**The Assessment of Rare Sesamoid Bone Prevalence in Lower Extremity Radiographs in Cross River State, Calabar**

**Abstract**

The sesamoid bone is a small oval-shaped bone found mostly within the tendons around the surface of joints, e.g. hand, wrist, foot and the knee, which has the biggest and most popular sesamoid bone. During the formation of sesamoid bones, the appearance of cartilaginous nodules undergoes replacement during a prepubertal stage in a process called endochondral ossification, which will metamorphose as sesamoid bone during puberty, though they occur first in female. This study, conducted in Calabar, Cross River State, Nigeria, aimed to evaluate and provide valuable insights into the prevalence and distribution of rare sesamoid bones in the lower extremities among patients who had radiological investigations conducted on them at UCTH and ASI-Ukpo Diagnostic Centre. The study was conducted using an observational, descriptive and cross-sectional study design with a random sampling approach. Inclusion and exclusion criteria were adhered to during data collection. The result shows that about 70% of the participants exhibit these bones.Asi-Ukpo Medical Centre had a significantly higher prevalence of sesamoid bones (92.3%) compared to UCTH (59.3%). The rare sesamoid bones in the knee were less prevalent. Only a small fraction of participants had sesamoid bones in this area, either bilaterally (12.5%) or unilaterally (10.7%). Symmetrical distribution of rare sesamoid bones was observed in 73.2% of the participants while, Females showed a slightly higher prevalence (70.8%) compared to males (68.85%). The findings from this study are largely and significantly consistent with global data, highlighting the universal patterns in the occurrence of sesamoid bones.

**Keywords:** Sesamoid bone, Radiograph, Prevalence, Metatarsophalangeal joints.

**1.0 Introduction**

The formation of sesamoid bones is associated with a response of the body natural growth, strained muscles and tendons though, they can also occur as a variant for those in the hand (Yeung, 2023). The sesamoid bone is a small oval shaped bone found mostly within the tendon around the surface of joints e.g. hand, wrist, foot and the knee which has the biggest and most popular sesamoid bone (Fox, et al., 2025). Sesamoid bones appear partially or completely embedded in tendons. The function of the sesamoid bones is to reduce friction and protect the tendons (Candan et al., 2022). Sarin et al., (1999) reported that about 42 sesamoid bones can be found in an individual. During the formation of sesamoid bones, the appearance of cartilaginous nodules undergoes replacement during prepubertal stage in a process called endochondral ossification which will metamorphose as sesamoid bone during puberty, though, they occur first in females. Sesamoid bones mostly function as a pulley to reduce the impact of stress on the located tendon or muscle. However, the lack of sesamoid bones during puberty suggests a delay in puberty (Abushhiwa et al., 2021). Most sesamoid bones begin as cartilaginous nodules that undergo endochondral ossification in early to late childhood, between the ages of 3 and 12 years. Sesamoid bones are generally thought to result from an interaction between mechanical and biological factors (Değermenci et al., 2024). Considering the uniqueness of sesamoid bones as they are not connected to other bones but are found within the muscles and connected to the tendon, their function has not been properly studied. The sesamoid bone in the knee cap (patella) of the lower extremities allows the knee to act as oscillation point. This function demonstrates the proficiency of the quadriceps to contain increased load with less friction. The sesamoid bones allow a unique connection between quadricep tendon and the patella ligament thereby, increasing biomechanical advantage (Yeung, 2023). However, not every sesamoid bone has this function, the fabella functions act as mostly pain and discomfort which is referred as fabella syndrome (Dalip, et al., 2018). Though, patella has demonstrated the importance of sesamoid bones, studies has shown that keyboard musicians tend to have a greater number of sesamoid bones in the hand indicating the adaptation of sesamoid bone formation to stressors (Dąbrowski, et al., 2021). However, it is difficult diagnosing sesamoid bones of the lower extremities because of their small size and low visibility in a standard lower limb radiograph. However, increase in sports with high impact has increased the incidence of traumatic sesamoid condition with a high prevalence rate (Nwawka et al., 2017). There two sesamoid bones are found in the metatarsophalangeal joint (MTPJ) though the variant is rarely seen. The reported prevalence for other sesamoid bone locations varies greatly from 3.6- 64 % for the second MCP joint to 0-76.5 % for the fifth MCP joint and 5-100 % for the first IP joint (Yildiz et al., 2021). Understanding the importance of sesamoid bones in clinical practice will aid in identification and management of injuries associated with sesamoid bones. There may be improper demonstration of sesamoid bone in the radiograph thereby leading to wrong diagnosis of latent pathology. Consequently, proper knowledge of the presence and variation of this bone will help prevent misdiagnosis. Therefore, investigating the prevalence of sesamoid bones in lower extremity radiographs will provide valuable data that can enhance clinical practice and improve patient outcomes.

