

## PASIG MONTHLY CITATION BLAST: No.43

August 2009

Dear PASIG members:

Summer is rapidly winding down and many of us are making fall plans. We will continue to keep you posted of any PA-related continuing education.

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Performing Arts continuing education, courses, and related conferences.

Orthopaedic Section Independent Study Course Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers. This is a 6monograph course and includes many PASIG members as authors. This home study course can be purchased at <u>http://www.orthopt.org/independent2.php</u>.

International Association for Dance Medicine and Science (IADMS) 19th Annual Meeting October 29- November 1, 2009 The Hague, The Netherlands Contact: <u>www.iadms.org</u>

Combined Sections Meeting San Diego February 17 – 20, 2010 PASIG Programming to be announced. Contact: www.apta.org

If you know of other courses of interest to our membership, please send the information to: Amy Humphrey PT, DPT, OCS, MTC

e-mail: ahumphrey@bodydynamicsinc.com

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For this June Citation BLAST, I've selected the topic: *Great Toe Sesamoid Injuries.* The format is an annotated bibliography of articles on the selected topic from 1998 – 2008. The BLASTS and updated libraries are posted on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at <u>http://www.endnote.com</u>, including a 30-day free trial).

If you are interested in contributing a special topic citation blast, please step up! As always, your comments and suggestions are welcome. Please drop me an e-mail anytime.

Regards, Shaw

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## **Great Toe Sesamoid Injuries**

The sesamoids are tiny bones, but injury to one or both can greatly interfere with performance. During gait the sesamoid bones protect the FHL tendons, reduce friction, and absorb weight. With injury, ability to relevé or push off is curtailed. Sesamoid injuries include sesamoiditis, stress fractures, fractures, and can go on to nonunion or avascular necrosis. While conservative immobilization is effective in most cases, more aggressive options remain controversial. Hemi-resection and resection of the sesamoid may drastically reduce hallux push off due to a shortened lever arm. Therefore, expedited, accurate diagnosis and treatment are imperative.

Shaw Bronner PT, PhD, OCS ADAM Center, Long Island University

Allen MA, Casillas MM (2001). The passive axial compression (PAC) test: a new adjunctive provocative maneuver for the clinical diagnosis of hallucal sesamoiditis. Foot Ankle Int **22**(4): 345-6.

The authors describe a previously unreported adjunctive passive provocative maneuver that has been found to clinically reproduce the intensity of symptoms in patients diagnosed with disorders of the sesamoids. This test is useful for the initial diagnosis as well as monitoring response to treatment.

Anderson RB, McBryde Jr AM (1997). Autogenous bone grafting of hallux sesamoid nonunions. <u>Foot Ankle Int</u> **18**(5): 293-6.

We first performed autogenous bone grafting for lesions of the hallux sesamoid in 1984. During the next 9 years, 21 patients (11 men and 10 women with an average age of 34 and 32 years, respectively) underwent this surgical procedure for symptomatic tibial hallux sesamoid non-unions. Successful bony union was achieved in all but two patients. The majority of patients obtained concomitant relief of preoperative symptomatology and returned to their preinjury level of activity. We believe that this procedure serves as an alternative to hallux sesamoid excision in selected cases.

Aper RL, Saltzman CL, et al. (1994). The effect of hallux sesamoid resection on the effective moment of the flexor hallucis brevis. <u>Foot Ankle Int</u> **15**(9): 462-70.

In this cadaver study, the functional significance of the hallux sesamoid bones was quantified by measuring the effective tendon moment arm (ETMA) of the flexor hallucis brevis (FHB) force. (The ETMA differs from the anatomic tendon moment arm in that ETMAs are determined by the experimentally measured moment of the tendon force, rather than by the actual location and orientation of the tendon pull in the joint). The intact case was compared with three levels of progressive sesamoid resection: distal half of the medial sesamoid excised, entire medial sesamoid excised, and both the medial and lateral sesamoids excised. Five dorsiflexion angles of the metatarsophalangeal joint were tested, ranging from -10 degrees to 50 degrees. A known active load was applied to the FHB muscle of fresh frozen cadaver specimens while the corresponding resisting forces from three orthogonally mounted transducers were being recorded. Results showed that the ETMAs decreased significantly (P < .05) only with the excision of both sesamoids. The percent decrease in ETMA was smallest at dorsiflexion angles of -10 degrees and 15 degrees (4.3% and 2.4%, respectively) and largest at dorsiflexion angles of 25 degrees, 35 degrees, and 50 degrees (29.2%, 22.4%, and 26.7%, respectively). The clinical significance of the results is that distal hemiresection of the medial sesamoid or full medial sesamoid excision is unlikely to appreciably compromise the effective mechanical advantage of the FHB muscle. However, this mechanical advantage may be profoundly diminished by excision of both hallux sesamoids.

