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PASIG MONTHLY CITATION BLAST: No.35 **September 2008**

Dear PASIG members:

Please remember to vote in the upcoming PASIG and Orthopaedic Section elections. Also, keep an eye out for the PASIG survey, planned for November. Finally, check out the PASIG programming in the next issue of OPTP for CSM in Las Vegas (February 9 – 12) and plan to attend! Our topic will be the foot and ankle.

By now acceptances for CSM posters and platforms have been sent out. Please don't forget, the PASIG sponsors an annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts research. The deadline for application is November 15, 2008. For more information on this award please check our webpage (www.orthopt.org/sig_pa.php) or contact Scholarship Chairperson, Amy Humphrey, at Phone: 703-527-9557, e-mail: ahumphrey@bodydynamicsinc.com, Fax: 703-526-0438.

October's Citation BLAST continues our special topic series: "*Os Trigonum / Posterior Ankle Impingements*". The format is an annotated bibliography of articles on the selected topic from 1996 – 2008. As always, each month's citations will be added to EndNote libraries available on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at http://www.endnote. com, including a 30-day free trial). If you'd like to suggest a topic or create one, please let me know.

Please write to me with your comments and suggestions. If you're seeking a research mentor, looking for a sounding board about a research idea, want some editorial suggestions on a manuscript, let me know and I'll try to connect you with the right researcher. Entry contributions to these Citation Blasts or other PA research ideas are always welcome.

As always, please drop me an e-mail anytime.

Regards,
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Os Trigonum / Posterior Ankle Impingements

The extreme plantar flexion of relevé en pointe in the ballet dancer and the pointed foot in ballet and modern dance can be associated with persistent posterior ankle pain. Differential diagnosis includes os trigonum syndrome, exostosis, chronic Achilles tendonitis, Haglund's deformity, hypertrophic posterior talar process, synovitis of the posterior capsule, osteoid osteoma of the calcaneus, retrocalcaneal bursitis, talar compression syndrome, posterior-medial talar facet fracture, tarsal tunnel syndrome, calcaneofibular impingement post conservative treatment of calcaneal fracture, pigmented villonodular synovitis, and tenosynovitis of the flexor hallucis longus muscle.

The forced plantar flexion test is suggestive of the presence of an os trigonum and generally rules out Achilles tendon related involvement. The os trigonum is an accessory bone of the foot, bones that are often confused with avulsion fractures. Cili et al. (2005) and Coskun et al. (2008) identified accessory bones in 18% and 21% of all foot x-rays.

Conservative treatment is generally successful and includes mobilization of the talus, release of the calf muscles, strengthening of the anterior leg muscles, retraining of the pointe tendu, and ice. If conservative treatment is not successful, corticosteroid injection may be helpful. For refractory cases, arthroscopic excision of the os trigonum is very successful. Dancers can return to full dance activity within 9 to 12 weeks.

Shaw Bronner PT, PhD, OCS
PASIG Research Chair

Abramowitz Y, Wollstein R, et al. (2003). Outcome of resection of a symptomatic os trigonum. J Bone Joint Surg Am **85-A**(6): 1051-7.

BACKGROUND: While an os trigonum at the posterolateral aspect of the talus is usually asymptomatic, this inconsistently present accessory bone has been associated with persistent posterior ankle pain, which has been described as the os trigonum syndrome. We present the clinical results of excision of the os trigonum through a posterolateral approach and report several factors affecting the clinical outcome. METHODS: During a five-year period from 1994 through 1999, forty-one patients had a failure of nonoperative treatment of os trigonum syndrome and underwent excision of a symptomatic os trigonum. In all cases, the os trigonum syndrome was diagnosed on the basis of the history, physical examination, and radiographs. Postoperatively, the patients were evaluated according to the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale. A questionnaire was used to evaluate the effect of several factors on the clinical outcome. RESULTS: The average duration of follow-up was forty-four months. The postoperative AOFAS score averaged 87.6 points. The thirty-three patients who had had symptoms for two years or less prior to the surgery had an average postoperative score of 90 points compared with 78 points for the eight patients who had had preoperative symptoms for more than two years (p = 0.011). Eight patients had sural nerve sensory loss, which was temporary in four and permanent in four. A superficial wound infection developed in one patient, and reflex sympathetic dystrophy developed in another. CONCLUSIONS: An os trigonum that is persistently symptomatic after a minimum three-month trial of nonoperative treatment can be excised through a posterolateral approach with highly satisfactory results. The main complication of this procedure is sural nerve injury.

Albisetti W, Ometti M, et al. (2008). Clinical evaluation and treatment of posterior impingement in dancers. Am J Phys Med Rehabil.

