INTRODUCTION
Accessory ossicles are well-corticated bony structures found close to bones or a joint. They result from unfused ossification centres and are frequently congenital. They may, however, also be the result of prior trauma. Accessory ossicles can be found adjacent to various joints, such as the wrist, shoulder, hip or knee, but the foot and ankle are relatively common locations.

Accessory ossicles are usually an incidental finding on radiographs and often overlooked. At times, they mimic fractures or loose bodies, proving to be a diagnostic conundrum, thus leading to misdiagnoses. They may also contribute to or exacerbate underlying pathology, giving rise to symptoms. Higher modalities, such as computed tomography (CT), magnetic resonance (MR) imaging and even scintigraphy, are used in cases with diagnostic difficulty or when resulting pathology is suspected. This paper aimed to provide a pictorial representation of the more commonly encountered accessory ossicles of the foot and ankle, and showcase their anatomic features, resulting pathology and potential pitfalls in diagnosis.

ACCESSORY NAVICULAR
Three types of accessory navicular have been described. Type 1 accessory navicular (Fig. 1) is found within the posterior tibial tendon, close to its attachment to the navicular, and makes up about 30% of cases. It is typically small, measuring about 2–3 mm in size, does not have a cartilaginous interface with the navicular and is considered to be a sesamoid bone of the posterior tibial tendon.  
Type 2 accessory navicular (Fig. 2), seen in about 50% of cases, is located close to the median eminence of the navicular bone, forming a flat facet with an intervening synchondrosis, which is a cartilaginous interface between the accessory navicular and the navicular bone. Type 3 accessory navicular (Fig. 3), which makes up the remaining 20% of cases, is a fused ossification.

Fig. 1 Type 1 accessory navicular. Axial CT image of the foot shows an ossicle (arrow) measuring about 3 mm in size, adjacent to the navicular (asterisk) and within the tibialis posterior tendon.

Fig. 2 Type 2 accessory navicular. Right foot radiograph shows an accessory navicular (arrow) forming a flat facet with an intervening synchondrosis at the median eminence of the navicular (asterisk).
centre, resulting in a prominent median eminence, and there is no synchondrosis. The accessory navicular is bilateral in about 50% of cases and is more common in women. Its overall prevalence is about 2%–21%, making it the second most common accessory ossicle.

Of the three types of accessory navicular, Type 2 is most commonly symptomatic, presenting as medial foot pain. This is also known as os naviculare syndrome. Shear stress at the synchondrosis caused by pull of the posterior tibial tendon is thought to be a cause. MR imaging is usually required to establish the diagnosis in symptomatic cases. Bone marrow oedema of the accessory navicular and the articulating navicular (Fig. 4), and thickening of the posterior tibial tendon (Fig. 5) are some features that may be observed in os naviculare syndrome. Posterior tibial tendon tears may also be seen.

OS TRIGONUM
The os trigonum is situated posteriorly to the talus and may be triangular or ovoid in shape (Fig. 6). A synchondrosis exists between the ossicle and the talus. The os trigonum has a reported prevalence of 7%–25% and is best seen on the lateral projection.

The os trigonum may contribute to posterior ankle impingement syndrome (Figs. 7 & 8), which is associated with repeated plantar flexion, and presents as posterior ankle pain and swelling. Imaging findings include soft tissue swelling, synovitis and flexor hallucis longus (FHL) tendon tenosynovitis. The FHL tendon traverses medially to the os trigonum, and repetitive stress or compression to the tendon with plantar flexion can result in inflammation (Fig. 8). Chronic impingement can result in degenerative change at the synchondrosis, with cystic and sclerotic changes on both sides of the synchondrosis.

A differential diagnosis for a bony opacity that is posterior to the talus is a fracture of the fused trigonal process of the talus, which may result from forceful plantar flexion. It also results in posterior ankle pain, but in this case, knowing the acute history of the pain would be helpful in diagnosis. Another common differential is a fracture of the lateral process of the talus (i.e. Shepherd’s fracture).
Fig. 6 Os trigonum. (a) Lateral radiograph of the ankle shows an ovoid bony structure (arrow) posterior to the talus (asterisk). The structure is well corticated, likely representing an os trigonum rather than a fracture. (b) Sagittal T1-weighted MR image shows an os trigonum (arrow) with a synchondrosis between the ossicle and talus.

Fig. 7 Posterior ankle impingement syndrome. (a & b) Sagittal T2-W MR images show bony oedema (arrows in a) in the ossicle and posterior talus at the synchondrosis. There is also synovitis with a small effusion (arrow in b) at the posterior ankle. (c) Sagittal MR image of the ankle of a 26-year-old man who presented with posterior ankle pain also shows bony oedema (arrows) in the posterior talus and os trigonum, with a small joint effusion (arrowhead).