Aper RL, Saltzman CL, et al. (1996). The effect of hallux sesamoid excision on the flexor hallucis longus moment arm. <u>Clin Orthop Relat Res</u>(325): 209-17.

Surgical treatments for chronic, painful hallux sesamoid disorders typically involve partial or complete resection of 1 or both sesamoids. Although these approaches generally result in satisfactory symptom relief, their effect on biomechanical function of the major hallux flexors is not completely understood. The effects of selective sesamoid resections on the effective tendon moment arm of the flexor hallucis longus tendon were evaluated. Twelve fresh frozen cadaver first rays were each mounted in a device that held rigid the metatarsal. A ramp-controlled displacement of an MTS ram supplied a functional load input force to the flexor hallucis longus force were transduced simultaneously by a multicomponent load cell. Subsequently, 3 progressively more extensive seasamoid resections were done: (1) distal hemiresection, (2) complete resection, and (3) resection of both sesamoids. Six specimens were tested with the medial sesamoid removed first and 6 with the lateral sesamoid removed first. Statistical analysis showed that significant decreases in the effective tendon moment arms occurred with full medial sesamoid resection, full lateral sesamoid resection, and resection of both the medial and lateral sesamoids.

Ashman CJ, Klecker RJ, et al. (2001). Forefoot pain involving the metatarsal region: differential diagnosis with MR imaging. <u>Radiographics</u> **21**(6): 1425-40.

Many disorders produce discomfort in the metatarsal region of the forefoot. These disorders include traumatic lesions of the soft tissues and bones (eg, turf toe, plantar plate disruption, sesamoiditis, stress fracture, stress response), Freiberg infraction, infection, arthritis, tendon disorders (eg, tendinosis, tenosynovitis, tendon rupture), nonneoplastic soft-tissue masses (eg, ganglia, bursitis, granuloma, Morton neuroma), and, less frequently, soft-tissue and bone neoplasms. Prior to the advent of magnetic resonance (MR) imaging, many of these disorders were not diagnosed noninvasively, and radiologic involvement in the evaluation of affected patients was limited. However, MR imaging has proved useful in detecting the numerous soft-tissue and early bone and joint processes that occur in this portion of the foot but are not depicted or as well characterized with other imaging modalities. Frequently, MR imaging allows a specific diagnosis based on the location, signal intensity characteristics,

and morphologic features of the abnormality. Consequently, MR imaging is increasingly being used to evaluate patients with forefoot complaints. Radiologists should be familiar with the differential diagnosis and MR imaging features of disorders that can produce discomfort in this region.

Biedert R, Hintermann B (2003). Stress fractures of the medial great toe sesamoids in athletes. <u>Foot Ankle Int</u> **24**(2): 137-41.

The purpose of this study was to determine whether specific symptoms and findings are present in patients with symptomatic stress fractures of the sesamoids of the great toe and, if so, whether partial sesamoidectomy is sufficient for successful treatment. Five consecutive athletes (five females; mean age 16.8 years [range, 13 to 22 years]) with six feet that were treated for symptomatic stress fractures of the sesamoids of the great toe were included in this study. Four athletes (five feet) performed rhythmic sports gymnastics; the fifth athlete was a long jumper. Some swelling to the forefoot and activity-related pain that increased in forced dorsiflexion, but disappeared at rest was found in all patients. While plain X-rays evidenced fragmentation of the medial sesamoid, MRI (n=2) and frontal plane CT scan (n=3) did not always confirm the diagnosis, but bone scan (n=3) and axial as well as sagittal CT scan were useful to detect the pathology. After failure of conservative treatment measures, surgical excision of the proximal fragment was successful in all patients, and there were no complications. All patients were pain free and regained full sports activity within six months (range, 2.5 to six months). At final follow-up which averaged 50.6 months (range, 20 to 110 months), the overall clinical results were graded as good/excellent in all patients, and there was only one patient with of restriction sports activities. The obtained AOFAS-Hallux-Score was 95.3 (75 to 100) points. Apparently, stress fractures occur more often at the medial sesamoid, and females are mainly involved. When a stress fracture is suspected, bone scan and CT scan are suggested as more reliable in confirming the diagnosis than other imaging methods. When conservative treatment has failed, surgical excision of the proximal fragment is recommended.

Blundell CM, Nicholson P, et al. (2002). Percutaneous screw fixation for fractures of the sesamoid bones of the hallux. J Bone Joint Surg Br **84**(8): 1138-41.

