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Incidence Of Wormian Bones In Dried Human Skull Bones At Rims, Manipur

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Abstract:
*Background: Wormian bones also known as sutural bones**,** supernumerary bones**,** intersutural bones or intercalated bones are small, irregular ossicles occasionally found within the sutures of the cranial vault. These bones as a detached fragments originating from the primary ossification centers of adjacent membranous bones. They are most commonly found along the lambdoid suture, which is characteristically more complex and tortuous compared to other cranial sutures. Less commonly, they may also be present in the sagittal and coronal sutures, as well as in the regions of the pterion and asterion.*
Materials and Methods: 50 dried human adult skulls were used for this study. These were collected from the Department of Anatomy, RIMS, Imphal. Various sutures were examined carefully for the presence or absence of Wormian bones. The number and location of Wormian bone along the coronal, sagittal, lambdoid, occipitomastoid, parieto-temporal suture, bregma, lambda, pterion, asterion were noted. These findings were documented and relevant photographs of the Wormian bones were taken by using a digital camera.
Results: We found wormian bones in total of 11 wormian bones out of 50 dried skull.Maximum wormian bones were observed at lambdoid suture 7 with incidence of 14%,lambda 1(2%),coronal suture 1 (2%),asterion 0 (0%) and inca bone 2(4%).

Keywords: *Wormian bone,inca or Goethe's ossicle*

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I. Introduction

In a historical perspective, the earliest description of wormian bones dates back to the period between 1460 and 1541 CE and is attributed to Paracelsus. However, the term "wormian bone" was later introduced in honor of Olaus Worm, a Danish anatomist who described these bones in a letter given to Thomas Bartholin in the year 1643.[1] Wormian bones, also known as sutural bones**,** supernumerary bones**,** intersutural bones or intercalated bones are small, irregular ossicles occasionally found within the sutures of the cranial vault.[2] Developmentally, they arise either from separated ossification centers of the cranium or from aberrant ossification center.[3] According to Cremin, Goodman, and Spranger (1982) described these bones as a detached fragments originating from the primary ossification centers of adjacent membranous bones.[13] Their occurrence is highly variable in both number and shape and can be observed bilaterally and symmetrically in both sexes with relatively of equal frequency. They are considered normal anatomical variants, resulting from deviations in the typical development of cranial flat bones.[1] They are most commonly found along the lambdoid suture, which is characteristically more complex and tortuous compared to other cranial sutures. Less commonly, they may also be present in the sagittal and coronal sutures, as well as in the regions of the pterion and asterion. While often encountered in healthy individuals but an increased number of wormian bones has been associated with several congenital and metabolic disorders, including osteogenesis imperfecta, congenital hypothyroidism(cretinism), cleidocranial dysostosis, progeria, hypophosphatasia, rickets etc. A distinct sutural bone sometimes present at the lambda is known as the inca bone or Goethe's ossicle representing another variant of these accessory cranial bones.[3]

Significance of wormian Bones:

The clinical significance of wormian bones has been acknowledged since the 16th century, with early anatomists such as Johann Dryander (Andernach) and Andreas Vesalius being among the first to associate their

presence with cerebral abnormalities.[5] These small, irregular ossicles, located within the sutures of the skull, are often considered important radiological markers of underlying pathological conditions. Wormian bones are most prominently associated with osteogenesis imperfecta, where their presence serves as a key diagnostic indicator of this hereditary connective tissue disorder characterized by bone fragility.[7] Additionally, they have been reported in a variety of other syndromic and metabolic conditions, including pyknodysostosis, rickets, Menkes disease (also known as "kinky hair syndrome"), cleidocranial dysostosis, hypothyroidism, hypophosphatasia, otopalatodigital syndrome, primary acro-osteolysis (Hajdu-Cheney syndrome), and Down syndrome.[6] An accurate understanding and identification of wormian bones are essential across multiple disciplines-including radiology, forensic science, anthropology, orthopedics, and neurosurgery-to avoid misinterpretation, particularly in distinguishing these bones from cranial fractures during radiological examinations. Their recognition not only aids in early diagnosis of certain systemic disorders but also contributes to comprehensive patient management and forensic investigations.[4]

II. Aim And Objective

Aim and objective of this study is to determine the incidence of wormian bone.

III. Material And Methods

50 dried human adult skulls were used for this study. These were collected from the Department of Anatomy, RIMS, Imphal. Various sutures were examined carefully for the presence or absence of wormian bones. The number of wormian bones per skull were examined systematically for the presence or absence of wormian bone. The number and location of Wormian bone along the coronal, sagittal, lambdoid, occipitomastoid, parieto-temporal suture, bregma, lambda, pterion, asterion were noted. These findings were documented and relevant photographs of the wormian bones were taken by using a digital camera.

