Case Reports and Series

Progressive flatfoot deformity accompanied with avulsion and dislocation of accessory navicular

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ABSTRACT

The accessory navicular is one of the most common accessory bones in the foot, and it is mostly asymptomatic. Symptomatic cases largely belong to type 2, which is characterized by the presence of a 1-3 mm synchondrosis between the large accessory navicular and the native navicular. Chronic injury to the synchondrosis is considered to be a major cause of symptoms. In this case report, we describe an uncommon case of an avulsed type 2 accessory navicular, which was dislocated to the level of the medial malleolus. A plantar slip existed between the accessory and the native naviculars, which enabled the patient to perform an active inversion of the foot, but not a single heel raise. The collapse of the medial longitudinal arch progressed rapidly over 4 months prior to surgery, with an increased lateral hindfoot pain, suggesting an impingement due to the progression of hindfoot valgus. Surgical treatments, including plication of the ruptured spring ligament, excision of the accessory navicular, and transfer of the flexor digitorum longus tendon, were successful in improving the symptoms and flatfoot deformity. This case represents an uncommon subtype of symptomatic accessory navicular with complete avulsion and dislocation, presenting as a posterior tibial tendon dysfunction disorder and progressive flatfoot deformity.

Introduction

The accessory navicular is an extra bone, located posterior to the posterm medial tuberosity of the navicular and is commonly seen in up to 25% of the population.1 The accessory navicular is classified into three types: 1) type 1: a small sesamoid bone embedded in the substance of the insertion of the tibialis posterior, 2) type 2: a separated accessory bone, attached to native navicular via synchondrosis, and 3) type 3: a fused accessory navicular, resulting in prominent navicular tuberosity.2 Although the majority of patients with accessory navicular are asymptomatic, symptomatic cases largely belong to type 2 and occur mostly in adolescents between the ages of 10 and 15, when they are likely to gain weight and become more active in sporting activity.2

The type 2 accessory navicular is usually 8-12 mm in size and connected to the native navicular by a 1-3 mm synchondrosis, composed of fibrocartilage.3 Damage to this fibrocartilaginous interface by tensile, shearing, or compressive forces transmitted through the posterior tibial tendon is suspected to be the source of pain.5 The accessory navicular can also be the source of foot pain associated with several conditions, including posterior tibial tendon dysfunction, flattening of the medial longitudinal arch, and others.6

To the best of our knowledge, there have been no reports of an avulsed and dislocated accessory navicular as the pathological cause of symptomatic accessory navicular. The tibialis posterior tendon plays a major role in supporting the medial arch of the foot, and its degeneration is the most common cause of adult-acquired flatfoot. However, no report has mentioned avulsed and dislocated accessory navicular as a cause of progressive flatfoot deformity. In this case report, we present an uncommon case of a type 2 accessory navicular that became symptomatic due to complete avulsion, dislocation, and led to subsequent progressive flatfoot deformity.

Case presentation

A 69-year-old woman presented with a complaint of a worsening right ankle pain while walking, for the last six months. She originally had pain over the medial aspect of her midfoot, nine months ago, which worsened while wearing shoes. She was diagnosed with an accessory navicular at a nearby clinic, and received a local corticosteroid injection at the site of pain. Although local pain was relieved after this injection, she started experiencing pain around the lateral malleolus, a few months after the injection. She visited another general hospital, and was referred...
to our foot and ankle clinic with a diagnosis of flatfoot deformity accompanied by an avulsed accessory navicular bone.

Visual inspection revealed a decreased medial arch height and heel valgus. A bony fragment was palpable, just distal to the medial malleolus, and slight tenderness was noticed between the bony fragment and the tuberosity of the navicular. The patient could invert her right foot with decent tension of the posterior tibial tendon around the medial malleolus; however, the power of inversion against resistance was weaker than that of the unaffected foot. She was unable to perform a single heel raise on her right foot, although she could perform it on her left foot.

An anteroposterior view of the foot radiographs showed a type 2 accessory navicular on the left foot and an avulsed navicular around the medial malleolus on the right foot (Fig. 1A & B). A computed tomography (CT) scan of the right ankle clearly demonstrated the avulsed fragment (Fig. 1C). The lateral weight-bearing view of the foot radiographs revealed a decreased medial longitudinal arch height in the affected foot, compared to the contralateral foot, with a lateral talar-first metatarsal angle of 27° with convexity downwards in the right, and 17° in the left. Ultrasonography demonstrated that the native navicular and the avulsed accessory navicular were connected at the plantar edge by a thin soft tissue with a fibrillar pattern (Fig. 2A & B). Magnetic resonance imaging showed an enlarged posterior tibial tendon around the medial malleolus with fluid in the tendon sheath, and an avulsed fragment. It also demonstrated a high signal intensity on T2-weighted image at the lateral talar facet, suggesting a lateral impingement due to pes planovalgus deformity. Operative treatment was recommended, but the patient requested postponement for 4 months because of family issues. During the 4 months of conservative treatment using medial arch support insoles, the pes planovalgus deformity progressed, accompanied with an increasing pain around the lateral malleolus. The lateral talar-first metatarsal angle increased from 27° to 34° (Fig. 3A & B).