Over a period of one year we treated nine fractures ofhe sesamoid bones of the hallux, five of which were in the medial sesamoid. All patients had symptoms on exercise, but only one had a recent history of injury. The mean age of the patients was 27 years (17 to 45) and there were six men. The mean duration of symptoms was nine months (1.5 to 48). The diagnosis was based on clinical and radiological investigations. We describe a new surgical technique for percutaneous screw fixation for these fractures using a Barouk screw. All the patients were assessed before and after surgery using the American Orthopaedic Foot and Ankle Society Hallux Score (AOFAS). There was a statistically significant improvement in the mean score from 46.9 to 80.7 (p = 0.0003) after fixation of the fracture with a rapid resolution of symptoms. All patients returned to their previous level of activity by three months. We believe that this relatively simple technique is an excellent method of treatment in appropriately selected patients.

Bronner S, Novella T, et al. (2007). Management of a delayed-union sesamoid fracture in a dancer. J Orthop Sports Phys Ther **37**(9): 529-40.

BACKGROUND: Misdiagnosed o sesamoid bone pathology in dancers may result in prolonged pain, disability, and career limitation. A thorough understanding of sesamoid disorders and appropriate treatment facilitates timely recovery. The potential loss of hallux plantar flexion strength consequent to sesamoidectomy is a major consideration for dancers. CASE DESCRIPTION: An 18-year-old dance student sustained a delayed-union fracture of

her lateral (fibular) sesamoid. Treatment included an inductive coupling external bone stimulator with pulsed electromagnetic field, activity, and weight-bearing restrictions, protective padding, strengthening, functional retraining, and progressive return to dance. OUTCOME: Following use of an external bone stimulator for 12 months, the dancer successfully returned to her previous level of dancing. Repeated SF-36 and Dance Functional Outcome System scores confirmed this improvement. DISCUSSION: Loss of hallux plantar flexion strength with sesamoid resection can be devastating to a dancer who requires push-off strength for multiple turns and jumps. Treatment with bone stimulation was therefore selected over more invasive measures. The dancer was compliant with systematic functional progression. Improvement, as seen on radiographs and outcome scores, accompanied her full functional recovery.

Carro LP, Llata E, et al. (1999). Arthroscopic medial bipartite sesamoidectomy of the great toe. Journal of Arthroscopic and Related Surgery **15**(3): 321-323.

This is the first report of a successful first metatarsophalangeal joint medial bipartite sesamoidectomy using great toe arthroscopy. The surgical trauma associated with open operative sesamoidectomy can be minimized using minimally invasive techniques under arthroscopic control. The authors describe the surgical principles and discuss the advantages compared with traditional surgery.

Chilvers, M., M. Donahue M, et al. (2007). Foot and ankle injuries in elite female gymnasts. <u>Foot</u> <u>Ankle Int</u> **28**(2): 214-8.

BACKGROUND: Gymnastics is a competitive and popular sport that is started at an early age, and elite female gymnasts reach their prime in mid-teenage years. The level of intensity of practice and competition, the number of events, and the degree of difficulty of the maneuvers make gymnastics one of the most injury-producing sports. METHODS: Over a 3-year period, 14 elite, female gymnasts were seen in one foot and ankle center. The mean age was 17 (range 14 to 21) years. All gymnasts sustained acute or sub-acute injuries to the foot or ankle requiring surgery. The mechanism of injury, the type of injury, operative repair, and followup were recorded. RESULTS: There were five Lisfranc fracturedislocations, and five talocalcaneal, two multiple metatarsal, one medial malleolar, one phalangeal, and one sesamoid fracture. All injuries had operative repair. One gymnast with a Lisfranc injury was able to return to full competition; all others with a Lisfranc injury retired from gymnastics, were lost to followup, or graduated from college. One gymnast with a talar osteochondral injury was not able to return to competition but all other injured gymnasts were able to return to gymnastics at the same level or higher. CONCLUSION: Elite female gymnasts can sustain significant injury to the foot and ankle region. In our study, Lisfranc injuries were most likely career-ending.

Chou LB (2000). Disorders of the first metatarsophalangeal joint: diagnosis of great-toe pain. <u>Physician & Sportsmedicine</u> **28**(7): 32-6, 41-2, 45

Disorders of the joint at the base of the hallux are common in active patients. Great-toe sprains (turf toe) can range from mild to severe with associated fractures. Hallux rigidus, a painful flexion deformity, is often seen in athletes who stress the joint repetitively. Heredity may predispose athletes to hallux valgus (bunion) but improper footwear, injury, and hyperpronation can also be implicated. Weight-bearing activities, climbing stairs, or wearing high-heeled shoes will aggravate sesamoiditis. Stress fractures, osteochondral defects, and gout are other causes of toe pain. X-rays are essential for accurate diagnosis. Nonoperative measures can reduce pain, but surgery is an option for recalcitrant cases.