**2.0 Materials and Methods**

2.1 Research Design

This study employed an observational, descriptive, cross-sectional design that investigated radiographs of male and female patients to determine the prevalent rate of the distribution of sesamoid bones in the lower limb. Participants in this study were patients who came for a radiographic study of the lower limb in the University of Calabar, Teaching Hospital and Asi-Ukpo diagnostic and medical Centre, in calabar, Cross River State,. A convenient sampling approach with a sample size of 80 patients was utilized to select patients who fulfilled the inclusion criteria.

2.2 Inclusion Criteria

Subject age from 18 to 70 years

Normal findings on the radiographs of the lower limb of these patients

Exclusion Criteria

1. Patients with history of fracture in lower extremity..
2. Patients in settings other than University of Calabar teaching hospital or Asi-Ukpo diagnostics in Calabar, Cross River State.
3. Patients with deformity and connective tissue problem

2.3 Data Collection

For each radiographic study of the foot and knee, the x-ray machine used at both the university of Calabar teaching hospital and Asi-Ukpo medical and diagnostic Centre was of a digital x-ray model.

The patient was then positioned for a knee or foot exam. For the knee, a lateral projection was used to visualize the fabella, which is best seen on a lateral radiograph of the knee, particularly when the knee was flexed to around 90 degrees. For the Patella, an anteroposterior and a lateral projection were employed, and for the Foot radiographic exam, an Anteroposterior, oblique and lateral projections were utilized. Standardized criteria were used to ensure consistency in identifying and classifying the sesamoid bones. The findings were then recorded in a structured format, noting the presence or absence of sesamoid bones, their location, their number and other relevant details (e.g., size, shape, or abnormalities). The data was then analyzed to determine the prevalence of sesamoid bones in the study population.

2.4. Data Analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 2023. Data coding was done to determine the presence and absence of sesamoid bones. Chi-Square was used to understand the relationship between demographic factors and the sesamoid bone.

**3.0 Result**

**3.1 Prevalence of sesamoid bones of the lower limb from radiograph of patients.**

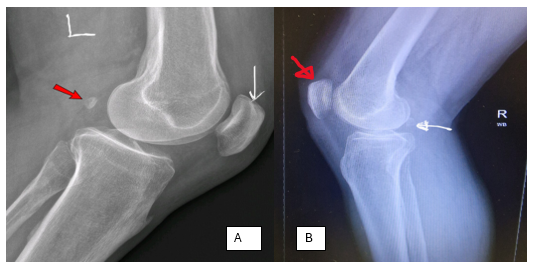
Table 1 shows the presence of sesamoid bones among participants. The study suggests that about 70% of the participants whose radiographs were examined indicate presence of sesamoid bones. However, about 30% of the participants had no rare sesamoid bone.

Table 1: Prevalence of sesamoid bone of the lower limb from radiograph of patients

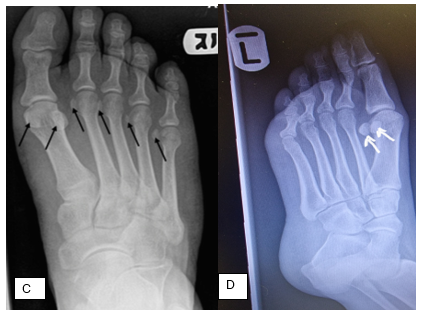
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Frequency (n = 80)** | | **Percentage (%)** | |
|  | **UCTH**  32  22 | **Asi-Ukpo**  24  2 |  |  |
| **Sesamoid Present**  Yes  No | 70%  30% |

