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A Radiographic Study on Accessory Navicular Bone and its Clinical Significance in Indian Population

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Abstract: ***Background: Accessory navicular bone is one of the most common ossicles in the foot. Its prevalence is widely variable. These bones involve various mid-foot pathologies because of wide anatomic variations. It can cause medial foot pain, flattening the medial longitudinal arch, and impingement syndromes. The reported prevalence of accessory navicular is 4-21%. Objective: This study aimed to estimate the prevalence, anatomical variants, and distribution of accessory navicular bone of the foot in the radiograph by gender in the Indian population. Materials and methods: A retrospective study of 2068 radiographs of the foot (anteroposterior and oblique view) was performed. Used descriptive statistics for data analysis to know the prevalence of Accessory navicular bone. Results: 2068 radiographs were examined, in which 67.9 % of male and 32.1 % of female patients. In our study, the prevalence of accessory navicular is 16%, in which Type I (5.3%), Type II (9.1 %), and Type III (1.6%). Conclusion: Knowledge of accessory navicular of the foot helps avoid the common pitfall in clinical practice.***

Keywords: Accessory navicular bone, Hallux, Tarsal Bones, Prevalence, Radiography

1. Background

Accessory ossicles are fused or unfused, and primary or secondary ossifications appear as well-corticated smooth bones.[1-5] An accessory navicular is one of the most ossicles in the foot. The accessory navicular has a reported prevalence of ~ 4 -21% and is the second most common ossicle in the foot.[6-10] According to the Geist, classification has three different morphological characteristics.[11] Type I Accessory navicular (or Os tibiale externum, Os naviculare secundarium). Type II Accessory navicular (or Pre-hallux or Bifurcate hallux). Type III Accessory navicular bone (or Cornuate navicular).[12] These bones are usually an asymptomatic and incidental finding in radiography. Various pathologies include fractures, dislocations, degenerative changes, osteoarthritis. Others have osteonecrosis, avascular necrosis, osteochondral lesion, and impingement syndromes. Others include medial foot pain, flattening of the medial longitudinal arch, and impingement syndromes. Therefore, the knowledge of these variations helps in diagnosing its pathologies.

2. Materials and Methods

The convenient sampling method used and retrospectively examined X-ray at a tertiary care Saveetha hospital, Chennai, from June 2020 to Oct 2021. 2068, radiographs of the foot (anteroposterior and oblique views) were studied. The study group includes both genders (male and female) in the age group between 12 to 80 years. Since the secondary ossification center appears between 7 to 12 years, <12 years children are excluded. The data was acquired from the Medsynapse PACS system with an individual age, gender, and hospital identification number. The prevalence and sex distribution of sesamoid and accessory ossicles of the foot examined. Exclusion criteria include foot deformity or known diseases, improper positioning, and metatarsal and tarsal bone fracture. The data was collected and analyzed by reading the view of foot anteroposterior and oblique radiographs.

3. Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Science (SPSS). For gender distribution, the chi-square test was used. A p valve <0.05 was considered to be statistically significant.

4. Results

Totally 2068 radiographs of foot were examined, out of which 67.9% of male (1404/ 2068) and 32.1% of female (664 / 2068), right 57.8% (1196/57.8%) and left (872/42.2%). This study is divided in 4 groups on the basis of age <12 years (122 / 5.9%), 21-40 years (1079 / 52.2%), 41-60 years (682 / 33%) and >60 years (185 / 8.9%).

In our study, the prevalence of accessory navicular is 16%.

Type I os navicular prevalence is 5.3% (110/2068). It is more prevalent in males (5.5%) than females (4.8%).

Type II os navicular prevalence is 9.1% (188/2068). It is more prevalent in female (13.7%) than male (6.9 %) and p-value is <0.05 (significant). This bone is frequently distributed on the left (10.7%) than the right side (7.8%), and the p-value is significant.

Type III os navicular prevalence is 1.6% (33/2068). It is more prevalent in females (3.6%) than males (0.6 %), and the p-value is significant. ‘

Figure 1:

Figure 2:

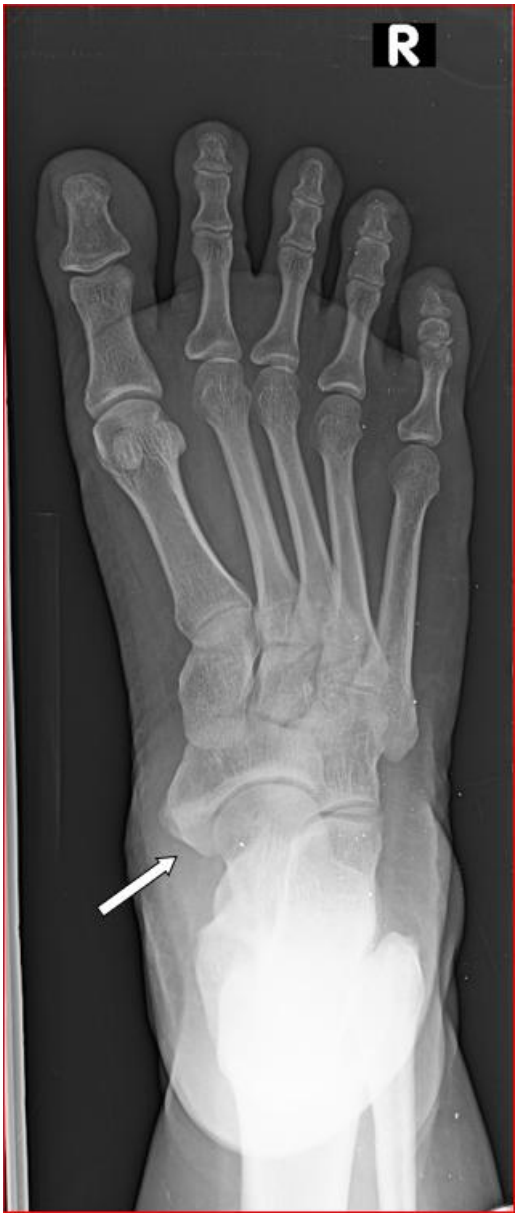


Figure 3:

Table 1: Demographic Distribution of Study Variables

Variables	Frequency (N)	%
Age		
< 20 Years	122	5.9
21 – 40 Years	1079	52.2
41 – 60 Years	682	33
> 60 Years	185	8.9
Sex		
Male	1404	67.9
Female	664	32.1
Side		
Right	1196	57.8
Left	872	42.2

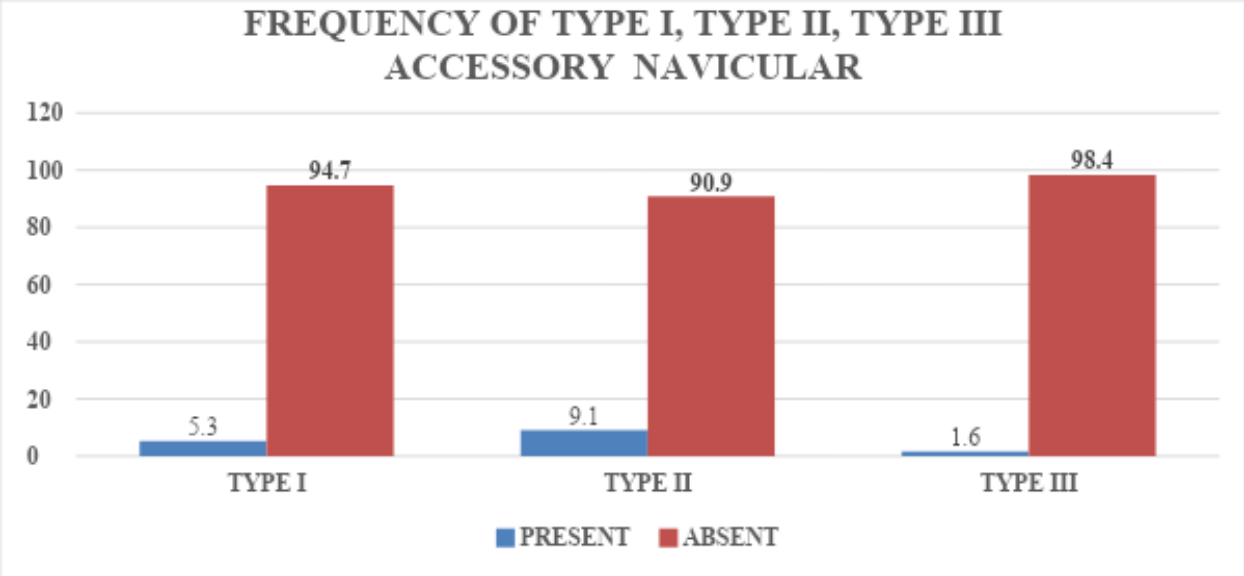


Table 2: Association between Variables And Type I Accessory Navicular Bone

Variable	Type 1 Present	Absent	P Value
Age			
< 20 Years	8(6.5)	114(93.5)	0.787
21 – 40 Years	56(5.1)	1023(94.8)	
41 – 60 Years	34(4.9)	648(95.1)	
> 60 Years	12(6.4)	173(93.5)	
Gender			
Male	78(5.5)	1326(94.5)	0.486
Female	32(4.8)	632(95.2)	
Side			
Right	72(6)	1124(94)	0.096
Left	38(4.3)	834(95.7)	