Churchill RS, Donley BG (1998). Managing injuries of the great toe. <u>Physician & Sportsmedicine</u> **26**(9): 29-36, 39, 69-71

Most of the common great-toe injuries that affect active people are self-limiting and easily treated if detected early. Reviewed here are the causes, symptoms, diagnosis, and treatment of hallux valgus, turf toe, hallux rigidus, sesamoid dysfunction, nail abnormalities, dislocations and fractures, calluses, and blisters. Conservative treatment will usually enable patients to return to activity relatively quickly. Continued disability may require referral to an orthopedist.

Cortes ZE, Baumhauer JF (2004). Traumatic lateral dislocation of the great toe fibular sesamoid: case report. <u>Foot Ankle Int</u> **25**(3): 164-7.

Traumatic dislocation of the hallucal sesamoids is uncommon. This case involves a 17-yearold female driver involved in a head-on collision who sustained traumatic lateral dislocation of the fibular sesamoid associated with intersesamoidal ligament disruption, partial plantar plate avulsion, and impaction fracture of the metatarsal head. The diagnosis was delayed due to incorrect interpretation of initial radiographs. In addition, the severity of the soft-tissue injury was not appreciated, possibly further delaying the diagnosis. The patient was treated with open reduction of the fibular sesamoid and reconstruction of the intersesamoidal ligament. Eight months after surgery, she had mild persistent symptoms, decreased range of motion, and near full resumption of prior activities.

Davies MB, Abdlslam K, et al. (2003). Interphalangeal sesamoid bones of the great toe: an anatomic variant demanding careful scrutiny of radiographs. <u>Clin Anat</u> **16**(6): 520-1.

We describe a patient who was found to have two sesamoid bones at the interphalangeal joint of the right great toe after radiographs for dislocation of the joint. Recognition of the sesamoids required careful scrutiny of the films. Interphalangeal sesamoids may cause painful callosities plantar to the joint or may become incarcerated in a dislocated joint. Our patient made a good recovery. The presence of sesamoid bones on the medial and lateral sides of the joint was unusual.

Efe T, Endres S, et al. (2004). Osteonecrosis of the medial sesamoid bone of the big toe. <u>Manuelle Therapie</u> **8**(3): 123-126.

In this case-report, a 28 years old woman, occupation apothecary, complained of repeated persistent pain in her right big toe joint, which she first experienced, during a dancing tournament injury 2 years ago. After seeing an orthopaedic doctor, the diagnosis of a fore foot contusion with a Tripartitum in the area of the medial **sesamoid** bone of the big toe was made. After frustrative, time consuming conservative therapy (analgetica, weight relief and physical therapy), the patient visited our office for consultation. Our clinical examination showed a local plantar pressure pain in the area of the medial sesamoid bone of the right big toe. The x-ray examination showed a Norm-variation in the sense of the Tripartitum of the medial sesamoid bone. The CT pictures also showed a possible Norm-variant. The skeletal scintigraphy showed nothing extraordinary. The MRT pictures showed however, the typical marrow-bone signal was missing in the area of the medial **sesamoid** bone. As a result that no pain relief had been achieved through previous therapy, a partial removal of the sesamoid bone, with resurfacing of the rest of the sesamoid bone was performed. The histological analysis showed an osteonecrosis. Now, behind a Norm-variant in the sense of a Tripartitum an osteonecrosis can hide. Axel Renander first wrote, in 1924, about the sesamoid bone necrosis of the large toe. Especially afflicted are young woman aged 18-30. Persistent pain after excessive conditions, or after an accident, the possibility of osteonecrosis should be taken into consideration. Exact knowledge of Norm-variant for example, sesamoid bone, patella or foot bones are very important in defining osteonecrosis as well as fractures, for an adequate therapy. Helpful diagnoses are X-ray, MRT, CT, and skeletal scintigraphy. The initial *diagnosis* of the fore-foot contusion along with the additional finding of a Tripartitum led in this case report to the patient having 2 years of frustration and an unsuccessful therapy

Fleischli J, Cheleuitte E (1995). Avascular necrosis of the hallucial sesamoids. <u>J Foot Ankle</u> Surg **34**(4): 358-65.

