

Identification and Variation of Sutural Bones in Indian Dry Cranium

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Abstract

Background: Sutural bones are supranumary bones occurring along the sutures and completely surrounded by sutures of the skull. Their number, morphology and location in skull vary in skulls. The knowledge of these bones is imperative in surgery, medicolegal cases involving child abuse or fracture of skulls and for anthropologic identification of human populations. Also, the prior knowledge about the Wormian bones is important because they are present in normal individuals as well as in various disorders such as osteogenesis imperfect, rickets, etc. Very few studies have been undertaken to study the anatomical aspects of sutural bones in dry human cranium.

Objective: The current study aimed to estimate the presence and variations of sutural bones in dry human cranium.

Materials and Methods: This retrospective, observational and single-center study carried out in the J. K. K. Nattraja Dental College, Kumarapalayam, Namakkal district and Vinayaka Missions Medical College, Karaikal from August 2021 to December 2021. A total of 110 dry cranium of unknown sex was collected from above institutions. All the dry cranium was observed carefully for sutural bones. Presence of sutural bones was noticed in unilateral and bilateral location and shape of sutural bones was identified. Data was entered in Microsoft Excel® and statistical analysis for descriptive variables was performed in IBM SPSS (Version 16.0).

Results: Out of 110 dry crania, sutural bones were found in 69 crania (62.72%) with highest number of sutural bones found at lambdoid suture and asterion part of dry cranium, whereas 9-12 sutural bones were present in three cranium at lambdoid suture and finally, 3-5 sutural bones were recorded at asterion in five bones. Among the unilateral and bilateral occurrence of sutural bones, this study noted lambdoid (60/54.54) and asterion (48 /43.63) areas with more sutural bones than at other sites. Pterion was another common site of sutural bones that showed higher frequency than the bones of parietal notch. At the parietal notch, this study recorded 2-3 sutural bones. Also, this study reported (6/ 5.45) sutural bones in lateral wall of orbit between zygomatic bone and greater wing of sphenoid.

Conclusion: Anatomical knowledge of sutural bones is clinically important, because their presence refers mainly to bone dysplasia like craniosynostosis and imperfect osteogenesis and used as a useful marker of some congenital disorders.

Keywords: Sutural Bone, Cranium, India, Variations

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Introduction

Human cranium is an interesting, well studied and mostly reported part of our skeletal system. Cranium is formed by lots of small flat bones, which ossify after birth with regular ossification centres in the cranium [1]. Sutural bones or wormian bones are formed from separate abnormal ossification centres during development of cranium and associated with epigenetic and hypostatic characters, related to delayed suture closer. Sutural bones are anatomical variants and termed as islands of bones within the sutures. The size, number and location of the sutural bones vary from skull to skull and the most common site lambda is not confused with fracture of the cranium [2].

Sutural bones have been documented on many mammals like the modern human cranium. The origin of sutural bone may be due to mechanical, pathological and genetic factors or due to other unknown causes. Sutural bones have even been observed in Australopithecine cranial fragments from Makapansgat. They were named Wormian bones after the Danish anatomist Olaus Wormius, a medical doctor at the University of Copenhagen. In 1643, he provided a detailed description in a letter to his colleague Thomas Bartholin in Padua, Italy following which Bartholin decided to call sutural bones “ossa Wormia” (Wormian bones). However, Wormian bones were described even before Olaus Wormius [3]. The first description was done by Hippocrates and the first diagram of the cranial structure noticed in Avicenna’s Canon. Sutural bones were also mentioned by Paracelsus, who located the bone in posterior fontanel the “ossiculum anti-epilepticum”. Vesalius was the first to associate sutural bones and cerebral disorders [4].

Wormian bones are the accessory bones within sutures of the skull bones, frequently observed in the lambdoid suture. A few of these bones are also seen in pterion and are known as pterion ossicle or epipteric bone and at the lambda, known as Inca bones. A few authors claim that they are developed from external influences, genetically determined or detached portion of the primary ossification centres of the adjacent membrane bones [4].

Locations of sutural bones are more common, but they are not named in international anatomical nomenclature as they vary in size, shape, number and thickness. Only the pre-inter-parietal bone, a triangular sutural bone located at the posterior fontanel is named as Inca bone being noticed in Peruvian mummies [5].

True sutural bones may be sagittal bone (between the two parietal bones) or develop in occipito-parietal sutures, fronto-parietal sutures, parieto-sphenoidal sutures, petro-occipital sutures or inter-parietal sutural bone. They can be bregmatic, lambdoid, pteric or orbital [6].