Os trigonum impingement is a frequent cause of posterior ankle pain in ballet dancers because they need extreme plantar flexion during the execution of releve in demipointe and en pointe positions. Clinical examination and standard and modified x-rays should be carried out to clearly identify the site and entity of the impingement. If a posterior impingement is clinically diagnosed, standard and modified magnetic resonance imaging should be also performed. From September 2005 to September 2006, we considered 186 young trainee ballet dancers. Twelve suffered from posterior ankle pain, and six of these had os trigona. We treated all the ballet dancers nonoperatively, and nine of them had good results. Conservative treatment failed in only three cases after 1-4 mos of physical and medical therapies, and, in these cases, good results were obtained through surgical excision of the accessory ossicle. Modified x-ray and magnetic resonance imaging help to determine the site and entity of the posterior impingement. If this is properly diagnosed, good results can be obtained through a nonoperative approach in a majority of cases.

Berkowitz MJ, Kim DH (2005). Process and tubercle fractures of the hindfoot. J Am Acad Orthop Surg **13**(8): 492-502.

Process and tubercle fractures of the talus and calcaneus can be a source of significant pain and dysfunction. Successful management requires extensive knowledge of the complex osseoligamentous anatomy of the hindfoot. The large posterior process of the talus is composed of a medial and a lateral tubercle; an os trigonum may exist posterior to the lateral tubercle. The talus has a lateral process that articulates with the fibula and subtalar joint; the calcaneus possesses a frequently injured anterior process that articulates with the cuboid. Injury to these hindfoot structures is caused by inversion and eversion of the ankle, which can occur during athletic activity. These injuries often are misdiagnosed as ankle sprains. A high degree of clinical suspicion is warranted, and specialized radiographs or other imaging modalities may be required for accurate diagnosis. Nonsurgical management with cast immobilization is frequently successful when the fracture is correctly diagnosed acutely. Large fragments may be amenable to open reduction and internal fixation. Untreated, chronic injuries can cause significant pain and functional impairment that may be improved substantially with late surgical intervention.

Brodsky AE, Khalil MA (1986). Talar compression syndrome. Am J Sports Med **14**(6): 472-6.

Ballet dancers frequently stand on the tips of their toes in the en pointe and demi pointe positions, resulting in compression of the posterior structures of the ankle during repeated plantar flexion of the foot, producing the talar compression syndrome. This mechanism may result in posterior block or impingement of an os trigonum or Stieda's process. When the dancer attempts to force the foot into plantar flexion, the os trigonum or the Stieda's process may be impinged between the calcaneus and the posterior edge of the tibia. Pain and tenderness are localized at the posterolateral aspect of the ankle behind the peroneal tendons. In nondancing members of the population, these conditions are usually asymptomatic. It is the requirement of the classical dance for a well-pointed foot that produces symptoms. We are reporting up to 7 years' followup of six professional ballet dancers in whom we removed the os trigonum for symptomatic talar compression syndrome, caused by the trauma of the en pointe position of toe dancing. Two patients had bilateral operations. All six patients returned to professional dancing within a few months and remained asymptomatic. The anatomy of this condition is reviewed, as well as the diagnosis and treatment.

Brown GP, Feehery Jr RV, et al. (1995). Case study: the painful os trigonum syndrome. J Orthop Sports Phys Ther **22**(1): 22-5.

The painful os trigonum syndrome is one cause of posterolateral ankle pain. This syndrome is most prevalent in athletes who perform frequent and/or forceful plantar flexion. The painful os trigonum may be misdiagnosed as Achilles and/or peroneal tendinitis. In this case, the patient was misdiagnosed for 15 months and treated for tendinitis. The appropriate clinical tests to evaluate the os trigonum as a source of posterolateral ankle pain are outlined. The surgical and postoperative management for the patient are discussed. Clinicians should be aware of the painful os trigonum syndrome as a possible source of posterolateral ankle pain.

Bureau NJ, Cardinal E, et al. (2000). Posterior ankle impingement syndrome: MR imaging findings in seven patients. Radiology **215**(2): 497-503.

PURPOSE: To report the magnetic resonance (MR) imaging findings in seven patients with posterior ankle impingement (PAI) syndrome. MATERIALS AND METHODS: Seven patients-three ballet dancers, one badminton player, one soccer player, one hockey player, and one construction worker-who presented with posterior ankle pain were assessed with MR imaging. Their clinical records and imaging studies were reviewed. The MR imaging studies were assessed for the presence of abnormal bone marrow signal intensity, osseous lesions, and soft-tissue abnormalities. RESULTS: One patient was treated surgically. In all patients, MR imaging demonstrated abnormal bone marrow signal intensity in the os trigonum and/or lateral talar tubercle, consistent with bone contusions. Two patients had a fragmented os trigonum or lateral tubercle, and two had a pseudoarthrosis of the posterolateral talus. Increased signal intensity was seen with distention of the posterior recess of the tibiotalar joint in two patients and with distention of the posterior recess of the subtalar joint in four patients. Three patients had fluid accumulation in the flexor hallucis longus tendon sheath. CONCLUSION: Bone contusions of the lateral talar tubercle and os trigonum are prevalent MR imaging findings of PAI syndrome. MR imaging clearly depicts the osseous and soft-tissue abnormalities associated with PAI syndrome and is useful in the assessment of this condition.

Chao W (2004). Os trigonum. Foot Ankle Clin **9**(4): 787-96, vii.