The authors present a literature review and systematic approach to the diagnosis and treatment of avascular necrosis of the sesamoids of the flexor hallucis brevis tendon. Renander, in 1924, was one of the earliest authors to call attention to this condition. Since that time, many other authors have written about this entity, some even questioning its existence. Many different treatment regimes have been postulated, encompassing both the conservative and surgical modalities. Most literature advocates attempted conservative treatment followed by surgical excision, only if conservative methods fail.

Hockenbury RT (1999). Forefoot problems in athletes. <u>Med Sci Sports Exerc</u> **31**(7 Suppl): S448-58.

Athletes who participate in high-impact sports involving running, jumping, or contact are at risk for forefoot injury. These injuries occur as a result of acute trauma or chronic overuse. Some athletes may be predisposed to injury because of preexisting foot deformity, such as cavus, hallux valgus, or Achilles contracture. This article reviews the common causes of forefoot pain in the athlete. The most common causes of forefoot pain in the athlete are metatarsal stress fracture, interdigital neuroma, sesamoid pathology, metatarsalgia, hallux rigidus, hallux valgus, and turf toe. The pathophysiology, clinical presentation, and treatment of these conditions are discussed.

Hussain A (1999). Dislocation of the first metatarsophalangeal joint with fracture of fibular sesamoid. A case report. <u>Clin Orthop Relat Res</u>(359): 209-12.

Dorsal dislocations of the first metatarsophalangeal joint are classified by Jahss into two types. In Type 1, the hallux with the intact intersesamoid ligament dislocates dorsally over the metatarsal head. Such cases in the literature have been irreducible by closed manipulation. In Type 2 the hallux is dislocated dorsally with rupture of the intersesamoid ligament, resulting in wide separation of the sesamoids (Type 2A) or a transverse fracture of one or both sesamoids (Type 2B). The importance in classifying these injuries allows one to predict whether closed reduction will be successful as in Type 2. The patient reported had a fracture of the fibular sesamoid in addition to dislocation of the hallux. The clinical findings were consistent with Type 1 injury, including an intact intersesamoid ligament, but the radiographs showed, in addition to the dislocation, that there was a fracture of the fibular sesamoid. Reduction was achieved surgically through a dorsal approach. Although such injuries have been unreported previously, Type 1 injuries may be associated with a fracture of the fibular sesamoid but without rupture of intersesamoid ligament, so the injury reported is classified as Type 1A.

Jones JL Losito JM (2007). Tibial sesamoid fracture in a softball player. <u>J Am Podiatr Med</u> <u>Assoc</u> **97**(1): 85-8.

A single case of a tibial sesamoid fracture in a softball player is reported here. A review of the literature confirms that this is an unusual and difficult problem to treat in the athletic population given the significant loads placed on the sesamoids during athletic activity. In the case presented, conservative care was not effective, and the athlete underwent surgical excision of the fractured sesamoid. With use of a postoperative orthosis and cleat

modification, surgical management was successful and allowed the athlete to return to her athletic endeavors without restrictions in 8 weeks.

Julsrud ME (1997). Osteonecrosis of the tibial and fibular sesamoids in an aerobics instructor. <u>J</u> Foot Ankle Surg **36**(1): 31-5.

Osteonecrosis of the sesamoids is a fairly uncommon clinical entity. The development of this condition involving both sesamoids has never been presented in the American literature. After extirpation of the sesamoids and interdigital fusion, the patient returned to her regular activities, including dance.

Kanatli U, Ozturk AM, et al. (2006). Absence of the medial sesamoid bone associated with metatarsophalangeal pain. <u>Clin Anat</u>. 19(7):634-9.

Pain at the first metatarsophalangeal (MTP) joint can result from inflammation, chondromalacia, flexor hallucis brevis tendinitis, osteochondritis dessecans, fracture of a sesamoid bone, avascular necrosis of sesamoids, inflamed bursae, intractable keratoses, infection, sesamoiditis, gout arthropathy, and rheumatoid arthritis. Congenital absence of a sesamoid bone is extremely rare. We present a 17-year-old male patient with pain at the plantar aspect of the right MTP joint associated with congenital absence of the medial sesamoid. There was tenderness and the range of motion was minimally restricted. He described the pain as necessitating changes in his social life. On radiographs, the medial hallucial sesamoid was absent on the right side. The MTP joint was also evaluated using magnetic resonance imaging (MRI). A metatarsal pad was prescribed and the patient was satisfied with the treatment at the 2 months follow-up period. MRI revealed no pathological tissue at the medial sesamoid site. Hallucial sesamoids absorb pressure, reduce friction, protect the tendons, act like a fulcrum to increase the mechanical force of the tendons, and provide a dynamic function to the great toe by elevating first metatarsal head. Congenital absence of these bones is very rare but we must consider it in a patient with MTP joint pain.