**3.2 The commonest site of sesamoid bone from radiograph of patients.**

The distribution of the 305 sesamoid bones found at different sites of the lower extremities of the study participants was shown in table 2. The X-rays exposed the presence of sesamoid bones at the first metatarsophalangeal joint (100%). The sesamoid bones from the participants at the right second metatarsophalangeal joints were about 16.1% while, the presence of sesamoid bone at the left second metatarsophalangeal joints was observed in about 8.9% of the participants. The sesamoid bone at third right and left Metatarsophalangeal joints were observed at 7.1% and 1.8% of the participants respectively. However, about 32.1% and 23.2% of the participants had their sesamoid bone at right and left fifth Metatarsophalangeal joints respectively. There was no sesamoid bone observed at the fourth Metatarsophalangeal joints within the participants. Further, the radiographic studies of the left foot indicate 100% presence of sesamoid bones at the first Metatarsophalangeal joint. About 18.9% of the participants showed the presence of sesamoid bone at the second Metatarsophalangeal joint while, a participant had sesamoid bone at third Metatarsophalangeal joint. About 19.3% participants had sesamoid bone at the fifth Metatarsophalangeal joint. However, only about 12.5% and 19.6% participants had sesamoid bones and it occurred at their first Interphalangeal joints of the right and left foot respectively. There was sesamoid bone observed from the patella of the knee joint in 100% of the participants. About 12.5% and 10.7% of the participants had sesamoid bone (fabella) in the right and left extremities respectively. Figures 1 and 2 below demonstrate radiographic images of the sesamoid bones.



**Fig. 1. Lateral knee radiograph. (A) Left knee; white arrow - patella, red arrow -fabella. (B) Right knee; white arrow - Fabella, red arrow – patella.**



**Fig. 2. Foot radiograph. (C) Right foot AP view; black arrows – first to fifth MTP sesamoid bones. (D) Left Foot oblique view; white arrows – first MTP sesamoid bones.**

Table 2 The commonest site of sesamoid bone from radiographs of patients.

|  |  |  |  |
| --- | --- | --- | --- |
| **Site** | **Right lower extremity** | **Left lower extremity** | **Total** |
| **Metatarsophalangeal Sesamoid (first MTPJ).** | 56(100%) | 56(100%) | 112(56.6%) |
| **Lesser Metatarsal Sesamoids:**  2nd MTPJ  3rd MTPJ  4th MTPJ  5th MTPJ | 9(16.1%)  4(7.1%)  0  18(32.1%) | 5(8.9%)  1(1.8%)  0  13(23.2%) | 14(7.1%)  5(2.5%)  -  31(15.7%) |
| **Interphalangeal Joint (1st IP).** | 7(12.5%) | 11(19.6%) | 18(9.1%) |
| **Patella** | 56(100%) | 56(100%) | 112(36.7%) |
| **Fabella** | 7(12.5%) | 6(10.7%) | 13(6.5%) |
| **Cyamella** | 0 | - | - |

**3.3 The symmetric pattern of sesamoid bone from radiograph of patients.**

Symmetrical distributions of sesamoid bones bilaterally were found 73.2% participants while, asymmetrical distribution was found in 26.8% as shown in table 3.

Table 3 The symmetric pattern of sesamoid bone from radiographs of patients.

|  |  |  |
| --- | --- | --- |
| **Symmetric Pattern of sesamoid bone** | **Frequency (n=56)** | **Percentage (%)** |
| Symmetrical | 41 | 73.2 |
| Asymmetrical | 15 | 26.8 |

**3.4 Socio-demographic factors associated with the prevalence of sesamoid bones of the lower limb.**

The association between demographic characteristics and prevalence of sesamoid bones of the lower extremity was tested using chi-square Table 4. Analysis reveals that sesamoid bones were more prevalent and were not statistically significant with gender considering p-value at (p=0.008). Therefore, being female was not significantly associated with high prevalence of sesamoid bones of the lower extremities. In the age group, the prevalence of sesamoid bones was higher among participants who were older at 31 years and above at 41.1% compared to other lower age groups. This implies that from the study, being older in age was significantly associated with high prevalence of sesamoid bones (p=0.0001).

