CHAPTER **26**

Overview of the Four Most Common Accessory Bones in the Foot

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INTRODUCTION

An accessory bone, sometimes referred to as an extra bone, is a portion of the bone that never fused together during growth and development. The human foot contains 26 bones; 7 tarsals, 5 metatarsals, and 14 phalanges. At birth, the bones are mostly cartilage, and cartilage eventually forms into bone. When the bone does not fuse during the growth and development in a child, then it is termed an accessory bone (1). This may also occur secondary to trauma. For most people, these bones are asymptomatic and often are an incidental finding on radiograph. However, in a few people, accessory bones could be a cause of significant discomfort and pain.

Some accessory bones are more common than other. A review of the literature shows the most common accessory bones to be the os trigonum, os tibiale externum, os peroneum and os vesalianum (2-6). According to literature, the overall incidence of accessory bone is between 2 and 10%, however a large Turkish study in 2009 radiographically evaluated the feet of 984 subjects and found an incidence of accessory bones to be 21.2% (2). Pain associated primarily with an accessory bone generally involves trauma, which can result in acute or chronic pain. Tendonitis can occur because some of the accessory bones are embedded within a tendon and over time (6) it can lead to a mechanical disadvantage to the tendon leading to chronic pain.

Clinically, focal pain is most often described. Following a thorough history and physical examination, a radiograph is usually used to confirm a diagnosis. The differential diagnosis includes stress fracture, avulsion fracture, or apophysitis. Infrequently, an accessory bone could be difficult to view on plain films. In these cases, magnetic resonance imaging (MRI) is warranted (5). Chronic pain secondary to an accessory bone can have an impact in activities of daily living.

Nonsurgical treatment includes nonsteroidal anti-inflammatory drugs (NSAIDs), ice, rest, protected weight-bearing, steroid injections, and physical therapy. Surgical options can involve excision of the accessory bone with reattachment or repair of the tendon.

All sesamoids are accessory bones, but not all accessory bones are sesamoids. Sesamoids begin to ossify between 9-11 years old. They are ovoid nodular bones found within a joint capsule or tendon. In the body, the patellar bone is arguably the most recognized sesamoid bone (6) as an accessory bone that lies outside of a tendon and develops as a secondary ossification center that did not fuse (5).

OS TRIGONUM

The os trigonum, also called the talus accessory, is an accessory bone in the posterior aspect of the lateral tubercle of the posterior process (Figure 1). The os trigonum is a common accessory bone in the foot. The posterior process of the talus consists of a medial and lateral process, both of which form a groove for the flexor hallucis longus tendon. Usually, within 1-3 years, the accessory bone fuses, with the talus forming part of the posterior process of the lateral tubercle. However, when it fails to fuse then it is a separate bone referred to as the os trigonum (6). A fibrous band connects the os trigonum to the talus and this is not easily visible on radiographs. Pain of the os trigonum is known as os trigonum syndrome. It is best seen on a lateral view, and can be mistaken for a fracture of the lateral process of the talus (4). A prominent posterior lateral process of the talus is called a stieda's process, and if fractured is known as a Shepherd's fracture (4). Therefore, it is important that the podiatric physician differentiate between a symptomatic os trigonum and a Shepherd's fracture. Shepherd fractures most often are caused by a traumatic injury involving ankle hyper-plantarflexion. Os trigonum syndrome is also common in ballet dancers, gymnastics, basketball, soccer, and football because of the extreme plantarflexion involved in these activities (6-8).

Patients generally will present to the office with a chief complaint of pain to the deep posterior aspect of the ankle joint. They often do not report any incidence of trauma, and

Figure 1. Os trigonum.

these patients are more likely to be active. Soccer players will present with severe pain when kicking the ball compared to just running. Ballet dancers will report extreme pain when on pointe.