***P Value <0.05 is statistically significant**

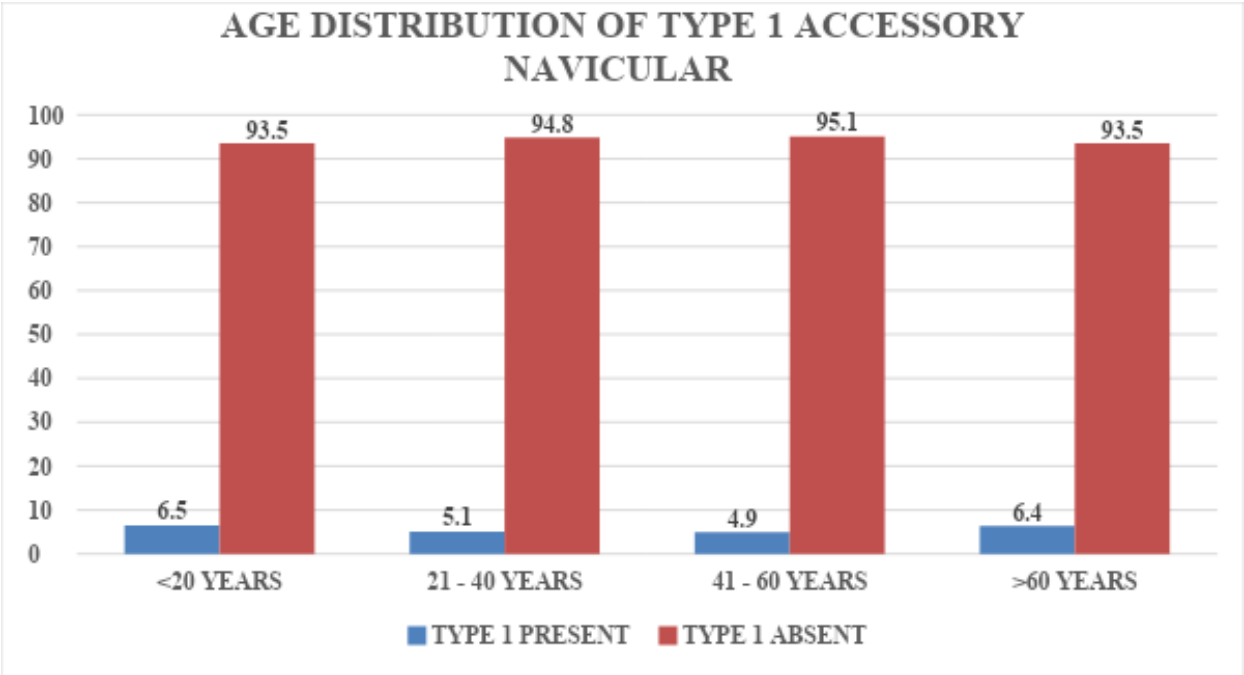


Table 3: Association between Variables and Type II Accessory Navicular Bone

Variables	Present	Absent	P Value
Age			
< 20 Years	8(6.5)	114(93.5)	0.149
21 – 40 Years	108(10)	971(90)	
41 – 60 Years	51(7.4)	631(92.6)	
> 60 Years	21(11.3)	164(88.7)	

Gender			
Male	97(6.9)	1307(93.1)	0.000*
Female	91(13.7)	573(86.3)	
Side			
Right	94(7.8)	1102(92.2)	0.023*
Left	94(10.7)	778(89.3)	