There is a wide variation in the nomenclature for the posterior aspect of the talus (eg, os trigonum, trigonal process, Stieda process, posterior process). Injuries to these structures can be caused by chronic, repetitive impingement of the bony prominence or by acute hyperplantar flexion of the foot and ankle. After failing appropriate nonoperative treatment, surgical excision of the bony involvement is recommended. Surgical options include open or arthroscopic excision of the bony structure.

Cilli F, Akcaoglu M (2005). The incidence of accessory bones of the foot and their clinical significance]. Acta Orthop Traumatol Turc **39**(3): 243-6.

OBJECTIVES: Accessory bones of the foot are often confused with avulsion fractures. This study was designed to investigate the incidence of accessory bones of the foot. METHODS: Anteroposterior and lateral foot radiographs of 464 male patients with an age range of 20 to 46 years were examined with regard to the presence, incidence, and distribution of accessory bones. Identification of the accessory bones were made according to the Kohler classification. RESULTS: Of 464 radiographs, accessory bones were identified in 85 feet

(18.3%), all of which were symptomless. The most common accessory bones in descending order were os peroneum (31.8%), os naviculare (28.2%), os trigonum (23.5%), os vesalianum (5.9%), os supranaviculare (3.5%), os infranaviculare (3.5%), os supratalare (2.4%), and os intermetatarseum (1.2%). CONCLUSION: Accessory bones of the foot should be well recognized and their clinical significance should be appreciated in order to decrease the rate of incorrect diagnoses and unnecessary orthopedic consultations on initial presentations of patients with foot complaints.

Coskun N, Yuksel M, et al. (2008). Incidence of accessory ossicles and sesamoid bones in the feet: a radiographic study of the Turkish subjects. Surg Radiol Anat.

Most accessory ossicles and sesamoid bones of the ankle and the foot remain asymptomatic; however, they have increasingly been examined in the radiology literature, because they can cause painful syndromes or degenerative changes in response to overuse and trauma. Our aim was to document a detailed investigation on the accessory ossicles and sesamoid bones of Turkish subjects in both the feet according to the sex, frequency and division of the bones, coexistence and bilaterality by radiography. A double-centered study was performed retrospectively to determine the incidence of the accessory ossicles and sesamoid bones in the ankle and foot. Accessory ossicles (21.2%) and sesamoid bones (9.6%) were detected by Radiographs of 984 subjects. The most common accessory ossicles were accessory navicular (11.7%), os peroneum (4.7%), os trigonum (2.3%), os supranaviculare (1.6%), os vesalianum (0.4%), os supratalare (0.2%), os intermetatarseum (0.2%). We observed bipartite hallux sesamoid in 2.7% of radiographs. Interphalangeal sesamoid bone of the hallux was seen in 2% of radiographs. Incidences of metatarsophalangeal sesamoid bones were found as 0.4% in the second digit, 0.2% third digit, 0.1% fourth digit and 4.3% fifth digit. We also identified the coexistencies of two different accessory ossicles as 6%, accessory ossicles and sesamoid bones as 7%, and bipartite sesamoid bones and sesamoid bones as 1.9%. Distribution of the most common accessory ossicles in male and female subjects was similar. We reported the incidence of accessory ossicles and sesamoid bones of the feet in Turkish adult population.

Fiorella D, Helms CA, et al. (1999). The MR imaging features of the posterior intermalleolar ligament in patients with posterior impingement syndrome of the ankle. Skeletal Radiol **28**(10): 573-6.

OBJECTIVE: To describe the MR imaging features of the posterior intermalleolar ligament (IML) in patients with posterior impingement syndrome (PIS) of the ankle. DESIGN AND PATIENTS: Three patients (one male and two females, 13-25 years of age) are presented. Each patient presented clinically with symptoms of PIS of the ankle. Plain film examination was negative for a structural cause of the PIS in all patients. MR images were obtained with a 1.5 T scanner using an extremity coil. Clinical data and, in one patient, findings at ankle arthroscopy, were correlated with the results of MR imaging. RESULTS: Ankle MR images from the three patients with a clinical diagnosis of PIS are presented. Findings in all patients included: (1) absence of another structural cause of the PIS (i.e., an os trigonum, trigonal process, fracture, loose bodies, etc.), (2) identification of the IML as a structure discrete from the posterior talofibular and tibiofibular ligaments, and (3) prominence of the IML as indicated by (a) identification of the IML in three different imaging planes, and (b) a caliber of the IML comparable to that of the conventional posterior ankle ligaments visualized in the same imaging plane. Arthroscopic resection of a meniscoid IML resulted in resolution of the PIS in one of the patients presented. CONCLUSIONS: MR imaging is an effective means of investigating the IML as a potential cause of PIS. The identification of a prominent IML in the absence of another structural cause of PIS indicates that impingement of the IML is the most likely cause of PIS.

Giuffrida AY, Lin SS, et al. (2003). Pseudo os trigonum sign: missed posteromedial talar facet fracture. Foot Ankle Int **24**(8): 642-9.