Table 4 Socio-demographic factors associated with the prevalence of sesamoid bone of the lower limb

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Presence of sesamoid bone** | | **Chi-square (p-value)** | |
|  | **Yes** | **No** | |  | |
| **Gender**  Male  Female | 22 (39.3%)  34 (60.7%) | 10 (17.9%)  14 (25.0%) | 7.0977  (0.008) \* | |
| **Age range (years)**  18-50  31-40  41-50  51-60  61 and above | 1(1.9%)  23(41.1%)  9(16.1%)  7(12.5%)  16(28.6%) | 4(7.1%)  10(17.9%)  5(8.9%)  2(3.6%)  3(5.4%) | 13.1169  (0.0001) \* | |
| **Diagnostic Center**  UCTH  Asi-Ukpo | 32 (57.4%)  24(42.9%) | 22(39.3%)  2(3.6%) | 39.2997  (0.003) \* | |

\*Statistically significant at p=0.05

**4.0 Discussion**

Sesamoid bones have always been part of human existence, however, there are rare sesamoid bones. This study was conducted to understand the prevalence of sesamoid bones in the body focusing on lower extremities. Sesamoid bones in the lower extremity have been a thing of concern for sports professionals considering that injury to this region can affect performance in the field. The study suggests a high prevalence of rare sesamoid bones among the participants. Asi-Ukpo medical center had a higher prevalence when compared to the University of Calabar teaching hospital. The difference can be attributed to the patient’s demographic, genetic and environmental factors. In the knee, the presence of the patella was very common as all the participants had patella sesamoid bones bilaterally, and about 10.7% the patients had patella in one knee as observed from the radiograph. Ghimire et al. (2017) reported the prevalence of fabella in his study population while, pop et al. (2018) observed about 16.93% of incidence rate of sesamoid bones in Romanian patients. However, the first metatarsophalangeal (MTP) joint is the most common site for sesamoid bones. Most of the studies carried out recorded high presence of sesamoid bones in MTP joints (Esua, 2023; Ghimire et al., 2017). Moreover, there was low presence of sesamoid bone in other MTP joints except for the fifth MTP joint which recorded 23.2%. The distribution pattern was consistent with the study of Shabibi et al., (2020) who reported significant presence of sesamoid bone in the first and fifth MTP joint. Additionally, the patella and fabella were the primary sites of sesamoid bones. During the study, patella was exposed bilaterally while the presence of fabella was small at 8.75%. This demonstrates a similar distribution pattern (Adedigba, et al., 2021). There is a symmetrical pattern of sesamoid distribution. This may be genetically induced during the formation of sesamoid bone and mechanical force during activities such as gait especially when they are observed at the same anatomical site at both sides of the body. The association of sesamoid bone and genetic factor such as familial trait and ancestry has been reported (Yammine, 2014). Furthermore, there was a relationship between sesamoid bone and age, gender.. There were more female with sesamoid bones than the male indicating high prevalence among the females but not statistically significant. This tend not to be abnormal as Abubakar, et al., (2019) reported a higher sesamoid bone prevalence in females. There is a positive relationship between age and the presence of sesamoid bone. It appears that the older the participant the more the sesamoid bones. This phenomenon is attributed to ossification of the sesamoid bones because of prolonged mechanical stress. .

**4.1 Conclusion**

This study provides a comprehensive understanding of the prevalence and distribution of sesamoid bones in the lower extremities among patients at UCTH and Asi-Ukpo Medical Centre. The high prevalence of these bones, particularly at the first MTP joint, underscores their common occurrence. The prevalence rates of sesamoid bones at various MTP joints and the knee are like findings from different populations, suggesting a universal pattern in their occurrence. However, slight variations in prevalence rates, particularly in the knee, may reflect differences in study populations. The influence of gender, age, and symmetrical distribution points to factors playing significant roles in their development. These findings contribute to the broader knowledge of sesamoid bones and highlight the need for further research to explore the underlying factors influencing their presence across different populations.

**ETHICAL APPROVAL**

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

**CONSENT**

As per international standards or university standards, Participants’ written consent has been collected and preserved by the author(s).

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**REFERENCE**

Abubaker, E., Talha, A., Abbas, A. A., & Mahdi, M. E. (2019). A radiographic study of the prevalence and distribution of sesamoid bones of the foot in adult sudanese. *World Journal of Pharmaceutical and Medical Research*, 2(4), 164–176.