Karasick D, Schweitzer ME (1998). Disorders of the hallux sesamoid complex: MR features. <u>Skeletal Radiol</u> **27**(8): 411-8.

Numerous painful conditions can affect the first metatarsophalangeal-sesamoid joint complex. Symptoms can be of sudden or insidious onset, and be of acute or chronic duration. Although conventional radiography is recognized as the initial diagnostic procedure for these symptoms, there is often a need to proceed to MR imaging. MR imaging is sensitive and can be utilized in the investigation of the hallux sesamoid complex to differentiate soft tissue from osseous pathology. Synovitis, tendonitis, and bursitis can be distinguished from bony abnormalities such as sesamoid fracture, avascular necrosis, and osteomyelitis. An understanding of MR imaging features and techniques will result in the highest diagnostic yield. Early and accurate diagnosis of sesamoid complex disorders can guide the physician to the appropriate clinical management and prevent potentially harmful longstanding joint dysfunction.

Lee S, James WC, et al. (2005). Evaluation of hallux alignment and functional outcome after isolated tibial sesamoidectomy. <u>Foot Ankle Int</u> **26**(10): 803-9.

BACKGROUND: Functional loss and clinical evidence of hallux malalignment have been reported to follow isolated tibial sesamoidectomy. METHODS: Thirty-two patients with isolated tibial sesamoidectomies were identified. Patients with a diagnosis of peripheral neuropathy, diabetes mellitus, inflammatory arthropathy or previous foot surgery were excluded as were patients who had concomitant joint realignment procedures. Twenty patients were available for followup with the Short Form-36 (SF-36), Foot Function Index (FFI) disability scale, visual analog scale (VAS), and questionnaire at an average of 62

(range 10 to 157) months after surgery. Fourteen patients returned for physical examination, radiographs, and pedographic and isokinetic examination. RESULTS: Physical examination of the 14 patients did not reveal any significant change in clinical alignment, range of motion or tenderness. Preoperative and postoperative comparison radiographs did not reveal significant differences in the intermetatarsal (IM) angle, hallux valgus (HV) angle distal metatarsal articular angle (DMAA), or sesamoid alignment (sesamoid station). Postoperative outcome measurements (VAS, SF36, and FFI) for 20 patients found significant relief of pain and improved functional outcome. Computerized dynamic pedographic measurements (Performance Orthotic) for 12 patients did not reveal any altered plantar pressures in the region of the hallux metatarsophalangeal joint. Isokinetic measurements of ankle plantar flexion push-off strength in eight patients did not reveal significant differences in side-to-side measurements. Eighteen of 20 (90%) patients indicated that they were able to resume all preoperative activities; six (30%) had extreme difficulty or an inability to stand on tip toe, but this did not impact their activities of daily living or their athletic endeavors. Two patients (14.3%) developed transfer metatarsalgia, but only one was symptomatic. CONCLUSION: Isolated tibial sesamoidectomy is a safe and effective treatment for recalcitrant tibial sesamoiditis. Hallux malalignment and deformity resulting in functional loss and change in hallux alignment can be avoided by meticulous surgical technique with repair of the soft tissues.

McBride ID, Wyss UP, et al. (1991). First metatarsophalangeal joint reaction forces during highheel gait. <u>Foot Ankle</u> **11**(5): 282-8.

First metatarsophalangeal (MTP) joint reaction forces were calculated for 11 normal females during the toe-off phase of gait while walking in bare feet and in high heeled shoes. A biomechanical model was used to calculate the forces utilizing kinematic, kinetic, footprint, and radiographic data. The results showed that the MTP joint reaction forces (FJ), the metatarsal-sesamoid forces (FS), and the resultant of these forces (FRES), were twice as large in high heels compared to barefoot walking. The average peak forces for barefoot and high-heeled gait were FJ: 0.8 and 1.58 times body weight, FS: 0.44 and 1.03 times body weight, and FRES: 0.93 and 1.88 times body weight. Also, the kinematics changed when wearing high heels, making angles of application of forces and sesamoidal articulations less favorable.

McCormick JJ, Anderson RB (2009). The great toe: failed turf toe, chronic turf toe, and complicated sesamoid injuries. Foot Ankle Clin **14**(2): 135-50.