BACKGROUND: Posteromedial talar facet fracture (PMTFF) is a rare injury, sparsely reported in the literature. This article proposes that PMTFF is often left undiagnosed by orthopaedic surgeons and suggests the routine application of advanced radiographic studies (i.e., CT scan) in the recognition of PMTFF. It also evaluates nonoperative management of PMTFF. METHODS: After obtaining Institutional Review Board approval, the medical records over a 5-year period (1997-2001) were retrospectively reviewed from the foot and ankle service of a level 1 trauma center, identifying all cases of PMTFF. Charts were reviewed for relevant data. Results of treatment were assessed during follow-up physical examination. RESULTS: Six cases of PMTFF were identified over a 5-year period. All injuries were associated with medial subtalar joint dislocation. Four of six (66%) patients were not initially diagnosed with PMTFF, but instead misdiagnosed as an os trigonum. The remaining two patients had an established diagnosis of PMTFF at the time of initial treatment. All had short leg cast immobilization for medial subtalar dislocation. CT evaluation yielded additional diagnoses in all six patients. All six patients showed a PMTFF. Five patients (83%) revealed persistent subtalar joint subluxation. Five of six (83%) patients required at least one additional procedure as a result of an undiagnosed or nonoperatively treated PMTFF. Four patients underwent subtalar joint fusion, and one patient underwent tibiotalar calcaneal fusion secondary to concomitant ankle/subtalar arthritis. The patient who did not undergo recommended fusion continued to be symptomatic. CONCLUSIONS: Diagnosis of PMTFF necessitates a heightened clinical suspicion, especially when a medial subtalar joint dislocation is present. Proper imaging studies, such as coronal CT scan, should be performed after any subtalar dislocation. Timely treatment, in the form of open reduction and internal fixation for large fragments involving the articular surface or surgical excision for smaller fragments, is recommended in order to restore proper anatomy and function of the subtalar joint. This study verifies the significant morbidity associated with an undiagnosed or nonoperatively treated PMTFF.

Hedrick MR, McBryde AM (1994). Posterior ankle impingement. Foot Ankle Int **15**(1): 2-8.

Thirty cases of posterior ankle impingement in 28 patients were treated over a 10-year period (1982-1992). All conditions were caused by forced plantar flexion. An os trigonum or posterior process fracture was demonstrated radiographically in 63% of these cases, and an intact posterior process was demonstrated in 33%. Ten cases were lost to follow-up. Of the remaining 20 cases, 18 patients 12 (60%) improved with nonoperative treatment; 8 (40%) required operative excision. The results were good to excellent in 7 patients and fair in 1 patient. Operative excision for the treatment of recalcitrant posterior ankle impingement can relieve symptoms and allow a return to full preinjury activities.

Horibe S, Kita K, et al. (2008). A novel technique of arthroscopic excision of a symptomatic os trigonum. Arthroscopy **24**(1): 121 e1-4.

We describe a new arthroscopic excision technique for a symptomatic os trigonum. With the patient lying in a prone position, a posterolateral portal just lateral to the Achilles tendon, at the 5-mm level proximal to the tip of the fibula, is used for the arthroscope and an accessory posterolateral portal just posterior to the peroneal tendon at the same level is used for instruments. The synovial tissues are then debrided with a power shaver through the accessory posterolateral portal for better visualization. An elevator is used to release the fibrous tissue between the os trigonum and the talus. The os trigonum is completely excised with a grasper to visualize the flexor hallucis longus tendon. Radiographic control is helpful to check the position of the arthroscope if it happens to be inserted into the ankle joint as a result of the reduced subtalar joint space. Postoperatively, no immobilization is necessary, and full weight-bearing is allowed as tolerated. Three of us have performed 11 procedures with excellent results and no cases of complications. This arthroscopic excision technique for the symptomatic os trigonum is a safe and effective procedure.

Iovane A, Midiri M, et al. (2000). [Os trigonum tarsi syndrome. Role of magnetic resonance]. Radiol Med (Torino) **99**(1-2): 36-40.

