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CASE REPORT

Lateral foot pain due to os vesalianum pedis in a young football player; a case report and review of the current literature

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Abstract

Os vesalianum pedis is a rare accessory ossicle located at the 5th metatarsal base. This anatomic variation is typically asymptomatic and usually detected incidentally on routine foot radiographs. However, it may be a source of lateral foot pain and rarely become symptomatic following traumatic ankle injuries such as an inversion ankle sprain. To date, seven symptomatic os vesalianum pedis cases that required surgical treatment have been reported in the current literature. Herein, a 17-year-old professional football player with a symptomatic os vesalianum pedis was presented. The ossicle was surgically removed upon failure of conservative treatment. At the sixth month, the patient returned to sport without any restriction or pain. Clinical presentation, diagnosis, and treatment options of symptomatic os vesalianum pedis were discussed with an extensive literature review.

Keywords Accessory ossicle · Foot · Os vesalianum pedis · Anatomic variation · Metatarsal apophysis

Introduction

Numerous skeletal variations such as accessory ossicles, bipartitions, and coalitions can be observed around the foot and ankle. These anatomic variations usually remain asymptomatic, but they rarely become symptomatic and involved in various disorders. Accessory ossicles are among the most common skeletal variation seen around tarsal bones [1]. Os vesalianum pedis (OVP) is an accessory ossicle located at the base of the fifth metatarsal bone. The anatomist and physicist Andreas Vesalius first defined this variation in his illustrated anatomy book '*De Humani Corporis Fabrica*' published in 1543. Later on, this accessory ossicle was named 'Os vesalianum pedis' by Pfitzner in the memory of Andreas Vesalius [2, 3]. It is a relatively rare accessory ossicle compared to commonly seen ossicles such as os trigonum and an accessory navicular bone. The incidence of OVP is reported to be between 0.1 and 5.9% in different radiographic survey studies [4–6]. Although it is identified as an incidental radiographic finding in asymptomatic cases, the number of symptomatic cases that required surgical treatment is rare in the current literature. To the best of our knowledge, only seven previous cases have been reported in the English literature to date (Table 1) [7–13]. Since symptomatic OVP is rare, there is insufficient knowledge about their treatment and follow-up in the relevant literature. In this article, a case with symptomatic OVP is presented and the diagnosis, treatment, and follow-up of this rare disorder have been discussed with an extensive literature review.

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Table 1 List of surgically treated symptomatic os vesalianum pedis cases in the current English literature

Case #	First author	Year	Age	Sex	Side	Main symptom	History of acute trauma	Sports activity/ Occupation	Treatment	Outcome
1	Baastrup CI.	1921	28	M	L	Pain on walking barefoot	None	Not reported	Excision	Not reported
2	Smith AD.	1984	17	F	B	Chronic foot pain with bilateral prominence at the 5th metatarsal base	None	Not reported	Bilateral excision of the ossicle and tenorrhaphy of the detached peroneus brevis tendon	Follow-up: 12 months Asymptomatic for both feet
3	Inoue T.	1999	13	F	B	Chronic foot pain on lateral margins of both feet. Right worse than the left one	None	Volleyball player	Right foot; Osteosynthesis with bone grafting from iliac wing Left foot; Shoe insert	Follow-up; 2 years Right remained asymptomatic Union was obtained Left foot had still pain
4	Wilson TC.	2011	24	F	R	Chronic pain of the fifth metatarsal base	None	Waitress	Excision of the ossicle Tenorrhaphy of the detached peroneus brevis tendon to remaining intact part	Follow-up: 6 months Remained asymptomatic Returned back to normal activity
5	Dorrestijn O.	2011	25	F	B	Right: Pain localized to the proximal portion of the fifth metatarsal Left: Pain on walking uneven surfaces	Right: Kicked a box with the lateral side of her left foot Left: None	Not reported	Excision of the right ossicle Tenorrhaphy of the detached peroneus brevis tendon to remaining intact part Conservative treatment for left	Follow-up: 8 months Asymptomatic for both feet Iatrogenic sural nerve injury resulted with a sensory loss at the lateral side of her right foot
6	Petrera M.	2013	41	M	B	Chronic right foot pain aggravated by his golf swing for 7 months Left: No pain	None	Golf player	The ossicle excised, and peroneus brevis tendon reattached using a suture anchor	Follow-up: 3 months Asymptomatic for both feet Returned to golf
7	Beil FT.	2017	19	F	L	Chronic pain over the lateral aspect of her left foot for several years	None	No intense athletic activity	Excision of the ossicle Insertion of the peroneus brevis tendon was intact that did not require re-insertion	Follow-up: 6 months Pain-free even after long working days
8	Current Case	2019	17	M	L	Chronic lateral sided foot pain that worsened after the recent ankle sprain	Acute ankle sprain	Football player	Excision of the ossicle Peroneus brevis tendon reattachment through bone tunnels with non-absorbable sutures	Follow-up: 6 months Returned back to the sport Free of pain even with strenuous physical activity