Turf toe injuries and sesamoid injuries are challenging because of the variety of causes that exist as sources of pain. Through a systematic approach to evaluation, injuries to the hallux metatarsophalangeal joint can be diagnosed properly. Correct diagnosis leads to accurate and efficient treatment. If conservative measures fail, operative interventions are available to relieve pain and restore function. With careful surgical technique and appropriate postoperative management, athletes can return to play and efficiently reach their pre-injury level of participation.

Mittlmeier T, Haar P (2004). "Sesamoid and toe fractures." <u>Injury</u> **35 Suppl 2**: SB87-97. Injuries of the toes and sesamoids of the first metatarsophalangeal joint comprise a wide spectrum of traumatic entities. Despite the fact that a majority of lesions may well respond to nonsurgical treatment and exhibit an excellent prognosis, appropriate clinical and imaging analysis is mandatory to select those injuries that require specific therapeutic and surgical measures to avoid long-term sequelae of functional disability. Ozkoc G, Akpinar S, et al. (2005). Hallucal sesamoid osteonecrosis: an overlooked cause of forefoot pain. J Am Podiatr Med Assoc **95**(3): 277-80.

Four cases of osteonecrosis of hallucal sesamoids are reported here. Surgical excision of necrotic sesamoid tissue yielded satisfactory results, with the patients reporting no residual pain. Although it has not been frequently addressed in the literature, avascular necrosis of the sesamoid bones should be considered in the differential diagnosis of persistent forefoot pain.

Ozkoc G, Hersekli MA, et al. (2004). latrogenic medial dislocation of hallucal sesamoids with hallux varus in an adolescent. <u>Arch Orthop Trauma Surg</u> **124**(8): 568-70.

BACKGROUND: latrogenic hallux varus is a rare deformity linked to bunion surgery at late adult age. Here reported is the first adolescent case of acquired hallux varus and medial dislocation of both sesamoid bones. CASE REPORT: The patient had had a surgical intervention under his first metatarsophalangeal joint when he was 10 years old. Correction of the deformity with a tendon transfer and medial capsular release alone-as was recommended for adults-was impossible in this adolescent, 8 years after the index surgery. Excision of the contracted medial structures and repair of the lateral retinaculum of the fibular sesamoid obtained a perfect correction of the dislocated sesamoid bones.

Richardson EG (1987). Injuries to the hallucal sesamoids in the athlete. Foot Ankle 7(4): 229-44.

The sesamoids of the great toe, which are small and seemingly insignificant bones, can be the site of disabling pathology for the athlete. Sesamoiditis, osteochondritis, partite sesamoids with stress fractures, displaced fractures, and osteomyelitis have all been reported in the athlete. Bursitis beneath the tibial sesmoid and flexor hallucis brevis tendonitis also occur in the athlete and may be confused with sesamoid injury. Excision of the involved bone is the recommended treatment for displaced fractures and for less severe conditions such as sesamoiditis, osteochondritis, and nondisplaced fractures, if conservative management fails to relieve symptoms.

Richardson EG (1999). Hallucal sesamoid pain: causes and surgical treatment. <u>J Am Acad</u> <u>Orthop Surg</u> **7**(4): 270-8.

The hallucal sesamoids, although small and seemingly insignificant, play an important role in the function of the great toe by absorbing weight-bearing pressure, reducing friction, and protecting tendons. However, the functional complexity and anatomic location of these small bones make them vulnerable to injury from shear and loading forces. Injury to the hallucal sesamoids can cause incapacitating pain, which can be devastating to an athlete. Although traumatic injuries usually can be diagnosed easily, other pathologic conditions may be overlooked. Careful physical and radiologic examinations are necessary to determine the cause of pain and allow a recommendation of the optimal treatment. Surgical treatment may include partial or complete resection of the sesamoid, shaving of a prominent tibial sesamoid, or autogenous bone grafting for nonunion. Excision of both sesamoids should be avoided if possible.

Riley J, Selner M (2001). Internal fixation of a displaced tibial sesamoid fracture. <u>J Am Podiatr</u> <u>Med Assoc</u> **91**(10): 536-9.

The authors present a surgical technique for the preservation and repair of an acutely fractured sesamoid using internal fixation of the sesamoid. A case report demonstrating the technique for the open reduction and internal fixation of a fractured tibial sesamoid is presented. The authors recommend this procedure as a viable alternative to surgical

excision of the tibial sesamoid. The use of the procedure as an adjunct for the surgical treatment of recalcitrant traumatic sesamoiditis is also discussed.

Rodeo SA, Warren RF, et al. (1993). Diastasis of bipartite sesamoids of the first metatarsophalangeal joint. Foot Ankle **14**(8): 425-34.