Inclusion criteria: Adult dried skull

Exclusion criteria: Fractured and deformed skull, fetal skull.

IV. Results

LOCATION	PRESENCE OF WORMIAN BONE	TOTAL NO. OF BONE EXAMINED	INCIDENCE
LAMBDOID	7	50	14%
CORONAL	1	50	2%
ASTERION	0	50	0%
INCA BONES	2	50	4%
LAMBDA	1	50	2%

Table 1: Location,total number of observed bones and incidence of Wormian bones

As shown in above Table 1, we found wormian bones in total of 11 wormian bones out of 50 dried skull. Maximum wormian bones are observed at lambdoid suture 7 with incidence of 14%, lambda 1(2%), coronal suture 1 (2%), asterion 0 (0%) and inca bone 2(4%).

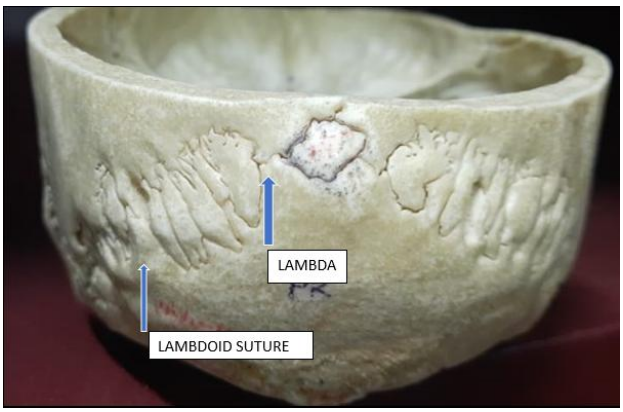

Fig 1: More than 15 numbers of island like sutural bones observed at lambda and along lambdoid suture.

Fig. 1. showed some zigzag like arrangements of sutural bones at lambdoid suture and lambda. They appeared like leaves of ferns. These patterns of sutural bones in radiographic view may be confused with multiple fractures. The picture shows more than fifteen number of bony islands at lambda and along the lambdoid suture

Fig 2: Inca bone or Goethe ossicle
Fig 3: Wormian bone observed along the coronal suture

In Fig 2. Inca Bones or Goethe's ossicles were identified in two skulls. These bones are results of non-union of squamous part of occipital bone with the rest. It is also called as inter-parietal bones. The above picture shows a rare case of half inca bone which mimicking occipital fracture.

V. Discussion

Wormian bones, or sutural bones, are accessory ossicles located within cranial sutures. They may be present in both normal and pathological skulls. Their exact origin is unclear but is thought to be influenced by genetic factors and mechanical forces such as cranial stress during growth. In normal skulls, typically two to three wormian bones are observed but their number may increase in pathological conditions like hydrocephalus.

In the present study, the overall incidence was 22%, with the highest frequency in the lambdoid suture (7%), followed by inca bones (2%), and 1% each in the coronal suture and lambda (1%).

These findings of distribution of incidence pattern is similar to the studies conducted by various researchers. Murli Manju B.V. et al. found wormian bones in 56.4% of cases at the lambdoid suture followed by the asterion (17.9%), pterion (11.5%), and 1.3% in the coronal and sagittal sutures.[8]

Natsis et al. noted 44.6% in the lambdoid and 39.8% in the coronal sutures.[9] Ghosh S.K. et al. similarly reported 53.33% incidence at the lambdoid suture.[10] Kumar A. A. observed 36 wormian bones in the lambdoid region and three inca bones among 250 skulls.[11] Bregman et al., approximately 40% of skulls exhibit sutural bones in the lambdoid suture.[3]

Padmaja Vasi M.B. documented bilateral inca bones along the lambdoid suture in place of a single midline bone whereas in the present study a single inca bone was observed.[12]

VI. Conclusion

The sutural bone may be mistaken as fracture of skull in case of trauma. Sutural bones can complicate burr hole procedures involving the skull vault. It is essential for neurosurgeons to be thoroughly familiar with these anatomical variations and to receive proper training to manage them effectively. Furthermore, in cases of cranial trauma, sutural bones may be mistakenly identified as skull fractures, highlighting the need for careful radiological assessment. This study highlights that wormian bones can be found not only in the lambdoid suture but also in other cranial sutures such as the coronal, sagittal, and asterion regions. Detailed anatomical knowledge of these bones is crucial for neurosurgeons and radiologists to avoid misinterpreting them as skull fractures, especially in cases of head trauma. Moreover, wormian bones can serve as important markers for several pathological conditions, including osteogenesis imperfecta, rickets, and other disorders associated with bone fragility.[3]

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