INTRODUCTION: The os trigonum tarsi is an accessory bone of the foot localized posterolateral to the lateral tubercle of talus. It is usually an asymptomatic condition. However, particular activities such as ballet, soccer, or football may cause repeated stress and chronic microtraumas to the hindfoot, resulting in the os trigonum syndrome. Pain is typically localized anterior to the Achilles tendon; nevertheless, diagnosis may be very difficult because other conditions may show the same symptoms. Radiography can only demonstrate the os trigonum and its morphostructural changes, while MR imaging can also depict associated soft tissue damage. We report on 9 cases of os trigonum tarsi syndrome studied with MR imaging. MATERIAL AND METHODS: Nine patients with the os trigonum tarsi syndrome were submitted to MRI. All the examinations were performed with the patients in supine recumbency with the injured foot in neutral position and then in forced plantar flexion. Axial and sagittal T1 SE, T2* GE and FIR images were acquired. We evaluated os trigonum location and shape, signal intensity of bone, cartilages and adjacent soft tissues, and possible associated tendon injuries. RESULTS: No changes were found in the os trigonum location and shape. Signal intensity changes were seen in 2/9 cases. Particularly, a small area of very high signal intensity, due to necrosis, was depicted on the talar aspect in 1 case; a subchondral spot of slightly increased signal intensity, with a low-signal outline, was seen on the calcanear aspect in another case. Disruption of the cartilaginous synchondrosis between the accessory navicular bone and the posterior tibial aspect was observed in 7/9 patients. Tenosynovitis of the flexor hallucis longus was associated in 6/9 patients. Pseudoarthrosis with irregular bone margins and high-signal spots within the cartilage was found in 3 cases. Finally, fluid effusion surrounding the os trigonum and adjacent soft tissues was always detected. DISCUSSION AND CONCLUSIONS: The os trigonum syndrome may result from chronic microtraumas. Indeed, forced plantar flexion may cause os trigonum compression between the posterior aspect of the tibial malleolus and the calcaneus, with disruption of the synchondrosis with the lateral tubercle of talus. Joint inflammation may be associated with possible development of pseudoarthrosis. Other possible complications are related to vascular changes which may lead to bone necrosis. Furthermore, the particular anatomical site of the os trigonum may sometimes cause compression to the flexor hallucis longus tendon, resulting in severe tenosynovitis. MR imaging allows complete morphostructural assessment because it depicts the margins and the signal intensity of bone and ligaments on the 3 spatial planes. Particularly, sagittal T2 images best demonstrate the cartilage changes indicating synchondrosis disruption. This condition may cause abnormal mobility of the accessory bone with possible impingement with the posterior aspect of the tibia, or hypomobility due to pseudoarthrosis. Forced plantar flexion acquisitions are particularly useful in this condition because they can demonstrate the mechanism of injury.

Lee JC, Calder JD, et al. (2008). Posterior impingement syndromes of the ankle. Semin Musculoskelet Radiol **12**(2): 154-69.

Acute, or repetitive, compression of the posterior structures of the ankle may lead to posterior ankle impingement (PAI) syndrome, posteromedial ankle impingement (PoMI) syndrome, or Haglund's syndrome. The etiology of each of these conditions is quite different. Variations in posterior ankle osseous and soft tissue anatomy contribute to the etiology of PAI and Haglund's syndromes. The presence of an os trigonum or Stieda process is classically associated with PAI syndrome, whereas a prominent posterosuperior tubercle of the os calcis or Haglund's deformity is the osseous predisposing factor in

Haglund's syndrome. PoMI has no defined predisposing anatomical variants but typically follows an inversion-supination injury of the ankle joint. This article discusses the biomechanics, clinical features, imaging, and management of each of these conditions. Magnetic resonance imaging (MRI) provides the optimal tool in posterior ankle assessment, and this review focuses on the MRI findings of each of the conditions just listed.

Lombardi CM, Silhanek AD, et al. (1999). Modified arthroscopic excision of the symptomatic os trigonum and release of the flexor hallucis longus tendon: operative technique and case study. J Foot Ankle Surg **38**(5): 347-51.

This article presents an operative technique for modified arthroscopic excision of the symptomatic os trigonum and release of the flexor hallucis longus tendon sheath. The procedure uses two stacked posterolateral subtalar joint portals, rather than the customary anterolateral and posterolateral portal combination. By visualizing the os trigonum with an arthroscope positioned in a distal portal and introducing instrumentation through a proximal portal, the ossicle may be quickly exposed and excised with minimal dissection. A case study with a 22-month follow-up and a discussion of os trigonum syndrome are included to illustrate this procedure as an alternative to open excision or traditional arthroscopic excision.

Lui TH (2007). Endoscopic lateral calcaneal ostectomy for calcaneofibular impingement. Arch Orthop Trauma Surg **127**(4): 265-7.

Lateral calcaneal bulging after conservative treatment of calcaneal fracture can result in calcaneofibular impingement or shoewear problem. We describe an endoscopic lateral calcaneal ostectomy. Through the anterolateral, middle subtalar portals, and a plantar portal, the soft tissue envelop is stripped from the bone and the posterior facet cartilage can be accurately assessed. The lateral cortical bulge is burred with an acromionizer and the degenerated cartilage debrided. With this approach, the integrity of the soft tissue envelop is preserved and the amount of cartilage debridement needed is accurately determined.

Maquirriain J (2005). Posterior ankle impingement syndrome. J Am Acad Orthop Surg **13**(6): 365-71.

Posterior ankle impingement syndrome is a clinical disorder characterized by posterior ankle pain that occurs in forced plantar flexion. The pain may be acute as a result of trauma or chronic from repetitive stress. Pathology of the os trigonum-talar process is the most common cause of this syndrome, but it also may result from flexor hallucis longus tenosynovitis, ankle osteochondritis, subtalar joint disease, and fracture. Patients usually report chronic or recurrent posterior ankle pain caused or exacerbated by forced plantar flexion or push-off maneuvers, such as may occur during dancing, kicking, or downhill running. Diagnosis of posterior ankle impingement syndrome is based primarily on clinical history and physical examination. Radiography, scintigraphy, computed tomography, and magnetic resonance imaging depict associated bone and soft-tissue abnormalities. Symptoms typically improve with nonsurgical management, but surgery may be required in refractory cases.