Fig. 8 Posterior ankle impingement syndrome. (a) Sagittal T2-W MR image shows bony oedema (arrowheads) in the talus (asterisk) and os trigonum posteriorly, with fluid surrounding the flexor hallucis longus tendon (arrows), which suggests tenosynovitis. (b) Axial proton-density MR image of the same patient with posterior impingement better demonstrates the fluid (arrows) surrounding the flexor hallucis longus tendon (asterisk), which suggests tenosynovitis.
OS PERONEUM
The os peroneum is located adjacent to the calcaneocuboid joint (Fig. 9) and embedded within the peroneus longus tendon. It is best seen on lateral or oblique views of the foot. The os peroneum may be bipartite in 30% of cases and bilateral in 60% of cases.²

The os peroneum may become symptomatic, presenting as lateral foot pain⁵⁻⁶ and tenderness, which is also known as painful os peroneum syndrome. This can be due to fracture of the ossicle (Fig. 10) or degeneration.⁸ In patients with this condition, axial T1-W MR imaging (Fig. 10) may show abnormal T2 signal within the ossicle and tendinosis of the peroneus longus tendon.¹⁰ Ultrasonography may also be used to demonstrate inflammatory change in the soft tissue, and tendon tears or tenosynovitis of the peroneus longus tendon.¹⁰

OS VESALIANUM
The os vesalianum (Fig. 11) is situated proximal to the base of the fifth metatarsal, within the peroneus brevis tendon.² It may be seen in about 0.1%–1.0% of individuals¹¹ and must be differentiated from an apophysis of the fifth metatarsal, which is oriented parallel to the metatarsal shaft. The os vesalianum rarely causes symptoms. In the setting of pain, other diagnoses should also be considered, such as a fracture of the fifth metatarsal base or apophysitis, which is inflammation of the apophysis at the fifth metatarsal base.
OS INTERMETATARSEUM

The os intermetatarseum (Fig. 12) is situated between the first and second metatarsals. Three types have been described; it may be (a) free-standing, having no articulation with the adjacent bones; (b) articulating, forming a joint between the first or second metatarsal bases and/or the medial cuneiform, in any combination; (c) fused, arising as a spur from any of the adjacent bones. The reported incidence shows variation between anatomical studies (up to 13%) and radiological studies (up to 7%). This variation may be due to the difficulty in identifying these small ossicles that can be easily obscured on radiographs by adjacent bony structures.

This ossicle may occasionally be symptomatic, presenting as dorsal foot pain or paraesthesia with numbness over the first intermetatarsal space, probably due to compression of the branches of the deep peroneal nerve. The onset usually follows trauma, with other reported inciting factors such as tight footwear and cavus feet. The os intermetatarseum may also be mistaken for a fracture at the base of the second metatarsal, which occurs in Lisfranc injuries. We present a case of a fractured os intermetatarseum in a patient post-trauma (Fig. 12).

Symptomatic os intermetatarseum is usually treated conservatively with nonsteroidal anti-inflammatory drugs and footwear or activity modification, failing which, surgical excision may be considered.

SESAMOIDS

Sesamoids of the foot can be subdivided into hallucal, interphalangeal joint and lesser metatarsal sesamoids. In humans, hallucal sesamoids are invariably present. Hallucal sesamoids have medial and lateral components. They can be bipartite, which is usually seen in the medial sesamoid if this occurs. Chronic pain over the sesamoids, often referred to as sesamoiditis, can occur from chronic stress and repetitive injury to the sesamoid. It most commonly involves the hallucal sesamoid. MR imaging (Fig. 14) is useful for diagnosis and shows abnormal signals in the sesamoids and surrounding soft tissue inflammation (i.e. tendinitis or synovitis). Bone scintigraphy may also be helpful in difficult cases to show increased tracer uptake in the sesamoids.
CONCLUSION
There are many different accessory ossicles of the foot, only some of which have been featured in this article. It is important to recognize the existence of these ossicles, as they can be an important cause of a patient’s symptoms. Being cognisant of these ossicles also prevents us from misdiagnosing them as fractures in the setting of foot pain, which is a commonly encountered situation. Apart from radiographs, advanced imaging techniques such as CT, MR imaging and even ultrasonography or nuclear medicine techniques can be helpful in establishing the diagnosis in difficult cases and evaluating foot pain secondary to accessory ossicles.

REFERENCES
Pictorial Essay

SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME
(Code SMJ 201804B)

Question 1. Regarding accessory ossicles:

a) They are only found in the foot. □ True □ False
b) They are usually congenital. □ True □ False
c) They are usually symptomatic. □ True □ False
d) They may mimic fractures. □ True □ False

Question 2. Regarding the accessory navicular:

a) Type 1 accessory navicular has a cartilaginous interface (synchondrosis) with the navicular bone. □ True □ False
b) Type 2 accessory navicular is most commonly symptomatic. □ True □ False
c) Radiographs are usually diagnostic for os naviculare syndrome. □ True □ False
d) Tears of the posterior tibial tendon may be seen in os naviculare syndrome. □ True □ False

Question 3. Regarding the os trigonum:

a) It is best seen on the anterior-posterior projection of the ankle radiograph. □ True □ False
b) It may mimic a lateral talocrural process fracture. □ True □ False
c) Bright T1-weighted signal is a sign of bone marrow oedema in posterior ankle impingement syndrome. □ True □ False
d) Flexor hallucis longus tenosynovitis may be a feature in posterior ankle impingement syndrome. □ True □ False

Question 4. Regarding accessory ossicles:

a) The os peroneum is located within the peroneus brevis tendon. □ True □ False
b) Lateral foot pain is a feature of os peroneum syndrome. □ True □ False
c) The os intermetatarsun is located between the third and fourth metatarsals. □ True □ False
d) Fracture at the base of the fifth metatarsal may mimic an os vesalianum. □ True □ False

Question 5. Regarding sesamoids of the foot:

a) Hallucal sesamoids have medial and lateral components. □ True □ False
b) Bipartite sesamoid is most commonly seen in the lateral hallucal sesamoid. □ True □ False
c) Sesamoiditis most commonly involves the interphalangeal sesamoid. □ True □ False
d) Increased T2-weighted signal in the sesamoid is a feature of sesamoiditis. □ True □ False

Doctor’s particulars:
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Specialty: ______________________________________________  Email: ______________________________________________

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