ORIGINAL RESEARCH ARTICLE

Radiographic Assessment of Accessory Ossicles in Foot and Ankle in Pondicherry Population – A Retrospective Study

Elamparidhi Padmanaban[1], Kamala Manogna Nibhanupudi[2], Umamageswari Amirthalingam[3], Anand AM[4], Mohammed Rafi Kathar Hussain[5], Sudhakar Pitchumani[6]

[1]Assistant Professor, Department of Radio-Diagnosis, [2]Junior resident, Department of Radio-Diagnosis, [3]Professor and Head, Department of Radio-Diagnosis, [4]Assistant Professor, Department of Radio-Diagnosis, [5]Assistant Professor, Department of Radio-Diagnosis, [6]Senior resident, Department of Radio-Diagnosis, Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Kalitheerthalkuppam, Puducherry 605107, India

Corresponding author: Dr. Kamala Manogna Nibhanupudi, Junior Resident, Department of Radio-Diagnosis , Sri Manakula Vinayagar Medical College and Hospital, Madagadipet, Kalitheerthalkuppam, Puducherry 605107, India

DOI: http://dx.doi.org/10.21276/ijcmsr.2021.6.3.4

How to cite this article: Elamparidhi Padmanaban, Kamala Manogna Nibhanupudi, Umamageswari Amirthalingam, Anand AM, Mohammed Rafi Kathar Hussain, Sudhakar Pitchumani. Radiographic assessment of accessory ossicles in foot and ankle in pondicherry population – a retrospective study. International Journal of Contemporary Medicine Surgery and Radiology. 2021;6(3):C16-C19.

A B S T R A C T

Introduction: Accessory ossicles are developmental anatomical variants appearing as secondary ossification centers. Sesamoid bones develop from their own ossification centers, which are partially or completely embedded within the tendon substance.

Material and methods: The retrospective study was conducted in the Department of Radio-Diagnosis of Sri Manakula Vinayagar Medical College, Pondicherry. 1000 patients who were referred for trauma work-up and chronic pain from June 2019 to June 2020, with normal radiograph were included in the study.

Results: In the present study, 181(18.1%) patients out of 1000 showed presence of at least one accessory ossicle and about 9% of the patients showed coexistence of more than one ossicle. The most common accessory ossicle detected was accessory navicular, found in 71 patients followed by Os Peroneum, Os Vesalianum, and Os trigonum. Of the 1000 patients, 674 were men and 326 were women. Sesamoid bones were found in 104 patients and in those, 12 had more than one sesamoid bone. Hallux sesamoid bone was practically found in all the patients. Bipartite hallux was found in 7.4% of the patients and is the most common sesamoid bone found in foot and ankle in our study.

Conclusion: The current study speaks to point-by-point report on the incidence of various accessory ossicles in the foot and ankle in Pondicherry population. It also provides anatomical information that helps clinicians in the diagnosis and management of disorders of accessory ossicles and sesamoid bones.

Keywords: Accessory Ossicles, Sesamoid Bones, Anatomical Variants, Ankle, Foot, Radiograph, Prevalence, Pondicherry Population

INTRODUCTION

There are a manifold of normal anatomical variations found in foot and ankle, such as accessory ossicles, additional sesamoid bones which can vary in number and configuration, coalitions, bipartitions, and accessory muscles. Most of them speak to developmental variations from the norm that constitutes accidental radiographic discoveries.[1,2] Out of these; accessory ossicles and sesamoid bones were assessed radiographically. Accessory ossicles are developmental anatomical variants. They appear as the secondary ossification centers in the ossification centers of the main bone. Accessory ossicles are frequently misdiagnosed as avulsion fractures. Usually, they remain asymptomatic in most of the patients. They can be detected by the use of routine plain radiograph referred for trauma workup of chronic pain. Rarely, they may be subject to fractures which if untreated may lead to infection and dislocation.[3,4] Sesamoid bones develop from their own ossification center and are 5-10 mm round to oval bones which are partially or completely embedded within the tendon substance.