M male, *F* female, *L* left, *R* right, *B* bilateral

Case report

A 17-year-old professional football player presented to our outpatient clinic with complaints of lateral-sided foot pain after he sustained inversion ankle sprain 3 weeks earlier. The pain was localized to the fifth metatarsal base at the attachment of the peroneus brevis tendon. The patient reported that he previously had intermittent lateral foot pain, which had been exaggerated after the intense sports exercises. However, the pain worsened after the recent ankle sprain, although he had been treated with rest, ice, and non-inflammatory medication by the team doctor. On physical examination, slight prominence was seen at the fifth metatarsal base that was tender on palpation (Fig. 1). Inversion and plantar flexion of the foot was painful. The ankle joint range of motion was normal without instability findings. The neurovascular examination was also normal. The Foot and Ankle Disability Index (FADI) score was 48.1 points.

Direct radiographic examination of the foot showed a bean-shaped oval bone fragment at the 5th metatarsal base (Fig. 2). Because the patient was an elite sportsman and had a recent ankle sprain, computerized tomography (CT) was performed to rule out the possibility of an acute 5th metatarsal base fracture or stress fracture. On CT examination, the fragment was rounded and well corticated and it was separated from the metatarsal with a synchondrosis-like joint (Fig. 3). These imaging findings were consistent with an accessory ossicle; i.e., OVP. To understand whether the identification of OVP was incidental or it is the actual reason for lateral foot pain, further imaging studies were requested. On MRI examination, there were no signs of peroneal tendon pathology, and the ossicle showed no edema (Fig. 4). However, on scintigraphy examination, there was increased uptake around the ossicle, which was consistent with an inflammatory process (Fig. 5). Based on these clinical and imaging findings a diagnosis of symptomatic OVP was made.

Initially, conservative therapy consisting of stretch exercises, rest, and anti-inflammatory medication was started.

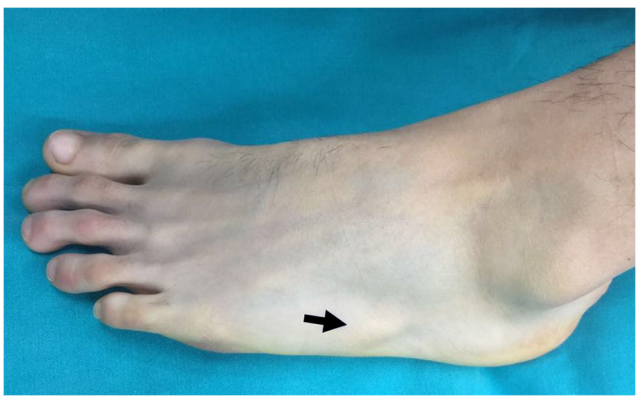

Fig. 1 Clinical appearance of the patient. The *black arrow* shows the prominence of the 5th metatarsal base

