic in nature without a known cause. All patients underwent nonoperative treatment before surgery. The average length of nonoperative care was 107 weeks for both males and females (time from first presentation to surgery) and included: physiotherapy (1 patient), boots/casts (4 patients), NSAIDS (6 patients), injections (1 patient), and orthotics (6 patients).

Preoperative examination revealed 1 male and 1 female had some MTP flexion strength loss and 3 females experienced nerve symptoms of tingling on the lateral toe from the common digital nerve. All patients had plantar pain with walking and activities. Only 1 female patient had dorsal pain, whereas 3 females and 1 male had start-up pain. Only 1 female had dorsal pain.
tenderness to palpation (TTP) on physical examination, the remainder had only plantar TTP. Three patients had a positive Tinel sign over the first web space, whereas 4 had MTP motion loss. The number and positive findings of x-rays, bone scans, MRIs, and CT scans are shown in Table 2. Not all patients received all tests. Fewer bone scans have been performed in recent years. CT is performed to further delineate possible fractures and MRI is performed to assess edema and sesamoid circulation.

Postoperatively, in all patients, MTP flexion strength was normal and nerve symptoms resolved. The preoperative strength deficit was due to pain at the MTP joint. The mean AOFAS hallux/MTP score was similar in males and females (90 and 92, respectively). The overall mean AOFAS score was 91. Workers’ compensation claims had no effect on AOFAS score (92 for workers compensation; 90 for nonworkers compensation). Two males and 1 female rated their satisfaction level as good, whereas a total of 5 individuals (2 males and 3 females) rated their satisfaction level as excellent with a full return to function. According to the 3 subjective rating scales, pain was rated at a mean of 1.3 of 5, and mean walking and overall satisfaction scores were both 4.63 of 5 (Table 3). There were no differences between workers’ compensation and nonworkers’ compensation patients with regard to walking and overall satisfaction. Pain scores were lower for workers’ compensation patients than for nonworkers’ compensation patients (P=0.02) (Table 3). The average return to activity was 15 weeks (12 wk in males and 17 wk in females). The x-ray findings postoperatively showed no varus or valgus drift and anatomic positioning of the remaining tibial sesamoid in all patients. No patients underwent additional surgery, and no one had complaints of pain in the tibial sesamoid.

Complications
No complications occurred in any of our patients in this study. There were no cases of loss of motion, delayed wound healing, varus drift, or nerve symptoms.

DISCUSSION
There are very few studies that examine sesamoidectomy for chronic sesamoid pain, and even fewer that document significant numbers of fibular sesamoidectomies.2,4,10,19–23 To the best of our knowledge, this is the first paper to study isolated fibular sesamoidectomy through a dorsolateral approach. As we have previously described, Mann et al,21 at the 1985 AOFAS meeting, reported on 13 tibial and 8 fibular sesamoidectomies. Fifty percent of all patients (tibial and fibular) had complete pain relief. Of the remaining 50%, three fourths of those had only occasional or mild symptoms. Plantar

<table>
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<th>TABLE 2.</th>
<th>The Incidence of Imaging Studies Performed on the 8 Patients in the Study is Listed Along With the Incidence of Significant Findings in the Studies Performed</th>
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<tbody>
<tr>
<td>Patient</td>
<td>X-ray Findings/#Done</td>
</tr>
<tr>
<td>Male</td>
<td>3/4</td>
</tr>
<tr>
<td>Female</td>
<td>3/4</td>
</tr>
<tr>
<td>Total</td>
<td>6/8</td>
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<tr>
<th>TABLE 3.</th>
<th>Mean Values Obtained From the 3 Subjective Rating Scales Separated Into Workers’ Compensation Patients and Nonworkers’ Compensation Patients</th>
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<tbody>
<tr>
<td></td>
<td>Pain (1-5)</td>
</tr>
<tr>
<td>Total</td>
<td>1.30</td>
</tr>
<tr>
<td>Work compensation</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonwork compensation</td>
<td>1.75</td>
</tr>
<tr>
<td>P</td>
<td>0.02</td>
</tr>
</tbody>
</table>

P-values for workers’ compensation versus non-workers’ compensation in the 3 categories are also displayed.
flexion weakness was seen in 60% and 10% had drift into varus or valgus. We had no planter flexion weakness and no drift into varus or valgus. Our overall satisfaction, however, was similar to Mann’s findings, with 5/8 being completely satisfied and the remaining 3 with only mild or occasional symptoms.