MATERIAL AND METHODS

The present study was conducted in the Department of Radio-Diagnosis of Sri Manakula Vinayagar Medical College, Puducherry. As this was a retrospective study, informed consent requirements were waived. Ankle and foot radiographs were performed at 50-55 kVp and 3 mAs in a 500 mA Allengers MARS 50+ x-ray machine. The cases were included in the study on the basis of a predefined inclusion and exclusion criteria. The demographic details such as age, gender and address of the patients were recorded. The signs and symptoms of the disease were also recorded in a proforma. 1000 patients who were referred for trauma

work-up and chronic pain from June 2019 to June 2020, with normal radiograph were included in the study. The radiographs were reviewed by expert radiologist for presence of accessory ossicles and sesamoid bones and the data was statistically analysed 9using SPSS 21.0 software.

Inclusion Criteria

All patients referred to Radio-diagnosis department for radiograph of foot and ankle between June 2019 to June 2020 as a work up for trauma and chronic pain with normal radiograph.

Exclusion Criteria

1. Patients showing bone destruction / tumors / trauma related bony abnormalities
2. Patients with implants in foot and ankle

RESULTS

In the present study, 181(18.1%) patients out of 1000 showed presence of at least one accessory ossicle and about 9%(n=18) of the patients showed coexistence of more than one ossicle. In our study, the most common accessory ossicle detected was accessory navicular which was found in 71 patients (7.1%) followed by Os Peroneum, Os Vesalianum, and Os trigonum. In the 1000, 674 were men and 326 were women. Out of the 199 accessory ossicle totally detected, 128(64.3%) were identified men and 71(35.6%) were identified in women.

Sesamoid bones were found in 104(10.4%) patients and in those, 12 had more than one sesamoid bone. Hallux sesamoid bone was practically found in 100% of the patients. Bipartite hallux was found in 7.4% (n=74) of the patients and is the most common sesamoid bone found in foot and ankle. Out of the 116 sesamoid bones detected, 71 (61.2%) were men and 45 (38.8%) were women.

Distribution of accessory ossicles and sesamoid bones were found to be higher in men than in women whereas the distribution of most common accessory ossicles and sesamoid bones are similar in both men and women.

DISCUSSION

Various developmental skeletal variations can be found in the foot and ankle including accessory ossicles, additional sesamoid bones which can vary in number and configuration, coalitions, bipartitions, and accessory muscles. Usually, they remain asymptomatic in most of the patients. They can be detected by the use of routine plain radiograph referred for trauma workup of chronic pain. These variations may get

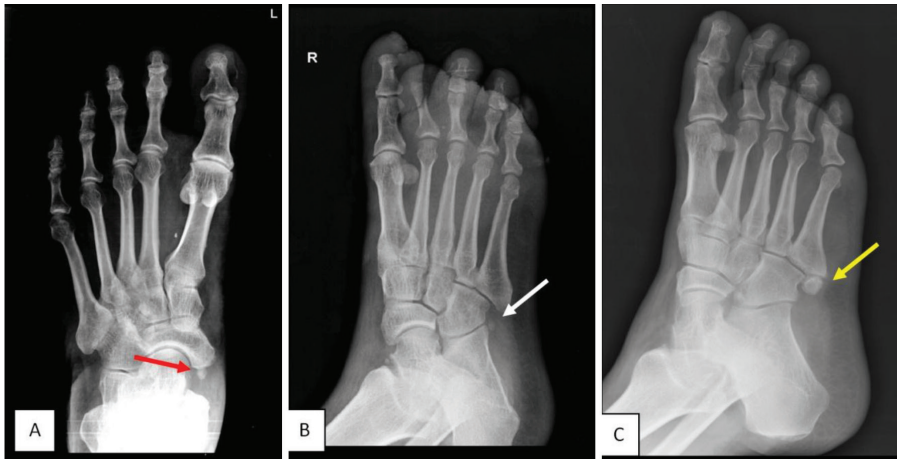

Figure-1: (A) AP view in foot radiograph showing Accessory navicular bone (red arrow), (B) and (C) Oblique view in foot showing Os Peroneum (white arrow) and Os vesalianum (yellow arrow). Technique- 50-55 kVp and 3 mAs in a 500 mA Allengers MARS 50+ x-ray machine