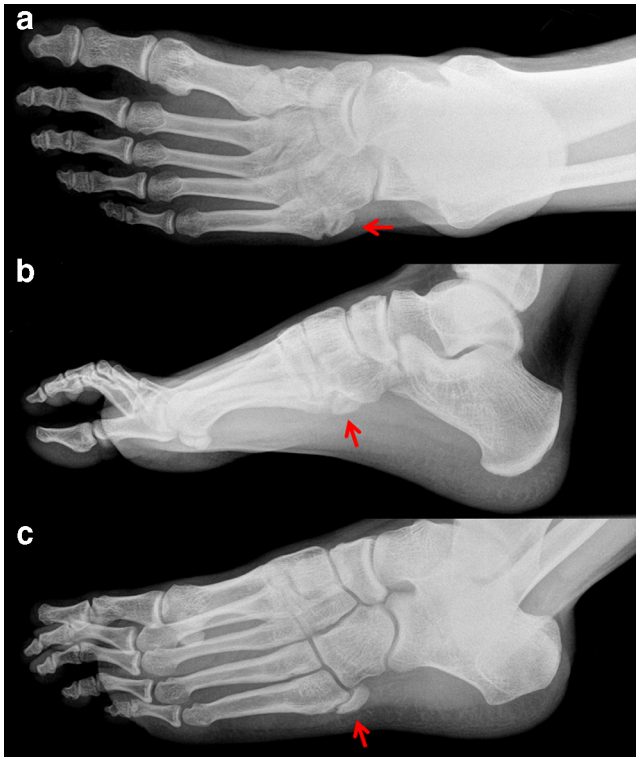

Fig. 2 Anteroposterior (**a**), lateral (**b**), and oblique (**c**) foot radiographs. *Red arrows* show the accessory ossicle

The number of training sessions and intensity were reduced. Despite adherence to conservative therapy for 3 months, lateral foot pain slightly improved. The patient continued to experience exacerbation of lateral foot pain even after simple straight running. FADI score at the end of conservative management was 53.8 points. Due to the failure of conservative therapy, surgical excision of the ossicle was decided.

Under spinal anesthesia and tourniquet control, a longitudinal 5-cm incision extending from the cuboid to the 5th metatarsal base was made. The lateral dorsal cutaneous nerve was dissected and protected. The peroneus brevis and longus tendons were identified. The ossicle was detached from the peroneus brevis tendon by sharp longitudinal dissection. Approximately 2 × 2 × 1-cm-sized ossicle was disarticulated and excised through its synchondrosis joint (Fig. 6). Almost half of the peroneus brevis tendon fibers were remaining attached to the metatarsal bone. Tenodesis of detached peroneus brevis tendon to the 5th metatarsal base was performed through bone tunnels using nonabsorbable sutures. The subcutaneous tissues and skin were closed properly. A below knee cast was applied to the patient immediately after the operation. The postoperative period was uneventful and the patient was discharged on the first postoperative day. Pathological examination of the ossicle demonstrated the presence of subchondral cortical bone and overlying hyaline-like cartilage at the articulating surface of the ossicle (Fig. 7).