Upon physical examination, pain will be elicited at the posterior ankle with flexor halluces longus tendon testing and increased ankle planterflexion. A thorough evaluation of a lateral view radiograph will help differentiate between an os trigonum syndrome and a Shepherd's fracture. A Shepherd's fracture will have a jagged edge while an os trigonum will have a smooth rounded edge. Chronic os trigonum syndrome can also lead to synovitis of the flexor halluces longus tendon (7). A computed tomography (CT) examination will be useful in making a definitive diagnosis (6). Conservative treatment includes RICE therapy (rest, ice, compression, elevation), physical therapy, NSAIDs, and steroid injections. Surgically, a posterolateral approach is most often utilized. Surgery involves a synovectomy and posterior ankle arthrotomy either via a scope or open procedure depending on the size of the fragment. A retrospective study in 2016 compared open (13 subjects) and endoscopic (12 subjects) approaches for ankle impingement and os trigonum syndrome in national professional dancers (7). This study, performed between October 2005 and February 2010, found a quick return to full time activity in the endoscopic group compared to the open group. However, both techniques were safe and effective in treatment of os trigonum syndrome in professional dancers and this is supported by other studies (8-10).

OS VESALIANUM

The os vesalianum is an accessory bone located proximally at the fifth metatarsal tuberosity (Figure 2). It has an unfused separate center of ossification found within the peroneus brevis tendon (4,11). This accessory bone is, by definition, also a sesamoid bone. The peroneal brevis tendon originates on the lateral fibula and courses posterior to the lateral malleoli to attach at the styloid process of the fifth metatarsal. It is a weak plantarflexor and everter of the foot. Os vesalianum derives its name from an anatomist and physician named Andreas Vesalius. He described it in "De Humani Corporis Fabrica" in 1543 (11). This accessory bone is usually asymptomatic; however it may became painful and occasionally be a cause of recurrent lateral foot pain. Os vesalianum is rare and often an incidental finding. The incidence rate has been shown to be between 0.1 and 5.9% (6,11).

Patients usually present with pain or tenderness at the lateral aspect of the foot, specifically at the area of the prominent fifth metatarsal styloid process. A history of acute trauma involving extreme plantarflexion and inversion of the foot is typically described. In a setting of trauma, the podiatric physician must differentiate between an avulsion fracture of the fifth metatarsal base or an os vesalinum (6). The peroneal brevis tendon also needs to be examined for any partial tear and an MRI will be useful in evaluating soft tissue structures. On radiograph, the os vesalinum is best visualized on the lateral oblique view (6). Its appearance is rounded with smooth edges.

In the pediatric population, the growth plate is still open so children can present with pain on the lateral aspect of the foot at the fifth metatarsal base. An apophysitis of the fifth metatarsal base is known as Iselin disease, and it is an osteochondritis (12). Conservative treatment includes restricted weightbearing, wearing wider shoes with padding, ice, NSAIDs, steroid injections, and physical therapy (13). Surgical treatment involves the excision of the accessory bone with repair or reattachment of the tendon with an anchor.

Case studies have reported favorable outcomes with the excision of os vesalianum (11,14,15). A rare case report was published in 2011 (16). It described a patient with symptomatic bilateral os vesalianum in which the right foot responded to surgical treatment and the left foot responded to conservative treatment (16). The study described a 25-year-old woman who became symptomatic after kicking a box accidently with the lateral aspect of her left foot. Initial radiographs were unremarkable; however she continued to have pain at the lateral aspect of her left foot. A second opinion was obtained, and radiographs showed a radiolucent line at the tuberosity of the fifth metatarsal. She was treated conservatively with a short-leg walking cast for a total of 10 weeks. The patient started experiencing pain to the lateral aspect of her right foot without any incidence of trauma. Diagnosis of bilateral accessory bones was confirmed using bone scintigraphy and a CT scan.

Figure 2. Os vesalianum.

OS TIBIALE EXTERNUM

Os tibiale externum was first described by Bauhin in 1605 (17). It is also known as an accessory navicular or accessory scaphoid. Three types of accessory navicular bones have been reported (4,6). It is found at the medial aspect of the navicular tuberosity as an unfused secondary area of ossification (Figure 3). It can also be found as a sesamoid embedded in the tendon of tibialis posterior. The tibialis posterior tendon originates at the posterior tibia and courses distally behind the medial malleoli through the tarsal canal with a broad insertion to the plantar aspect of the tarsal and metatarsal bone, especially the navicular (18). It is a powerful supinator of the foot, using traction to lock the tarsal bones, and it sustains the medial arch. It also plantarflexes the foot at the ankle joint. The navicular is a quitessential tarsal bone of the medial column of the foot. It articulates distally with 3 cuneiform bones and proximally with the talus.