Accessory ossicles	Present	Absent	Prevalence (%)
Accessory navicular	71	929	7.1
Os peroneum	45	955	4.5
Os trigonum	27	973	2.7
Os vesalianum	41	979	4.1
Os Intermetatarseum	18	982	1.8
Os Supranaviculare	6	994	0.6
Os Supratalare	4	996	0.4
Os Talotibiale	2	998	0.2
Os Calcaneus Secundarius	3	997	0.3
SESAMOID	**Present**	**Absent**	**Prevalence (%)**
Bipartite Hallux	74	926	7.4
Lesser Metatarsal	49	971	4.9
First Interphalangeal	9	991	0.9

Table-1: Prevalence of various accessory ossicles and Sesamoid

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

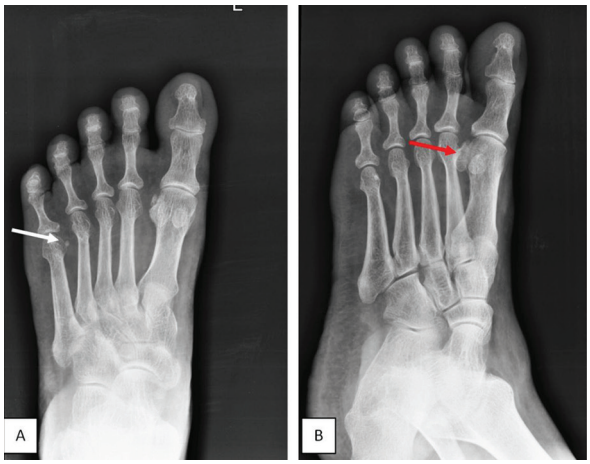

Figure-2: AP view (A) and Oblique view (B) of foot radiograph showing lesser metatarsal sesamoid bone(white arrow), and Bipartite hallus sesamoid bone(red arrow). Technique- 50-55 kVp and 3 mAs in a 500 mA Allengers MARS 50+ x-ray machine

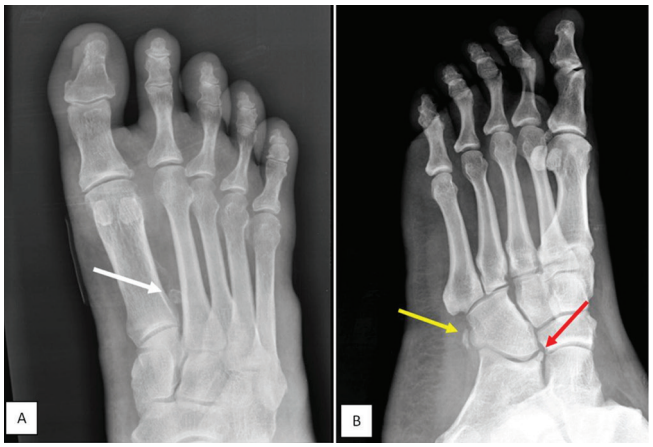

Figure-3: (A) AP view in foot radiograph showing first interphalangeal sesamoid bone (white arrow), (B)Oblique view of foot showing os peroneum(yellow arrow) and os calcaneus secundarius(red arrow). Technique- 50-55 kVp and 3 mAs in a 500 mA Allengers MARS 50+ x-ray machine

fractured or they may be misinterpreted as fractures and as a result of this, there might be restriction of the range of movement of the involved foot or ankle. [3] In reviewing the literature, it was found that, the incidence of accessory ossicles in foot and ankle was 18-36% in general population. [1] In our present study, the incidence of accessory ossicles was found to be 18.1%. Accessory navicular bone which lies next to the postero-medial tuberosity of the navicular bone has an incidence of 4-21%. It may be associated with flat foot deformity. In our study, accessory navicular bone was the most common ossicle with an incidence of 7.1%. The prevalence of accessory navicular bone, os peroneum, and os trigonum is variable in different studies. Kruse and Chen stated that the most common accessory ossicles of the foot and ankle were the os peroneum, os accessory navicular, and os trigonum.[4] The os peroneum, os accessory navicular, and os trigonum were the most common accessory bones. This study was performed in both sex, and coexistence and bilaterality were not addressed.