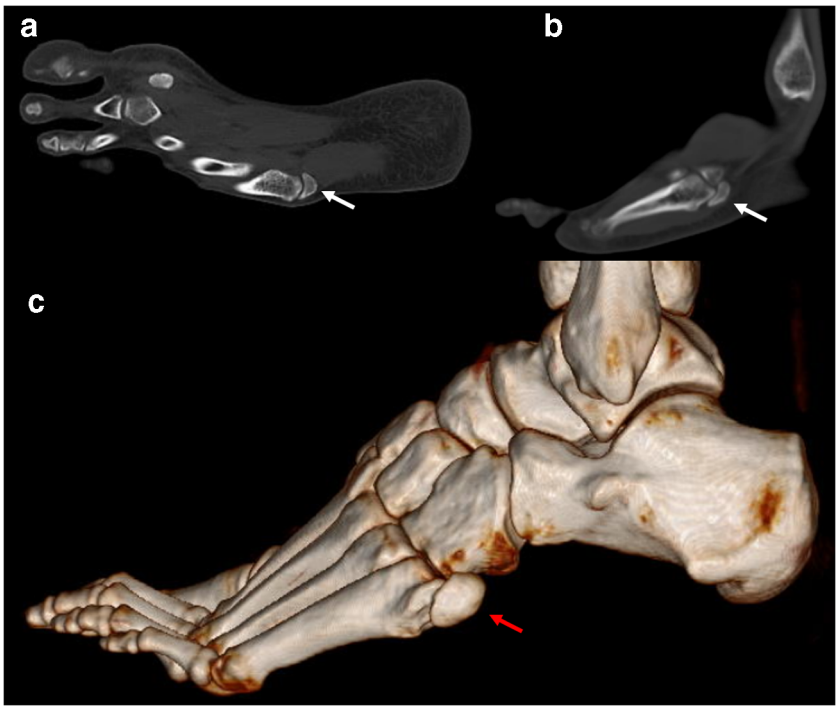

Fig. 3 Computerized tomography (CT) examination of the foot. Axial (**a**), and sagittal (**b**) sections demonstrated (*white arrows*) a corticated and rounded ossicle at the base of 5th metatarsal bone. 3D CT (**c**) reconstruction of the foot shows the OVP (*red arrow*)

The patient wore a below-knee splint for 10 days. Afterward, the cast was removed and weight-bearing was allowed as tolerated with ankle air-cast boot, and physical therapy program including ankle range of motion and strengthening was initiated. Symptoms completely regressed at the end of the second postoperative month. Straight running exercises were initiated at the third month and the intensity of training exercises increased gradually. At the postoperative 6th month, the patient returned to regular sporting activities without any restriction and pain. FADI score at the final follow-up was 100 points.

Discussion

The exact origin of the OVP is unknown, however there are some theories about the occurrence of this accessory ossicle. In normal development of the foot, the fifth metatarsal bone ossifies from two main ossification centers; a primary center for the shaft, and a secondary epiphyseal center for the head. Ossification of the shaft starts at about third month of gestation, and the head ossification appears between the third and fourth years (4.5 years in boys, 3.2 years in girls). These ossification centers unite with each other at about 14 to 16 years

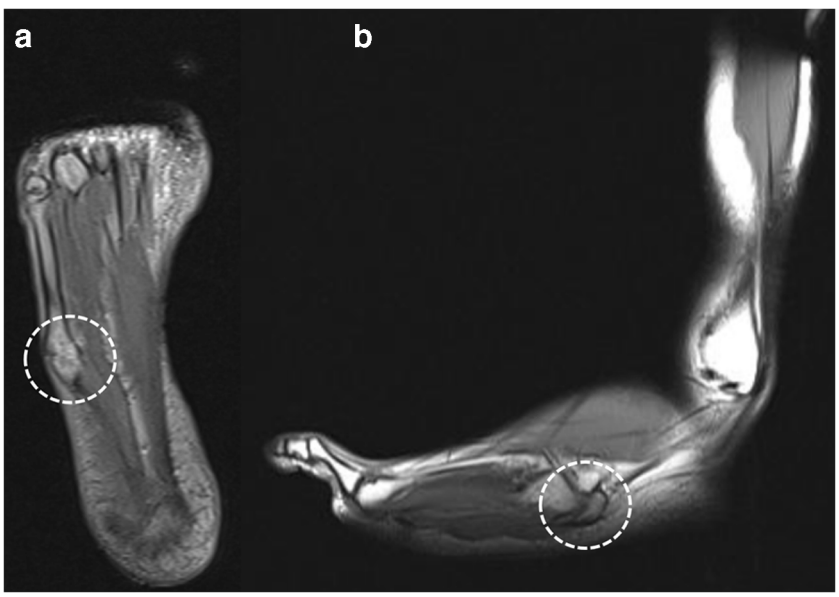

Fig. 4 T2 weighted axial (**a**) and T1-weighted sagittal (**b**) MR imaging of the foot. *White circles* show the OVP without any abnormal intensity