These is tremendous clinical significance of sutural bones. The number of sutural bones range from two or three to more than a hundred in the cranium of an adult hydrocephalic skeleton. To be pathologically significant, incidences of sutural bones have some definite criteria: they should be more than ten in number; arranged in a general mosaic-type pattern; size must be larger than 6 mm by 4 mm. Sutural bones may be mistaken for fractures. Wormian bones are clinically important markers for many pathological entities. Though common in adults, their occurrence in children can be associated with a plethora of pathological entities

such as Rickets syndrome, “Kinky-hair” Menke’s syndrome, Otopalatodigital syndrome, Hajdu-Cheney syndrome (platybasia and WBs, osteoporosis with fractures, and acro-osteolysis), acrocallosal syndrome (facial dysmorphism and midline abdominal defects), Down’s syndrome, cleidocranial dysostosis, pycnodysostosis, hypoparathyroidism, hypophosphatasia and osteogenesis imperfecta. Mutations of stable proteins may lead to a skeletal homeostasis disorder and WBs appearance. Additionally, wormian bones are of diagnostic value, since their presence may be occasionally misinterpreted as fractures during radiological examination. WBs morphological and topographical details are of paramount importance from the medico-legal point of view in forensic investigation of non-accidental skull injuries in order to rule out physical abuse and brittle bones [7].

Very few studies have been undertaken to study the anatomical aspects of sutural bones in dry human cranium in India. The current study aimed to estimate the presence and variations of sutural bones in dry human cranium.

Material and Methods

This retrospective, observational and single-center study carried out in the J. K. K. Natraja Dental College, Kumarapalayam, Namakkal district and Vinayaka Missions Medical College, Karaikal from August 2021 to December 2021. A total of 110 dry cranium of unknown sex was collected from above institutions. All the dry cranium was observed carefully for sutural bones. Presence of sutural bones was noticed in unilateral and bilateral location and shape of sutural bones was identified. Data was entered in Microsoft Excel® and statistical analysis for descriptive variables was performed in IBM SPSS (Version 16.0).

Results

Out of 110 dry crania, sutural bones were found in 69 crania (62.72%) with highest number of sutural bones found at lambdoid suture and asterion part of dry cranium. 9-12 sutural bones were present in three cranium at lambdoid suture (Fig.1), 3-5 sutural bones present at asterion in five bones (Fig.2). Presence of sutural bones in this study has shown in the Table 1.

Table 1: Occurrence of sutural bones

Sites of sutural bones	Unilateral	Bilateral	Total number with (%)
Lambdoid suture	18	42	60 (54.54)
Asterion	12	36	48 (43.63)
Parietal notch	5	15	20 (18.18)
Pterion	7	18	25 (22.72)
Sagittal suture	-	-	4 (3.63)
Coronal suture	6	-	6(5.45)
Orbit	2	4	6 (5.45)
Nasion	1	-	2 (1.81)

Among the unilateral and bilateral occurrence of sutural bones, we noted lambdoid (60/54.54) and asterion (48 /43.63) areas with more sutural bones than at other sites. The other common sites of sutural bones were pterion, which showed higher frequency than the bones of parietal notch. At the parietal notch we observed 2-3 sutural bones.

Fig:3 a showed the small plate of squamous part of temporal bone.

Fig:4 a, b showed 1-2 sutural bone at pterion.

At the nasion there was a small bony projection at frontonasal suture, one more bone showed split nasal bones on unilateral side. The sutural bones in the orbit, the first of its kind reported by us as

the “orbital sutural bones”. We reported (6/ 5.45) sutural bones in lateral wall of

orbit between zygomatic bone and greater wing of sphenoid (Figure 5-7).