Accessory ossicles

Various accessory ossicles of the foot and ankle are portrayed within the current literature. A few of these bones are under-recognized accessory ossicles; subsequently, distinctive authors have named these bones differently, which causes perplexity within the literature.

1. *OS TRIGONUM*: The os trigonum is one of the largest and most common accessory ossicles in the ankle and foot region, with an estimated prevalence of 1 to 25%. In some cases can be fragmented or bipartite. The os trigonum commonly presents as an incidental radiographic finding. Although it is usually asymptomatic, it may be associated with persistent posterior ankle pain known as 'os trigonum syndrome'.[5]
2. *OS PERONEUM*: It is located within the peroneus longus tendon next to calcaneocuboid joint. It may be bipartite in 30% of cases and bilateral in 60% of the cases. Pain and tenderness along the lateral aspect of the foot due to fracture, dislocation or degeneration of the os is known as painful os peroneum syndrome. [6]
3. *ACCESSORY NAVICULAR*: The accessory navicular, also known as os tibiale, os tibiale externum and naviculare secundarium, is located next to the posteromedial tuberosity of the navicular bone. It has a prevalence of 4–21%. There are three types of accessory navicular described.
   a. Type 1- is found within the posterior tibial tendon, adjacent to its navicular attachment. It is seen in 30% of the cases.
   b. Type 2- it is located close to the median eminence of the navicular bone forming a flat facet with an intervening synchondrosis and is seen in 50% of the cases.
   c. Type 3 - it makes up the remaining 20% of cases and is a fused ossification.[6]
4. *OS INTERMETATARSEUM*: It has a reported prevalence of 0.2-10% and is located between the first and second metatarsals and the medial cuneiform. They may be symptomatic sometimes, with pain in the dorsum of the foot or paresthesia with numbness over the first intermetatarsal space. The os intermetatarseum may be misdiagnosed as fracture at the base of the second metatarsal occurring in a Lisfranc injury. The os intermetatarseum may be of three types as follows,
   (a) Free-standing- has no articulation with the adjacent bones;
   (b) Articulating- forms a joint between the first or second metatarsal bases and/or the medial cuneiform, in any combination;
   (c) Fused- arises as a spur from any of the adjacent bones[6]
5. *OS VESALIANUM*: It is located just proximal to the base of the fifth metatarsal and is embedded within the peroneus brevis tendon. The prevalence of os vesalianum is about 0.1-1.0% of the individuals. Usually asymptomatic, but rarely causes pain similar to os peroneum syndrome. Apoptosis of the fifth metatarsal

is a close mimic and it will be oriented parallel to the metatarsal shaft and fractures of the same will lie in the transverse plane. [7]

6. *OS SUPRANAVICULARE*: It is also known as os talonaviculare dorsale, talonavicular ossicle or Pirie's bone. Its prevalence has been reported as 1%-3.5 %. The ossicle may be fused with the talus or with the navicular bone. Pavlov, et al. reported a series of 23 navicular stress fractures, 22% of which involved an os supranaviculare. Avulsion fractures can be differentiated from os supranaviculare, os supratalare, or os talotibiale by its irregular surface and lack of cortication, and by the patient's history of trauma. [8,9]
7. *OS SUPRATALARE*: Its prevalence is around 0.2-2.4%. It is located dorsal to the talar head-neck junction between the ankle and the talonavicular joint and typically over the ridge along the talar head/neck.[10] Talar avulsion fracture is a close mimic to os supratalare.[11]
8. *OS TALOTIBIALE*: It has a reported incidence of 1% and is situated dorsal to the talus at the tibiotalar joint. It can be misinterpreted as anterior tibial avulsion fracture. [11]
9. *OS CALCANEUS SECUNDARIUS:* This ossicle is located between the anteromedial aspect of the calcaneus, the cuboid, the talar head and the tarsal navicular. The incidence of the os calcaneus secundarium has been reported between 0.6 and 7 %. It is better visualized on CT rather than plain radiograph and has no clinical significance. Its location makes it difficult to differentiate it from fracture of the anterosuperior calcaneal process. [9]