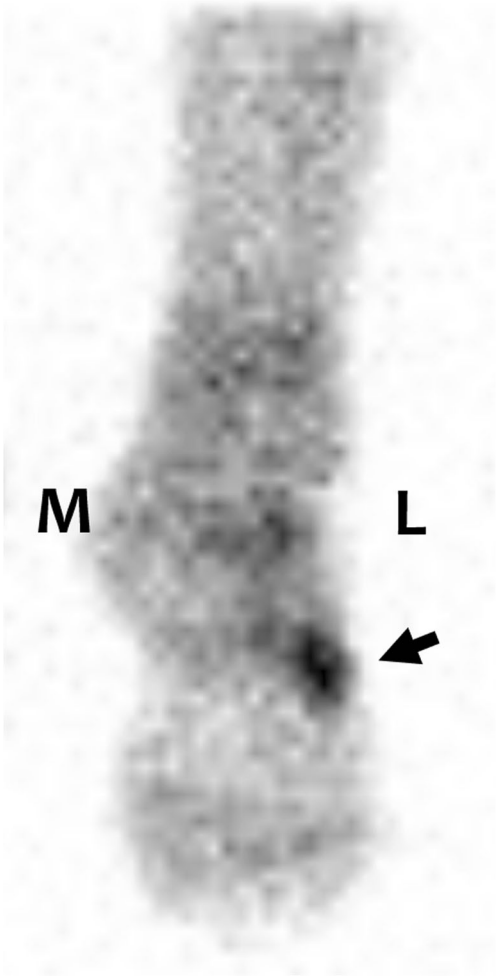

Fig. 5 Scintigraphy of the foot demonstrated increased uptake at the base of 5th metatarsal bone (*black arrow*). *L* lateral, *M* medial

of age (16 years in boys, 14.1 years in girls) [14]. However, at an average age 12 for boys (range, 11–14) and 10 for girls (range, 9–11), another apophyseal line appears at the fifth metatarsal base on plain radiographs. Fusion of the apophysis to the metatarsal base usually occurs within the following 2–4 years [15]. First theory proposes that failure of fusion of the

Fig. 7 Postoperative radiograph at the final follow-up

apophysis to the shaft of the fifth metatarsal base results in the formation of OVP. In other words, it is proposed that OVP is a persistent apophysis [7, 16]. The second theory suggests that OVP may be an ununited metatarsal tuberosity avulsion fracture. If the fracture ends with pseudarthrosis, the sharp edges of the fragments may become rounded and a fibrous cartilaginous connection between the fragments may resemble a free ossicle on radiographs [7]. However, it is hard to explain the bilateral presence of the ossicle, which is usually a mirror image of each other. Finally, Northover et al. proposed that this ossicle may be incomplete postaxial polymetatarsia in the absence of a supernumerary digit [17], but the authors have no evidence to support their proposal. Despite these arguments, it is widely accepted that OVP is a true accessory ossicle and an anatomical variant.

Symptomatic OVP usually presents with lateral foot pain located at the 5th metatarsal base. In fact, the presence of OVP does not always mean that it will be symptomatic and cause foot pain and disability. There are numerous cases whom OVP was incidentally detected without any symptoms and problems [17–19]. It is not exactly known why OVP becomes symptomatic or which factors are responsible for the initiation of pain. In this presented case, the patient was actively engaging in sporting activities and sustained an ankle sprain just before the symptoms were exaggerated. Similarly, Boya et al. reported a 22-old-man who sustained ankle sprain and