Marotta JJ, Micheli LJ (1992). Os trigonum impingement in dancers. Am J Sports Med **20**(5): 533-6.

Sixteen patients underwent surgical excision of an impinging ossicle through a posterior lateral approach. Twelve of these patients (15 ankles) were available for followup and were retrospectively surveyed at an average of 28 months after surgery. There were 9 women and 3 men. Nine were professional ballet dancers and 3 were students of advanced ballet schools. Preoperative symptoms included pain localized to the posterior ankle, limitation of motion, weakness, swelling, or neurologic changes associated with dance activities. All

patients were severely hampered in their dance participation and had failed nonsurgical therapies. Postoperatively, all patients followed an aggressive rehabilitation protocol. All had improvement in their impingement symptoms; eight (67%) still had occasional discomfort. All professional dancers returned to unrestricted dance activity. The mean time to full activity was 3 months. One patient had a superficial wound infection requiring antibiotic treatment and another suffered a transient tibial nerve neurapraxia. Both of these complications resolved without sequelae. We conclude that posterior ankle impingement in ballet dancers, caused by an os trigonum and resistant to nonsurgical therapies, is effectively treated with simple excision of the offending structure.

Masciocchi C, Catalucci A, et al. (1998). Ankle impingement syndromes. Eur J Radiol 27 Suppl 1: S70-3.

The ankle impingement syndrome is a frequent condition in both athletes and the normal population. We investigated this painful syndrome from both a clinical and a diagnostic viewpoint. Depending on what ankle tissue impinges on the other, it is possible to distinguish bone impingement, soft tissue impingement and peripheral nerve entrapment. For each of these pathologic conditions we investigated the diagnostic role of conventional radiography, Computed Tomography and Magnetic Resonance Imaging. The evidence of osteophytes, exostosis and presence of the os trigonum on plain films make clinical diagnosis easy in both anterior and posterior bone impingement. CT can provide useful information about the component of the posterior ankle. MRI always adds important information about chondral or subchondral bone injuries, synovial reaction and adjacent soft tissue involvement. The anterolateral impingement syndrome is caused by repeated injuries in plantar flexion and ankle intrarotation. MRI well detects the meniscoid injury thanks to high contrast sequences; it can also distinguish this syndrome from painful chondral and/or bony lesions at this level. MRI is also the method of choice to study sinus tarsi impingement, especially thanks to fat suppression sequences which increase MR diagnostic capabilities in this important anatomic area. Deep peroneal nerve entrapment, the medial plantar nerve entrapment syndrome and the tarsal tunnel syndrome are the most important entrapment neuropathies of the ankle. US and MRI are very useful to study the tendon and soft tissue abnormalities causing the anterior tarsal tunnel syndrome. CT and particularly MRI can easily detect many pathologic conditions causing the medial plantar nerve entrapment and the tarsal tunnel syndromes.

Mouhsine E, Crevoisier X, et al. (2004). Post-traumatic overload or acute syndrome of the os trigonum: a possible cause of posterior ankle impingement. Knee Surg Sports Traumatol Arthrosc **12**(3): 250-3.

The purpose of this paper is to discuss the post-traumatic overload syndrome of the os trigonum as a possible cause of posterior ankle impingement and hindfoot pain. We have reviewed 19 athletes who were referred to our foot unit between 1995 and 2001 because of posterior ankle pain, and in whom a post-traumatic overload syndrome of os trigonum was diagnosed. All these patients were followed up over a period of 2 years. In 11 cases a chronic repetitive movements in forced plantar flexion was found. In the other eight cases the pain appeared to persist after a standard treatment of an ankle sprain in inversion plantar flexion. The diagnosis was based on clinical history, physical examination and X-rays that revealed a non-fused os trigonum. The confirmation of diagnosis was carried-out injecting local anaesthetic under fluoroscopic control. In all cases a corticosteroid injection as first line treatment was performed. In 6 cases a second injection was necessary to alleviate pain because incomplete recovery with the first injection. Three cases (16%) were recalcitrant to this treatment and in these three cases a surgical excision of the os trigonum was carried out. Our conclusion is that after some chronic athletic activity or an acute ankle

sprain the os trigonum, if present, may undergo mechanical overload, remain undisrupted and become painful. Treatment by corticosteroid injection often resolves the problem.

Niek van Dijk C (2006). Anterior and posterior ankle impingement. Foot Ankle Clin **11**(3): 663-83.