SESAMOID BONES

They are usually small, well-corticated, ovoid or nodular, may be bipartite or multipartite, and are found close to a bone or a joint

1. *HALLUCAL SESAMOIDS*: They are constantly present in the plantar aspect of the first metatarsal head. Bipartite variation is commonly seen in medial sesamoid. These bipartite sesamoid fragments do not tend to fit in perfectly which differentiates it from a fracture. [12]
2. *LESSER METATARSAL SESAMOIDS*: They are seen embedded in the plantar aspect of the joint capsule at the second through fifth metatarsals. Most commonly present at the fifth metatarsal with a prevalence of upto 4.3%. [12]
3. *INTERPHALANGEAL JOINT SESAMOID:* It is located at the plantar aspect of the first interpahlangeal joint and is embedded within the joint capsule. It has a variable prevalence of 2-13%. [12]

CONCLUSION

The current study speaks to point by point report on the incidence of various accessory ossicles in the foot and ankle in Pondicherry population. The results from the study seem to be in accordance with the studies being performed in other population. It also provides anatomical information that helps clinicians in the diagnosis and management of disorders of accessory ossicles and sesamoid bones, which are often overlooked in patients who present with pain and discomfort in the feet.

REFERENCES

1. Coskun N, Yuksel M, Cevener M, Arican RY, Ozdemir H, Bircan O, et al. Incidence of accessory ossicles and sesamoid bones in the feet: A radiographic study of the Turkish subjects. Surg Radiol Anat. 2009;31(1):19–24.
2. Aparisi Gómez MP, Aparisi F, Bartoloni A, Ferrando Fons MA, Battista G, Guglielmi G, et al. Anatomical variation in the ankle and foot: from incidental finding to inductor of pathology. Part I: ankle and hindfoot. Insights Imaging. 2019;10(1):1–14.
3. Lawson JP. International Skeletal Society Lecture in honor of Howard D. Dorfman. Clinically significant radiologic anatomic variants of the skeleton. Am J Roentgenol [Internet]. 1994;163(2):249–55.
4. Kruse RW, Chen J. Accessory Bones of the Foot: Clinical Significance. Mil Med [Internet]. 1995;160(9):464–7.
5. Kose O, Okan AN, Durakbasa MO, Emrem K, Islam NC. Fracture of the os trigonum: a case report. J Orthop Surg (Hong Kong). 2006;14(3):354–6.
6. Vora BMK, Wong BSS. Common accessory ossicles of the foot: Imaging features, pitfalls and associated pathology. Singapore Med J. 2018;59(4):183–9.
7. Summers A. Accessory ossicles and sesamoid bones: Recognition and treatment. Emerg Nurse. 2015;22(10):27–32.
8. Pavlov H, Torg JS, Freiberger RH. Tarsal navicular stress fractures: radiographic evaluation. Radiology. 1983;148(3):641–5.
9. Mellado JM, Ramos A, Salvadó E, Camins A, Danús M, Saurí A. Accessory ossicles and sesamoid bones of the ankle and foot: Imaging findings, clinical significance and differential diagnosis. Eur Radiol. 2003;13(SUPPL. 4):164–77.
10. Keles-Celik N, Kose O, Sekerci R, Aytac G, Turan A, Güler F. Accessory Ossicles of the Foot and Ankle: Disorders and a Review of the Literature. Cureus. 2017;9(11).
11. Chan BY, Markhardt BK, Williams KL, Kanarek AA, Ross AB, Sesamoids S, et al. Os Conundrum : Identifying Accessory Ossicles of the Foot. AJR Am J Roentgenol. 2019;213(August):417–26.
12. Nwawka OK, Hayashi D, Diaz LE, Goud AR, Arndt WF, Roemer FW, et al. Sesamoids and accessory ossicles of the foot: Anatomical variability and related pathology. Insights Imaging. 2013;4(5):581–93.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 10-06-2021; **Accepted:** 08-07-2021; **Published online**: 11-08-2021