Figure 1: Showing lambdoid suture

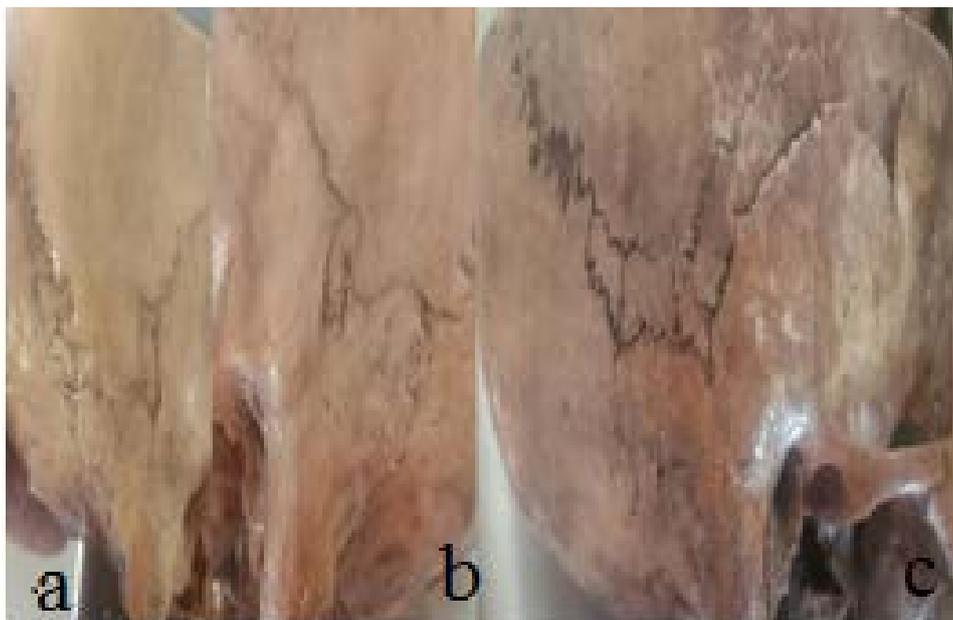


Figure 2: Sutural bones at parietal notch

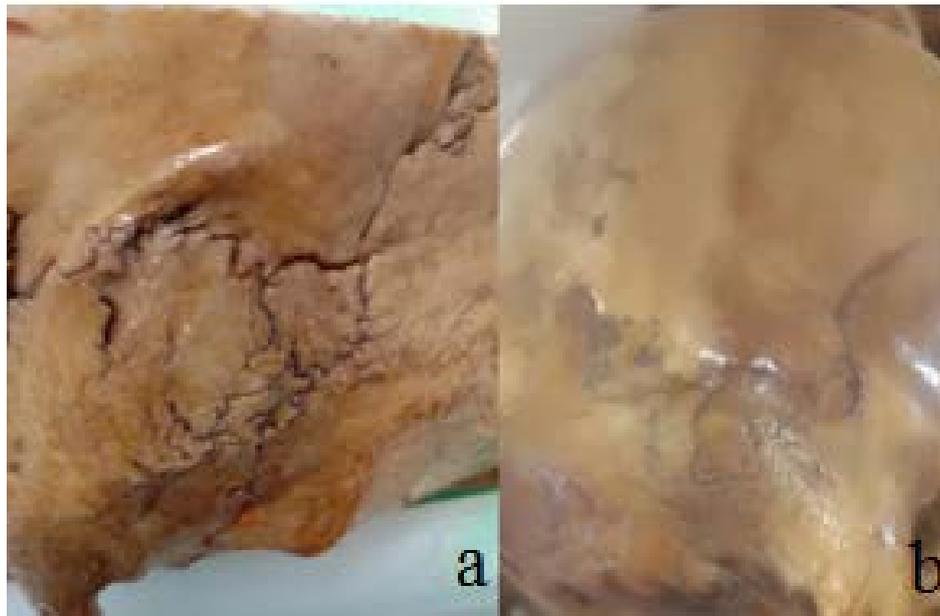


Figure 3: At Asterion



Figure 4: Pterion



Figure 5: Sagittal and Coronal suture bones



Figure 6: At nasion



Figure 7: In the orbit

Discussion

Wormian bones which were firstly described by Danish anatomist Olaus Wormius are accessory, small, different-shaped bones located on the cranial sutures which are appeared from additional centres of ossification. The incidences of sutural bones are common, its origin is still unclear, but the primary reason of this incidence is mechanical, pathological and genetic factors [8]. Sutural bones are classified into true and false variants. False sutural bones are ossification centers not welded to independent bones, such as occipital or temporal bones. True sutural bones are derived from one or many points of ossification developed in the marginal part of the cranial bones.

Depending on their location, sutural bones can be true sutural bones, fontanels or isolated ones. The isolated sutural bones are those that develop at a distance from the sutures and fontanels. The rarity of wormian bones within the anterior fontanelle makes it difficult to establish any specific association between its occurrence and other syndromes. A recently published case report suggested a novel association between wormian bones involving the anterior fontanelle and

severe facial dysmorphisms and midline abdominal defects. Wormian bones articulate with the surrounding bones by sutures and their dentations are complex outside than on the internal surface of the skull. They are considered to be supplementary points of ossification and do not have role in supporting the cranium. The sutural bones are of different shapes and sizes such as oval, oblong, round, quadrilateral, polygonal and triangular which can range from below 1 mm in diameter to as big as 5 x 9 cm.

Our study reported 60 (54.54%) cases of sutural bones at the site of sutural bones. The presence of wormian bones more along the lambdoid suture is the common finding in most of the previous studies [9-13] Further, our study also mentioned about the laterity of Wormian bones. Since higher proportion of sutural bone occurrence had tendencies towards unilaterality, a study of side wise distribution for these sutural bones was undertaken in skulls with unilateral sutural bones. The distribution on both sides was found to be overall approximately similar thus implying no side preference for any sutural bone occurrence. This is in unison with the works of GP Pal who also noticed

no significant side predilection for sutural bones in general [14].

The sutural bones may be mistaken for fracture of skull in case of trauma at the pterion or occipital region [15]. Knowledge of interparietal bone at this region is useful for neurosurgeons and radiologists to avoid missed diagnosed of skull fracture. Anthropologist and forensic scientist also can be using this information for personal identification related to the ethnic variation [16].

Limitations of the study can be considered as the study sample did not include infant skulls and skulls with syndromic background and asymmetries, or pathological skulls so we could not investigate the effect of these variants in WBs appearance. Also, we could not represent gender differentiation for all the study samples.

Conclusion

Anatomical knowledge of sutural bones is clinically important, because their presence refers mainly to bone dysplasia like craniosynostosis and imperfect osteogenesis and used as a useful marker of some congenital disorders.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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