Saxena et al reported on 26 sesamoidectomies in 24 athletic and active individuals. Ten patients had excision of the lateral sesamoid with the approach dorsolateral in 7 and plantar in 3. All patients returned to their previous level of activity. Athletes returned in 7.5 weeks and active patients in 12 weeks. Although only 5/8 of our patients returned to full activity and did so at a later date than patients in Saxena and colleagues’ study, the remaining 3 would have the surgery again, and there were no complications. Complications in Saxena and colleagues’ study included 2 cases of postoperative scarring with neuroma-like symptoms and 1 case of hallux varus in fibular sesamoidectomies. One case of hallux valgus occurred after tibial sesamoidectomy. Interestingly, complications were higher with the dorsal than the plantar approach for fibular sesamoidectomy. More recently, Waizy et al reported on 2 patients with at least 2-year follow-up after fibular sesamoid excision using a plantar approach with excellent clinical and radiologic results.

Whereas Mann et al,21 and classically, Inge and Furguson,2 noted loss of both flexion strength and cock-up deformity, Van Hal et al23 noted no loss of strength and no cock-up deformity. Reportedly, Van Hal and colleagues’ results were due to careful reapproximation of the adductor/abductor as well as maintenance of the joint capsule. As an attempt to further preserve the “normal” anatomy, Biedert24 did only a partial sesamoid excision for chronic stress fractures in athletes. The 5 athletes treated all returned to their previous level of activity by 6 months, and the average AOFAS score was 95.3 of 100. Our AOFAS scores were slightly lower (91/100), but we had a slightly faster return to activity (average of 14 wk) with all dorsal approaches. In our series we had 2 professional dancers treated with dorsolateral sesamoid excision. One dancer returned to her previous level, but is now limited after a shoulder injury that led to chronic instability. The remaining dancer was much improved and can function well with activities of daily living, but was unable to return to professional dancing and thus made a career change.

Another option for fibular sesamoidectomy is the medial approach described by Pinto and colleagues in 2010. This approach has the advantage of being familiar to most foot and ankle surgeons, as well as allowing the incorporation of a medial capsulorrhaphy, which can both the development of postoperative hallux varus deformity.

Alternatively, the fibular sesamoid can be approached through a plantar incision. To help avoid painful scar formation, the plantar approach is made through the intermetatarsal space rather than directly plantar to either the metatarsal head or the sesamoid. The incision is made slightly curvilinear on the border of the hallucal metatarsal fat pad, beginning distally near the tibial side of the second toe and the distal extent of the metatarsal fat pad. The lateral plantar digital nerve of the halluc is found on the fibular side of the sesamoid or directly over the fibular sesamoid. This nerve should be identified and protected to avoid injury.

Even with meticulous surgical technique, postoperative scarring or keloid formation can still occur directly beneath the metatarsal or sesamoid which can cause intractable pain. The skin incision may heal, but the underlying fatty tissue can atrophy over a short period and leaves the patient with inadequate cushioning on the plantar aspect of the foot. This complication can be easily avoided with an alternate incision for excision of the sesamoid.

Although all of our patients felt they were improved, and no complications occurred, the total number of those who returned to their former activity level was only 5 of 8. A possible explanation for the lack of total satisfaction of all patients could be the extensive length of nonoperative treatment, especially for those with nonunions. This may have manifested as altered biomechanics that subsequently led to chronic pain following surgery.

Chronic pain at the surgical incision site is a potential complication of this surgery. This can also occur with the plantar approach to the sesamoids, particularly when the incision is centered directly under the sesamoids or the metatarsophalangeal joint. We believe the dorsolateral approach allows for access to the fibular sesamoid without the risk of a potentially painful plantar incision which can lead to chronic pain after surgery. The common digital nerve of the first and second intermetatarsal space can be injured with the dorsolateral approach to the fibular sesamoid. Care must be taken during dissection to ensure that these neurovascular structures are seen and protected to prevent painful neuromas in the postoperative period.

CONCLUSIONS

Fibular sesamoid pain is usually successfully treated nonoperatively using a combination of physical therapy, NSAIDs, orthotics, and activity/shoe modifications. When pain persists, a fibular sesamoidectomy through a dorsolateral approach can yield a high percentage of excellent-good results with minimal complications. However, patients should be cautioned about residual pain, development of hallux varus deformity, stiffness, and an inability to return to their preoperative activities.

REFERENCES

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