*P Value <0.05 is statistically significant

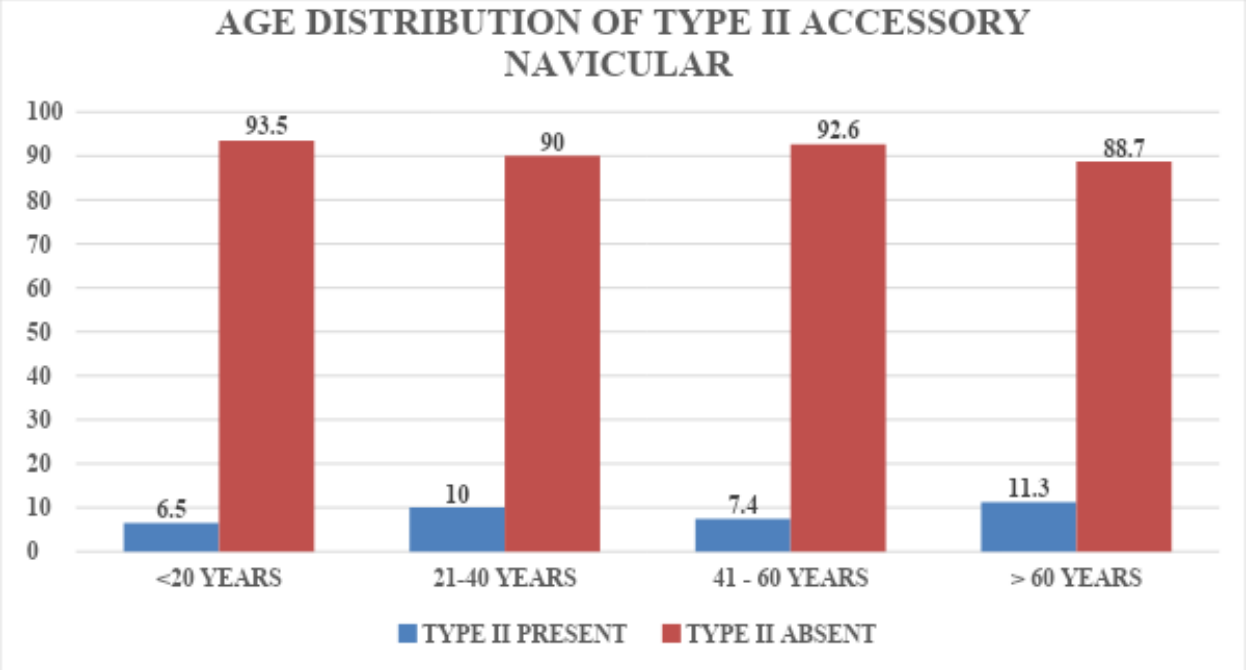
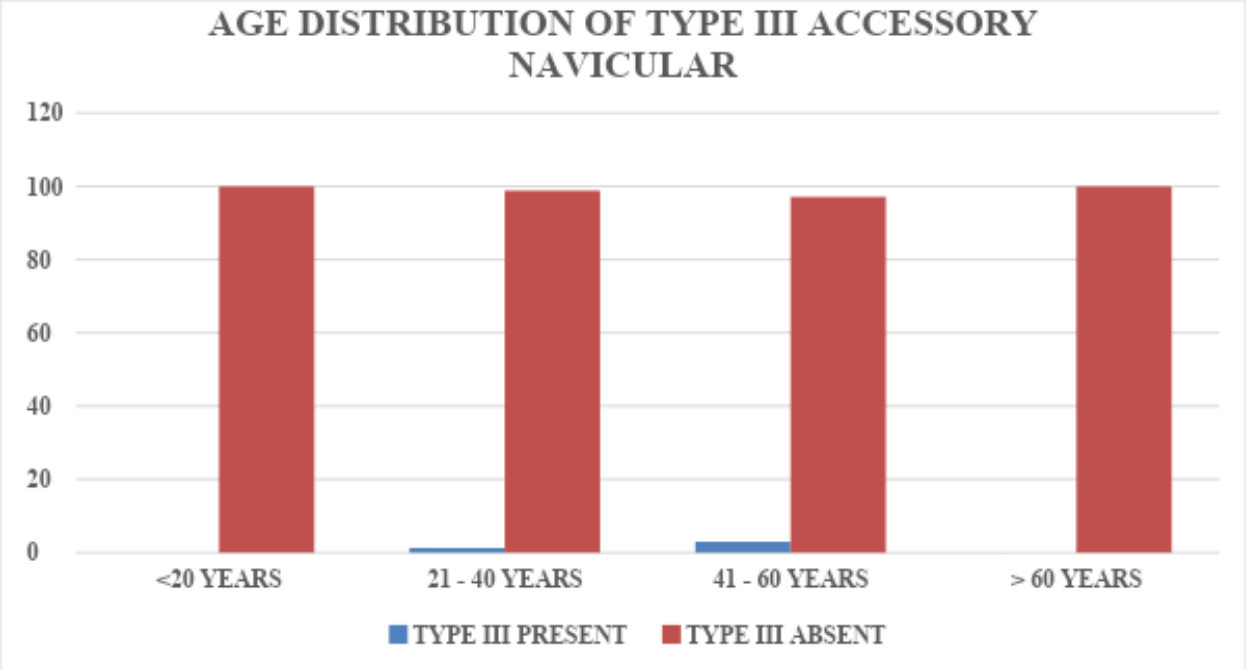