Os tibiale externum is seen in approximately 10% (range 4-21%) of the population. It is more common in females, and has a bilateral prevalence of about 70% (range 50-90%) (4). Os tibiale externum usually ossifies around 9 years of age, and will become part of the navicular. It is usually asymptomatic, but in a few cases, can become very painful. Patients will present with pain along the medial arch that is provoked by weight-bearing activities such as running or walking, and rubbing or friction from shoe wear. Some patients present with a pes planus valgus deformity, which will cause more strain on the posterior tibial tendon (19). Physical examination reveals pain on palpation at the area of the medial arch, navicular tuberosity, and also along the insertion of the PT tendon. Callus formation may be present at the area due to chronic pressure. Upon stance, arch height could appear decreased and a heel raise test will help appreciate the integrity of the posterior tibial tendon if a posterior tibial tendon dysfunction (PTTD) is suspected. Os tibiale externum is best seen on the lateral external oblique view (Figure 3). An MRI should be ordered by the podiatric physician to evaluate the integrity of the PT tendon (20) and a CT scan can be used to properly assess the size of the accessory ossicle (21). Takahashi et al (20) published an article in 2014 showing that MRI can be used to diagnose and monitor the healing in patients with symptomatic navicular tuberosity. The edema-like bone marrow pattern will diminish in intensity with clinical healing. Differential diagnoses include avulsion fracture of the navicular and Kohler's disease (6). Nonsurgical treatment includes ice, NSAIDs, physical therapy, padding, mole skin, and orthosis with a navicular cutout. Surgical treatment involves excision of the bone with repair or reattachment of the posterior tibial tendon in a more plantar position. The Kidner procedure is indicated for patients with pes plano valgus and an os tibiale externum (22), because it disrupts the insertion of the posterior tibial tendon thereby causing a mechanical disadvantage to the tendon, ultimately weakening it, and causing a collapse to the longitudinal arch.

OS PERONEUM

Os peroneum is an accessory bone, round, or oval (Figure 4), located within the peroneus longus tendon, which is located at the plantar lateral aspect of the cuboid (6). It is common, and seen in approximately 25% of feet (4,23). The peroneal longus tendon originates at the proximal aspect of

Figure 3. Os tibiale externum, lateral oblique view.

Figure 4. Os peroneum.

the fibula. It travels posteriorly to the lateral malleoli, and continues distally along the lateral aspect of the calcaneus and courses plantarly through the peroneal groove in the cuboid. It inserts at the lateral base of the first metatarsal and stabilizes the medial column in the sagittal plane. It everts the foot at the subtalar joint and plantarflexes at the ankle joint.

An os peroneum within the tendon can weaken the tendon causing os peroneum syndrome (4). Patients present to the office complaining of pain to the lateral aspect of the foot, usually without any incidence of trauma. In an event of trauma, an inversion injury with sudden supination is the most common mechanism of injury. This causes the os peroneum to compress against the cuboid leading to fracture or tear the peroneus longus tendon. Another common complaint is shoe irritation, because many shoes are narrow at the midfoot portion. Patients are usually active, and it is common in runners and dancers.

Physical examination reveals pain on palpation at the lateral aspect of the plantar cuboid. It can easily be confused with os vesalianum. Other differential diagnoses include avulsion fracture of the fifth metatarsal base, partial tear of the peroneus longus tendon, apophysitis of the fifth metatarsal, and tenosynovitis (6). Radiographs are helpful in diagnosis and best seen in the lateral oblique view (6). MRI or ultrasound assist to access the soft tissue structures (24). Conservative treatment includes NSAIDs, ice, physical therapy, and wider shoes. Surgery is an option after conservative treatments have failed. Surgery involves excision of the accessory bone or cartilage, and care is taken not to damage the peroneus longus tendon. However, the tendon should be repaired if already damaged.

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