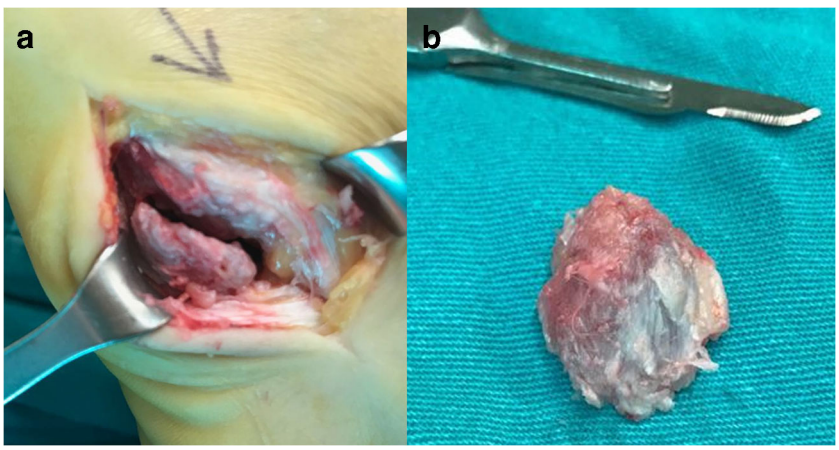

Fig. 6 **a** Intraoperative appearance of the OVP. **b** Excised ossicle was 2 × 2 × 1 cm in size

presented to the ED with lateral foot pain [20]. Dorrestijn et al. reported another case who had symptoms after the patient had accidentally kicked a box with the lateral site of her left foot [11]. Besides examples of initiation of symptoms after an acute traumatic event, there are other cases related to repetitive microtrauma and long-lasting symptoms. Petrera et al. reported a golf player with a chronic lateral sided foot pain, which is aggravated during the follow-through phase of his golf swing [12]. Inoue et al. reported another 13-year-old girl who is a volleyball player with chronic foot pain [9]. On the contrary, there are other symptomatic cases without an antecedent traumatic event or overuse. Beil et al. reported a 19-year-old girl who had no history of trauma to the foot or ankle, and did not report any intense athletic activity [13]. It is difficult to make a clear decision on this issue because of the clinical pictures that contradict with each other. However, we think that chronic inflammation caused by the instability of synchondrosis joint after repeated microtrauma or acute trauma triggers pain. This is the most probable mechanism in athletes. The clinical presentation of acute fifth metatarsal base fractures and OVP is the most confusing scenario. In context of trauma, OVP may be mixed with fifth metatarsal base avulsion fractures. However, the absence of edema, ecchymosis, and severe tenderness are useful physical examination findings to exclude a fracture [18]. The radiological examination provides more reliable information for the discrimination.

OVP and numerous different entities which have similar radiographic appearance may cause confusion on imaging examination (Fig. 8). However, direct radiographic examination of OVP has some distinct characteristics that help for the identification and prompt diagnosis. OVP is usually separated from the metatarsal base by a thin synchondrosis joint line with a constant width. This joint line follows an oblique course with the long axis of the 5th metatarsal bone. The ossicle is surrounded by cortical bone and the edges are usually oval. However, the most remarkable radiographic finding of OVP is its articulation with adjacent cuboid bone [20–23]. These features are not observed in the commonly seen avulsion fractures of the 5th metatarsal bone. The fracture line has sharp edges and the avulsed fragment lack cortical bone at the fracture plane [18]. Os peroneum, an accessory ossicle that can be detected in this region, should be kept in mind in the differential diagnosis. Os peroneum is a sesamoid bone embedded in the tendon of peroneus longus muscle. This ossicle is usually found in the location where the tendon changes direction at a sharp angle around the cuboid and it articulates with cuboid bone. In the oblique foot radiographs, os peroneum may be mixed with OVP due to its proximity to the 5th metatarsal base. However, os peroneum is smaller than that of OVP and it is bean-shaped sesamoid bone [1, 22, 23]. In skeletally immature patients, normal 5th metatarsal apophysis appears as a small, shell-shaped fleck of bone oriented parallel to the metatarsal shaft and is located on the plantar lateral aspect of the fifth metatarsal tuberosity [16]. This radiographic appearance may be mixed with OVP in skeletally immature patients. The patient's age is a crucial clinical