Surgery was performed in the supine position with a thigh tourniquet. An incision was made at the medial side of the foot, from the distal tip of the medial malleolus to the plantar side of the base of the first metatarsal. While a detached accessory navicular was found 2 cm proximal to its proper position, a connection between the detached accessory navicular and native navicular was maintained by a part of the posterior tibial tendon at the plantar edge, in accordance with the findings of ultrasonography (Fig. 4A). The spring ligament was torn longitudinally at its mid-substance, and repaired using pant-over-vest sutures (Fig. 4B). A few longitudinal tears were noted in the posterior tibial tendon located around the medial malleolus (Fig. 4C). The torn posterior tibial tendon was excised with the avulsed accessory navicular, leaving 2 cm of the attachment site to the native navicular intact. This residual tendon was used for augmentation of the spring ligament with a suture anchor at the sustentaculum tali, in accordance with the method of Ryssman et al. After the medial protuberance of the native navicular was...
Symptomatic accessory naviculars are predominantly classified as type 2. Repetitive loads on the synchondrosis through the biomechanical tension of the posterior tibial tendon lead to chronic inflammation and degenerative changes at the synchondrosis, and eventually destabilize the synchondrosis, which is considered a major pathology of symptomatic accessory naviculars. Rare conditions such as fracture or avascular necrosis of the accessory navicular have also been reported as causes of pain due to accessory navicular in adults. To the best of our knowledge, this is the first report in English literature presenting an avulsed and dislocated accessory navicular as a pathological condition in symptomatic cases.

Although the exact cause of the avulsion was unknown, the local corticosteroid injection was considered a possible trigger of this rare condition because of the absence of any history of trauma. A link between local corticosteroid injection and tendon rupture has been reported at various sites in the extremities. The posterior tibial tendon attaches to both the accessory navicular and native navicular in type 2. Larger the accessory navicular, lesser is the attachment of the posterior tibial tendon to the native navicular. The smaller cross-sectional area of the attachment of the posterior tibial tendon to the native navicular in case of a large accessory navicular is presumed to be vulnerable to injury and stress.

Simple excision of the accessory navicular, with or without repair of the attachment of the posterior tibial tendon or fusion of the native and accessory naviculars are the standard surgical procedures for type 2 accessory navicular. Simple excision is an easy and appropriate procedure for small fragments; however, large accessory naviculars involving a major part of the posterior tibial tendon attachment have the potential risk of loss of power of the tendon post-excision, and are often addressed by repairs of the attachment site. The bone-to-bone union preserves the complex anchoring structure between the calcified fibrocartilaginous layer and the bone layer at the tendon-accessory navicular junction, which is considered mechanically advantageous. Fusion can be a reasonable option for fragments that are large enough to accept internal fixation devices, such as small fragment screws. In the present case, degenerative changes in the posterior tibial tendon and difficulty in pulling down the dislocated fragment excluded these procedures, preserving the function of the posterior tibial tendon. Instead, we transferred the FDL tendon to the native navicular to replace the function of the posterior tibial tendon.

The crucial role of the spring ligament in the pathological process leading to flatfoot deformity has received much attention, along with the growing understanding of its anatomy and biomechanics. Pisani described that the presence of an accessory navicular bone is suspected to be a possible pathogenic cause of degenerative changes in the spring ligament. In the present case, the plication of the spring ligament in addition to the FDL tendon-transfer provided good clinical outcomes and radiographic recovery of the flatfoot without bony correction.

The patient could invert her foot, regardless of diastasis at the synchondrosis. This was attributed to the continuity of the part of the posterior tibial tendon at the plantar edge between the accessory and native navicular. A cadaveric study by Olewnik described that the morphology of the insertion of the posterior tibial tendon was classified into four types.
based on the number of bands at the distal attachment: type I, a single band; type II, a double distal attachment; type III, a triple distal attachment; and type IV, quadruple distal attachment.15 Type III is the most common (43.8%) where the main tendon inserts into the navicular and the medical cuneiform, with two accessory bands to the medial, lateral, or intermediate cuneiforms or to the metatarsals. All types have commonality in having a main tendon inserted into the navicular and also to the plantar surface of medial cuneiform. The remaining connection between the dislocated accessory navicular and native navicular in the present case was formed by the plantar part of this main band attached distally. Although the patient could perform active inversion of the foot, she could not perform a single heel raise, and had a progressive flatfoot deformity for a brief period of 4 months. A case series study by Chen et al. involving 14 patients (mean age, fifty-five years) with intra-operatively confirmed injuries of the accessory navicular synchondrosis demonstrated that the complete separation of synchondrosis was associated with a decreased function of the posterior tibial tendon and a collapsed arch of the foot.5 Patients with accessory navicular type 2 presenting with posterior tibial tendon dysfunction should be carefully differentiated between tendon degeneration and synchondrosis separation.

Conclusions

This case report describes a rare case of progressive flat foot deformity in an elderly woman resulting from an avulsed and dislocated accessory navicular. Excision of the accessory navicular and soft tissue procedures, including FDL transfer and plication of the spring ligament, provided good clinical outcomes. This case represents an uncommon subtype of symptomatic accessory navicular and it may stress the need for surgical treatment of this condition.

Author contribution

Conception and design of the study: SN, TM, ST; Acquisition of data: YM, TJ, HT; Analysis and interpretation of data: SA, SN, TM; Writing–original draft: SA, Writing – review & editing: TM, ST; Final approval of the version to be submitted: All authors.

Declaration of Competing Interest

None.

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Informed consent

Written informed consent was obtained from the patient.

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