Anterior ankle impingement is characterized by anterior ankle pain on activity. Recurrent (hyper) dorsiflexion is often the cause. Typically, there is pain on palpation at the anteromedial or anterolateral joint line. Some swelling or limitation in dorsiflexion are present. Plain radiographs can disclose the cause of the impingement. In the case of spurs or osteophytes, the diagnosis is anterior bony impingement. In the absence of spurs or osteophytes, the diagnosis is anterior soft tissue impingement. In patients with anteromedial impingement, plain radiographs ae often falsely negative. An oblique view (anteromedial impingement view = AMI view) is recommended in these patients. Arthroscopic management with removal of the offending tissue provides good to excellent long-term (5-8 years) results in 83% of patients with grade 0 and grade I lesions. Long-term results are good/excellent in 50% of patients with grade II lesions (osteophytes secondary to arthritis with joint space narrowing). In posterior ankle impingement, patients experience hindfoot pain when the ankle is forcedly plantarflexed. Trauma or overuse can be the cause. The trauma mechanism is hyperplantarflexion or a combined inversion plantarflexion injury. Overuse injuries typically occur in ballet dancers and downhill runners, who report pain on palpation at the posterolateral aspect of the talus. On plain radiographs, an os trigonum or hypertrophic posterior or talar process can be detected. Surgical management involves removal of the os trigonum, scar tissue, or hypertrophic posterior talar process. In the case of combined posterior bony impingement and flexor hallucis longus tendinopathy, a release of the flexor hallucis longus is performed simultaneously. Endoscopic management is associated with a low morbidity, a short recovery time, and provides good/excellent results at 2-5 years follow-up in 80% of patients.

Peace KA, Hillier JC, et al. (2004). MRI features of posterior ankle impingement syndrome in ballet dancers: a review of 25 cases. Clin Radiol **59**(11): 1025-33.

AIM: To describe the magnetic resonance imaging (MRI) features of posterior ankle impingement syndrome (PAIS) in classical ballet dancers. MATERIALS AND METHODS: A retrospective review was undertaken of 25 MRI examinations of the ankle performed on 23 ballet dancers over a 26-month period. Images were examined for the presence of osseous and soft-tissue anatomical variants at the posterior ankle and imaging signs of PAIS. All patients presented with symptoms and signs suggestive of PAIS including posterior ankle pain, swelling and stiffness during plantar flexion. RESULTS: Anatomical variants predisposing to PAIS including as os trigonum and tuberosity arising from the superior calcaneum were clearly depicted. The most common imaging feature of PAIS in our series was high T2 signal posterior to the talocalcaneal joint indicating synovitis (n = 25). Thickening of the posterior capsule (n = 13) and tenosynovitis of flexor hallucis longus (n = 17) were also common. An os trigonum was an infrequent finding (n = 7). Bone marrow oedema, commonly in the posterior talus (n = 10) or in a patchy distribution (n = 10) was often noted. CONCLUSION: MRI is a useful diagnostic tool in PAIS, and in the present series, clearly demonstrates the anatomical variants and range of osseous and soft-tissue abnormalities associated with this condition. Prospective studies are needed to understand the significance and importance of individual MRI findings in producing the symptoms of PAIS.

Saxena A (2000). Return to athletic activity after foot and ankle surgery: a preliminary report on select procedures. J Foot Ankle Surg **39**(2): 114-9.

One hundred thirty-eight "athletic" patients from the author's practice underwent retrospective review of their foot and ankle surgery that was performed from 1990 to 1997 to evaluate the time to return to activity. Athletes were defined as follows: professional, varsity college and high school, runners amassing more than 25 miles per week, or those involved in regular competition. No recreational athletes were included. Average follow-up for the group as a whole was 49.4 months, (range, 12-108 months). One hundred seventeen of the 138 patients were able to be contacted and/or had been evaluated by September 1998. One hundred thirteen patients considered their surgery a success. All but two patients were able to return to the desired level of performance. Twenty-three of the patients increased their activity level after surgery. Twenty-eight athletes underwent Achilles tendon-related surgery (average follow-up was 44.5 months). Runners undergoing peritenolyses had an average return to activity of 4.0 weeks (range, 3-6 weeks). Patients undergoing Achilles procedure involving bone resection had an average return to activity of 13.8 weeks (range, 10-20 weeks). Forty-four bunionectomy procedures were performed, including 31 first metatarsal osteotomies. The group's average follow-up was 52.9 months (range, 13-100 months), and average return to activity for the first metatarsal osteotomies was 8.9 weeks. There were 48 rearfoot procedures. Lateral ankle stabilization procedures returned to activity on an average of 10 weeks (range, 7-16 weeks), while excised ossicles (os tibiale externum, os trigonum) had an average return to activity of 9.1 weeks (range, 8-14 weeks). Seven neuroma patients (via dorsal approach) had a return to activity of 4.0 weeks (range, 2.5-6 weeks), sesamoidectomy 7.5 weeks (range, 4-10 weeks), and Valenti arthroplasty of 6.5 weeks (range, 4-12 weeks), respectively. There were minimal complications. Two patients in the Achilles surgery group required revision surgery. One patient with a bunionectomy had postoperative hallux limitus. Eight patients had symptomatic screws removed.

Strauss JE, Forsberg JA, et al. (2007). Chronic lateral ankle instability and associated conditions: a rationale for treatment. Foot Ankle Int **28**(10): 1041-4.