Table 4: Association between Variables and Type III Accessory Navicular Bone

Variables	Present	Absent	P Value
Age			
< 20 Years	0	122(100)	0.001**
21 – 40 Years	13(1.2)	1066(98.8)	
41 – 60 Years	20(2.9)	662(97.1)	
> 60 Years	0	185(100)	
Gender			
Male	9(0.6)	1395(99.4)	0.000*
Female	24(3.6)	640(96.4)	
Side			
Right	24(2)	1172(98)	0.081
Left	9(1)	863(99)	

*P Value <0.05 is Statistically Significant
**Fisher Exact Test



5. Discussion

Accessory ossicles are small well-corticated smooth, round to oval-shaped bones embedded within the joint capsule or tendon sheath. These bones are typically located adjacent to the tendons. It helps prevent frictional injuries and aids in changing the direction of tendons, thereby protecting the tendons.[13-16]

Accessory navicular bones are three types according to Geist classification in 1914 based on their morphological characteristics.[11] Type I Accessory navicular bone (or Os tibiale externum, Os naviculare secundarium) located within the posterior tibialis tendon insertion. Type II Accessory navicular bone (or Prehallux, or Bifurcate hallux) is seen in the insertion site of the posterior tibialis tendon. It is connected to navicular tuberosity by synchondrosis. Type III Accessory navicular bone (or cornuate navicular) is formed by fusion of the secondary ossification center with navicular bone.[12]

The prevalence of accessory navicular bone varies from 4-21%.[17] This ossicle was found in 11.7% of Turkish population[1] and 21.3% of Japanese population. Koo et al.[18] reported that the incidence of the accessory navicular was 23% on conventional radiography, but 33% on digital tomosynthesis in a Korean population.

The reported incidence of accessory navicular bone Type I, Type II, and Type III were Mallikarjun et al., as 34.72%, 50%, and 15.27% respectively,[19] Coskun N et al., like 3.3%, 3.1 %, and 4.6% respectively.[1] Our study results show the prevalence of Type I, II, and III are os navicular is 5.3% (110/2068), 9.1% (188/2068), and 1.6% (33/2068), which is lower than Mallikarjun et al. and higher than Coskun N et al. Huang J et al., like 41.6%, 36.8% and 21.6% respectively.[3]

Mallikarjun et al., reported incidence is 14.4% (144 / 1000).[19] Another two studies conducted among the Turkish population, Coskun N et al., reported 11% and 11.7%.[1] Tsuruta T et al. reported a incidence of 21.3%. While our study prevalence of ~ 16% appears to be slightly higher than the Turkish study but slightly lower than the Coskun study.

The prevalence of Type II os navicular in females (13.7%) is slightly higher than males (6.9 %), and the p-value is <0.05 (significant). It is frequently distributed on the left (10.7%) than the right side (7.8%), and the p-value is significant. Type III os navicular prevalence in females (3.6%) is slightly higher than males (0.6 %), and the p-value is significant.

Accessory navicular bones are usually incidental findings, normal anatomic variants. It is generally asymptomatic but, in some patients, can be the cause of pain. The painful accessory navicular bone diagnosis includes fractures, degenerative/infective arthritis, osteonecrosis. Others include avascular necrosis, osteochondral lesion, impingement syndromes, and posterior tibial tendon rupture.

Among the three types of accessory ossicles, type II and type III are predominantly associated with various pathologies in the second decade of life. If there is the displacement of the tendon of tibialis posterior at its insertion site onto type II or type III accessory navicular bone, which results in valgus deformity and pes planus.[20]

Painful accessory navicular syndrome is due to the repeated trauma to the accessory navicular bone resulting in stress fracture.[21]

6. Conclusion

Knowledge of accessory navicular bone helps Radiologists not to misinterpret these ossicles as avulsion fractures or miss the avulsion fracture as ossicles. In any symptomatic

patient diagnosing these conditions and treating them will restore their quality of life.

List of abbreviations
Nil

Competing Interests
Our study shows no competing interests.

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Author's Contribution

Principal author:
Dr. Govindarajan R.
Conceived and designed the analysis.
Collected the data.
Contributed data analysis.
Performed the analysis.
Wrote the paper

Co- author:
Dr. Swaran Kumar M.
Contributed data analysis.
Wrote the paper
Final review of the paper and publication.

Co-author & guide:
Dr. Praveen sharma.
Conceived and designed the analysis.
Contributed data analysis.
Final review of the paper.

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