Injury to the metatarsophalangeal (MP) joint of the great toe, often termed "turf-toe", is a common occurrence in football. We have identified four cases of first MP plantar capsular injury with diastasis of a bipartite sesamoid. In three cases, observation and protection resulted in progressive widening of the fragments associated with pain and disability. These players required resection of the distal sesamoid fragment and repair of the volar capsule. The fourth player underwent acute repair of the medial retinaculum and capsule. All players have had a full return to sports activity. Diastasis of components of a partite sesamoid provides objective evidence of disruption of the plantar capsular mechanism. Early recognition of this condition confirmed by stress radiographs is recommended. Treatment may include early protection followed by resection, if painful, or acute repair of the retinaculum. Previous descriptions of turf-toe have not included injuries to the sesamoid complex of the first MP joint. In our opinion, the term turf-toe should represent the consequences of a hyperextension injury to the first MP joint in which the volar capsule has been disrupted proximal to the sesamoid. A classification for first MP joint injuries is presented.

Sanhudo JA (2002). Stenosing tenosynovitis of the flexor hallucis longus tendon at the sesamoid area. <u>Foot Ankle Int</u> **23**(9): 801-3.

The author presents a case of stenosing tenosynovitis of the flexor hallucis longus tendon at the sesamoid area of the great toe following injury of the hallux. Although stenosing tenosynovitis of the flexor hallucis longus tendon is not rare, occurring frequently in ballet dancers, its entrapment at the sesamoid area was rarely described in the literature. Early recognition of this condition is very important for successful treatment. This patient did not respond to nonoperative treatment and surgical tenolysis was very successful for relief of the symptoms.

Saxena A, Krisdakumtorn T (2003). Return to activity after sesamoidectomy in athletically active individuals. <u>Foot Ankle Int</u> **24**(5): 415-9.

Sesamoidectomy of the first metatarsophalangeal joint in athletically active patients may be indicated in cases of chronic sesamoiditis resistant to nonsurgical care or symptomatic displaced fractures or nonunion. Painful scar, hallux deviation, and delayed return to activity are all potential complications. These need to be considered especially when performing surgery in the athletically active individual. Twenty-six sesamoidectomies in 24 patients (21 females and 3 males) were reviewed for type of sesamoidectomy, incision location, time to return to activity, and complications. Mean age was 35.4 years (range, 16-68 years) with mean follow-up 86.4 months. Eleven athletes (defined as professional or varsity level sports) operated on had a mean return to activity of 7.5 weeks (range, 4-10 weeks), while 13 "active" patients had a mean return to activity of 12.0 weeks. This difference was statistically significant using the t-test, (p < .02). There were 10 fibular and 16 tibial sesamoids excised. Complications included one hallux varus and two cases of postoperative scarring with neuroma-like symptoms, all associated with fibular sesamoidectomy; there was one case of hallux valgus deformity with tibial sesamoidectomy. Despite the functional importance of tibial and fibular sesamoids, athletically active individuals can return to sports after a sesamoidectomy as early as 7.5 weeks.

Toussirot E, Jeunet L, et al. (2003). Avascular necrosis of the hallucal sesamoids update with reference to two case-reports. Joint Bone Spine **70**(4): 307-9.

We report two cases of nontraumatic metatarsal pain with sclerosis and fragmentation of the lateral sesamoid bone on roentgenographs and computed tomography images. One patient underwent magnetic resonance imaging (MRI), which showed low signal from the sesamoid bone. These imaging findings suggested osteonecrosis. Histology of the sesamoidectomy specimen confirmed this diagnosis in one patient. Avascular necrosis of the metatarsal sesamoid is an uncommon disorder. The suggestive roentgenographic and MRI findings rule out the other painful conditions of the sesamoid bone. The features are reviewed and the treatment options discussed.

Yildirim Y, Saygi B (2006). Congenital absence of the lateral sesamoid. <u>J Am Podiatr Med</u> <u>Assoc</u> **96**(1): 78-81.

Congenital absence of the lateral sesamoid is an extremely rare condition. We present a case of congenital absence of the lateral sesamoid in which magnetic resonance imaging was performed. The literature is reviewed regarding the clinical significance of this anomaly.

Yu GV, Nagle CJ (1996). Hallux interphalangeal joint sesamoidectomy. <u>J Am Podiatr Med</u> <u>Assoc</u> **86**(3): 105-11.

Painful lesions on the plantar aspect of the interphalangeal joint of the great toe respond well to surgical excision of the accessory bone found lying superior to or within the flexor hallucis longus tendon. Several incisional approaches are available, each with potential advantages and disadvantages. Failure to consider each incisional approach and address concomitant deformities may result in a less than desirable postoperative result.