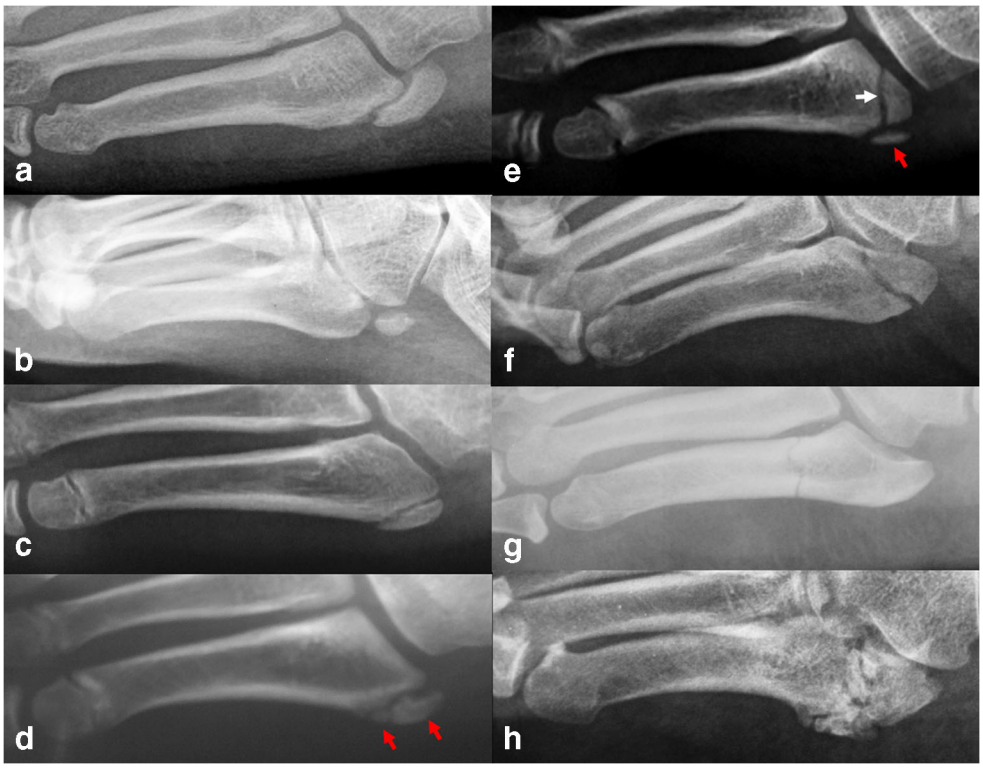

Fig. 8 Differential diagnosis of OVP, which may have similar radiographic appearance. **a** Os vesalianum pedis. **b** Os peroneum. **c** Normal apophysis of the 5th metatarsal. **d** Iselin's disease. Please note the irregular apophyseal line and fragmentation (*red arrows*). **e** Avulsion fracture (*white arrow*) in the presence of apophysis (*red arrow*). **f** Jones fracture at the metaphyseal-diaphyseal junction. **g** Pseudarthrosis of avulsion fracture of 5th metatarsal bone

information in radiographic discrimination. Iselin's disease should also be remembered during the assessment of the apophysis in adolescents particularly patients presenting with pain. In Iselin's disease, the apophysis may be fragmented and the apophyseal line becomes somewhat irregular. However, these radiographic findings should accompany pain and tenderness at the 5th metatarsal base [24, 25]. After confirmation of the diagnosis of OVP, one should also confirm that the exact cause of the foot pain is the ossicle. MRI is useful for the demonstration of inflammation around the ossicle which is seen as bone edema. However, it may be inconclusive as in our case. Scintigraphy is reported to be sensitive but not specific for discrimination between symptomatic versus asymptomatic accessory ossicles [26]. Doresjtin et al. reported a bilateral symptomatic OVP case detected with scintigraphy [11]. Similarly, the source of pain was confirmed with scintigraphy in the presented case.