Adedigba, J. A., Idowu, B. M., Hermans, S. P., Okwori, O. F., Onigbinde, S. O., Oluwadiya, K. S., Amoako, A. A., &Weidenhaft, M. C. (2021). Fabella and patella variants: radiographic prevalence, distribution and clinical relevance in a population of black african descent. *Anatomy & Cell Biology*, *54*(2), 184–192.

Ghimire, I., Maharjan, S., Pokharel, G. B., & Subedi, K. (2017). Evaluation of occurrence of sesamoid bones in the lower extremity radiographs. *Journal of Chitwan Medical College*, 7(2), 11–14. Retrieved from <https://www.nepjol.info/index.php/JCMC/article/view/22995>

Pop, T. S., Pop, A. M., Olah, P., &Trâmbiţaş, C. (2018). Prevalence of the fabella and its association with pain in the posterolateral corner of the knee. *Medicine*, 97(47), e13333. <https://doi.org/10.1097/MD.0000000000013333>[BioMed Central+9PubMed+9KoreaMed+9](https://pubmed.ncbi.nlm.nih.gov/27418991/?utm_source=chatgpt.com)

Shabibi, A. A., Sirasanagandla, S. R., Thuhli, Z. A., Dhuhli, H. A., Mushaiqri, M. A., & Jaju, S. (2020). Radiological Study on Sesamoid Bones of the Foot among Omani Subjects. Oman Medical Journal, 35(4), e163.

Yammine, K. (2014). The sesamoids of the feet in humans: a systematic review and meta-analysis. Anatomical Science International, 90(3), 144–160.

Abushhiwa, M. H., Warwar, A., & Ghallab, A. (2021). *Anatomy and clinical significance of sesamoid bones: A review*. Libyan Journal of Medicine, 16(1), 1-7. https://doi.org/10.1080/19932820.2021.1875560

Dalip, D., Prasad, R., Mahapatra, A., & Thakur, R. (2018). *Fabella syndrome: A rare cause of posterolateral knee pain*. Cureus, 10(6), e2869. https://doi.org/10.7759/cureus.2869

Dąbrowski, M., Dąbrowska, A., & Ciszek, B. (2021). *Variability and prevalence of hand sesamoid bones in relation to professional activity*. Folia Morphologica, 80(4), 747–753. https://doi.org/10.5603/FM.a2020.0120

Fox, M. G., Chang, E. Y., & Stribling, W. K. (2025). *Musculoskeletal imaging: Foundations and advanced techniques* (2nd ed.). Elsevier.

Nwawka, O. K., Hayashi, D., Diaz, L. E., Goud, A. R., Arndt, W. F., & Roemer, F. W. (2017). *Sesamoids and accessory ossicles of the foot: Anatomical variability and related pathology*. Insights into Imaging, 4(5), 581–593. https://doi.org/10.1007/s13244-013-0271-1

Sarin, V. K., Erickson, G. M., Giori, N. J., & Bergman, A. G. (1999). *Coincident development of sesamoid bones and clues to their evolution*. The Anatomical Record, 257(5), 174–180. https://doi.org/10.1002/(sici)1097-0185(19991015)257:5<174: aid-ar5>3.0.co;2-r

Yeung, P. (2023). *Sesamoid bones: Anatomical features and clinical implications*. Journal of Orthopedic Research and Reviews, 15, 35–45.

Yildiz, G., Gursoy, M., Bulut, T., Mete, B. D., Coban, I., Yildiz, G., ... & Coban, I. (2021). Prevalence, coincidence and distribution patterns of sesamoid bones of the hand. *Int J Morphol*, *39*, 1399-405.

Candan, B., Torun, E., & Dikici, R. (2022). The prevalence of accessory ossicles, sesamoid bones, and biphalangism of the foot and ankle: a radiographic study. *Foot & Ankle Orthopaedics*, *7*(1), 24730114211068792.

Değermenci, M., Aygün, A., Yılmaz, H., Tokpınar, A., & Bas, O. (2024). Accessory and Sesamoid Bones in the Body: A study on their Size and Presence. *Medical Records*, *6*(1), 50-57.