BACKGROUND: Ankle sprains have a high incidence of associated injuries and conditions that may be unrecognized at the initial time of injury. Failure to treat these conditions at the index surgery may compromise outcomes and delay recovery. The purpose of this study was to determine the type and frequency of associated injuries and conditions in military patients with chronic lateral ankle instability. METHODS: Between 1996 and 2002, 160 patients had 180 modified Brostrom-Gould lateral ankle ligament reconstructions for chronic ankle instability. A retrospective review of the clinical history, physical examination, radiographs, and intraoperative findings was conducted. RESULTS: The overall incidence of associated extra-articular conditions and injuries found in this study was 64%; 115 conditions were identified in 180 ankles. Peroneal tendon injuries occurred with the highest frequency (28%), followed by os trigonum lesions (13%), lateral gutter ossicles (10%), hindfoot varus alignment (8%), anterior tibial spurs (3%), and tarsal coalitions (2%). Twenty revision lateral ankle ligament reconstructions were required for either persistent pain or recurrent instability. The most common associated conditions were undiagnosed hindfoot varus alignment abnormalities (28%) followed by untreated peroneal injuries (25%). CONCLUSIONS: This study confirms the frequency of conditions associated with lateral ankle instability and emphasizes several conditions that have received little attention in the literature. Identifying these associated conditions before surgery enables the surgeon to treat all conditions at one operation, returning the patient to full activity sooner. Guidelines are presented to assist clinicians in screening patients for these associated conditions.

van Dijk CN, Scholten PE, et al. (2000). A 2-portal endoscopic approach for diagnosis and treatment of posterior ankle pathology. Arthroscopy **16**(8): 871-6.

We describe a 2-portal endoscopic approach of the hindfoot with the patient in the prone position. By means of this approach, it is possible to visualize and treat a variety of posterior ankle problems. Not only can pathology of the posterior ankle joint and subtalar joint be visualized and treated, but also periarticular pathology, such as calcifications or scar tissue, can be diagnosed and treated. We describe a professional ballet dancer with chronic flexor hallucis longus tendinitis and a posterior ankle impingement syndrome caused by an os trigonum of both ankles. The patient was successfully treated by removing the os trigonum and releasing the flexor hallucis longus tendon. She resumed her professional activities within 2 months after endoscopic treatment.

Willits K, Sonneveld H, et al. (2008). Outcome of posterior ankle arthroscopy for hindfoot impingement. Arthroscopy **24**(2): 196-202.

PURPOSE: To provide short-term clinical results of posterior ankle arthroscopy in the treatment of posterior ankle impingement. METHODS: This was a retrospective evaluation of the clinical outcomes of posterior ankle arthroscopy in a series of patients with posterior ankle pain. RESULTS: Of 23 patients who underwent 24 posterior ankle arthroscopies between July 1998 and February 2004, 15 patients (mean age, 25 years) with 16 posterior ankle arthroscopies were evaluated at a mean follow-up time of 32 months (range, 6 to 74). Procedures carried out were: excision of os trigonum (11); decompression of prominent posterior talar process (5); tenolysis of flexor hallucis longus (5); removal of loose body (1); osteochondritis dissecans lesion debridement (1); and arthrotomy (1). The average time to return to work was 1 month (range, 0 to 3) and to sports, 5.8 months (range, 1 to 24). Fourteen patients returned to their preinjury level of athletics. Mean Health Survey Short Form (SF-12) scores were 51.80 for the mental component (range, 30.77 to 60.53) and 55.80 for the physical component (range, 44.26 to 63.33). Mean score on the American Orthopaedic Foot and Ankle Society Ankle and Hindfoot Scale was 91 (range, 77 to 100) and on the Lower Extremity Functional Scale was 75 (range, 65 to 80). Documented complications included temporary numbness in the region of the scar in 5 patients and temporary ankle stiffness in 1 patient. There were no permanent neurovascular injuries. All subjects reported significant improvement and indicated that they would undergo the surgery again if needed. CONCLUSIONS: Functional and clinical evaluations following posterior ankle arthroscopy revealed that all patients were very satisfied. They reported good to excellent health-related quality of life scores, satisfactory functional outcomes, and a high rate of return to sporting activities. Most importantly, no significant complications were encountered. This review suggests that posterior ankle arthroscopy is a safe and effective surgical procedure in the treatment of posterior ankle impingement. LEVEL OF EVIDENCE: Level IV, therapeutic case series.

Wredmark T, Carlstedt CA, et al. (1991). Os trigonum syndrome: a clinical entity in ballet dancers. Foot Ankle **11**(6): 404-6.

Thirteen Swedish National classic ballet dancers were surgically treated for an "os trigonum syndrome."Their main symptom was an impingement pain in the hind foot while actively plantar flexing the ankle during ballet dancing. The surgical procedure included excision of an os trigonum or a prominent lateral posterior process of the talus, together with division of the flexor hallucis tendon sheath if it was thickened. This procedure was safe and resulted in return of the dancers to the same level of ballet dancing within 5 to 10 weeks.