The treatment of symptomatic OVP should be started with conservative methods. Rest or activity modification, shoe inserts, stretching exercises, and non-steroid anti-inflammatory medications are most commonly used traditional treatment modalities [7–13]. Surgical treatment should be performed in case of refractory cases. Before any surgical intervention, it should be ensured that the actual cause of lateral foot pain is the OVP. In other words, other possible cause of lateral foot pain should be excluded to avoid overtreatment. Two different surgical techniques have been used in the reported cases. One of them is excision of the ossicle and the other is the fixation of the ossicle to obtain fusion between the ossicle and the fifth metatarsal. Fusion technique was used in only one case. Inoue et al. treated a 13-year-old volleyball player with osteosynthesis of the ossicle with a cannulated screw after resection of fibrous tissue and iliac bone grafting. They obtained fusion and removed the screw at fifth month postoperatively. The patient remained symptom-free at the final follow-up 2 years after the operation [9]. They recommended fusion technique if the ossicle is sufficiently large for fixation, to protect the peroneal functions in patients who desire to participate in strenuous physical activity. Apart from this case, all other authors preferred total excision of the ossicle [7, 8, 10–13]. Since the peroneus brevis inserts to this ossicle, the tendon must be detached either partially or entirely from the ossicle during excision. Therefore, reattachment of peroneus brevis tendon is necessary for the continuation of peroneal functions. Beil et al. reported that the tendon continuity was not impaired during excision of the ossicle and they did not perform any additional intervention [13]. Wilson and Dorrestijn et al. reported that a small portion of the tendon had to be detached and they repaired it with side to side suture [10, 11]. In addition, in our case, almost half of the tendon was found to be attached to the ossicle, thus tenodesis had to be performed by using nonabsorbable sutures through bone tunnels. Similarly, Petrera et al. reported that they performed tenodesis using suture anchor [12]. In the light of these intraoperative findings of the reported cases, the peroneus brevis tendon inserts to the ossicle with a variable amount of attachment. The surgeon should decide how to repair the tendon after excision of the ossicle in each case. Although satisfactory outcomes were reported in both surgical techniques, we think that the fusion technique has some distinct disadvantages. First, the fusion technique requires iliac bone grafting, which is usually associated with donor site complications such as pain and poor cosmesis. Second, it involves the use of metallic screws, which is frequently removed in another session of operation. Furthermore, there is still a possibility of nonunion of the ossicle. Therefore, we recommend excision over fusion technique based on the disadvantages as mentioned above. During surgical exposure, the cutaneous branch of the sural nerve lies within the surgical area. Therefore, it should be carefully dissected and protected. Dorrestijn et al. reported an iatrogenic injury to this cutaneous nerve that resulted in permanent hypoesthesia over the lateral side of the foot [11].

Conclusions

In conclusion, OVP is a rare accessory ossicle located at the fifth metatarsal base. It may become symptomatic and cause lateral foot pain following an acute ankle sprain or repetitive microtrauma. Localized pain on the 5th metatarsal base and visualization of OVP on direct foot radiographs is usually sufficient for the diagnosis. However, in cases where the main source of pain is not fully understood, further advanced imaging methods are very useful. Differential diagnoses of OVP include several distinct entities namely os peroneum, the apophysis of the 5th metatarsal bone, Iselin's disease, and fractures of the 5th metatarsal tuberosity. All of these diagnoses with similar radiographic appearance should be carefully evaluated and discriminated before the definitive diagnosis is made. Treatment of symptomatic OVP should start with conservative treatment. Cases that are unresponsive to conservative treatment should be managed with surgical treatment. Excision of the ossicle and tenodesis of OVP to the 5th metatarsal base through bone tunnels is an excellent option that provides satisfactory outcomes.

Compliance with ethical standards

Conflict of interest statement The authors declare that they have no conflict of interest.

Informed consent Written informed consent has been obtained from the patient for publication of medical records and imaging.

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