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A Comprehensive Study of Wormian Bone in Dry Skull: Incidence, Number and Topography

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ABSTRACT

Objective: The bones presents in between the two bones of skull - sutures or fontenelles known as Wormian or Sutural or Accessory bones. Methods: we evaluate the number of intrasutural bone, as the structural distribution and prevalence of the sutures with Sutural bones, the number of wormian bone in each skull, and the variations in incidence between the paired sutures with intrasutural bones, were the parameters assessed in this study. The exact age and the sex of dried skull were unknown. In order to identify the area of the skull with the highest incidence of Sutural bone, we visually inspected all of the sutures and fontenelles in the viscera cranium, orbital cavity, and neuro cranium and noted the existence, shape, topographic location, and numbers of Wormian bone. RESULTS: Wormian bones evaluated in 110 dry skulls, indicating their high prevalence in our study. DISCUSSION: The term "Wormian bone" has been around for a very long time. It comes from a letter written in 1643 to Thomas Bartholin by Danish anatomist Ole Worm (1588-1654), which described intrasutural bones. According to our research, there are more wormian bones in lambdoid sutures than in coronal sutures. According to Sanchez-Lara et al., this investigation supported the idea that mechanical forces have an impact on the high prevalence of wormian

bones in the midline with sagittal or metopic synostosis. According to certain theories, osteogenesis imperfecta and wormian bones are related (Cremin et al). According to earlier research, wormian bones differ in shape, quantity, position, and incidence. According to a study that examined the relationship between artificial deformation and wormian bone incidence, adults had a greater incidence of wormian bones than fetuses (El-Najjar & Dawson, 1977).

INTRODUCTION

The skull anatomy is challenging and important for the details of its stages of development, which is not recall easily by radiologists and compound because of its relation with the nervous system. The complex structure of the skull, carried out from the variable nature and changing appearance of sutures. The cranium divided into two parts –the neuro-cranium and splencno-cranium. The cranium is composed of numerous bones, in fetal life separated by fibrous membrane, which fuses after birth to form sutures. The majority of the bones of cranium developed through an intramembranous ossification after second month of gestation. At the beginning, there are 110 ossification centers responsible for the formation of 45 fetal skull bones. Union of those 45 bones produces 22, which make up the adult skull.

The sutures are a type of fibrous joint that are presents only in the skull. The large sutures –sagittal, coronal, lambdoid and squamous sutures, are seen in all infants (<1 yr of age) and toddlers (age 1-4years). These sutures demonstrate consistent anatomic location and appearance. The age of time of closure varies in person to person. The sagittal suture if the first to close typically at around 22 yrs of age the coronal suture close around 24 yrs ; and the lambdoid and squamosal suture close at around 26 and 60 yrs respectively.

Human anatomy, forensic medicine, radiology, physical anthropology and other fields are curious in the study and reporting of Sutural bones as ethnic factors. In honor of “Danish anatomist Olaus Wormius” a physician at the University of Copenhagen, termed as Wormian bones. Although Hippocrates is credit with describing them initially, he provided a thorough account of them in 1643.Osseous bridging is presents in all of these sutures by premature fusion of skull bones. Craniosynostosis is a phenomenon that may alters the development of skull. It may result in an irregular shape of cranium. There are some

mechanisms, which explain the shape of head is determined by cranial sutures while the size depends upon the brain growth.

Metopic sutures close by three months of age in up to thirty-three percent of patients, and they should close in almost all children by nine months. Though it can take up to ten years, the spheno-squamosal suture usually closes by the age of six. Between the ages of 15 and 16, the sphenofrontal and occipitomastoid sutures normally close. As previous study said, 18% of all maltreatment involve physical abuse, with Abusive head trauma (AHT) being a severe type that frequently results in skull fractures. However, supplementary sutures and wormian bones (schalthknoch), intercolony bones, or Inca bones (Goethe's ossicles) are frequently discover during radiological studies and can occasionally result in incorrect conclusions.

Wormian bones are tiny additional bones that develop in the skull's typical fontenelles or sutures. They are regard as a basic anatomical variation. Frequently, these are observed in patients with specific types of bone dysplasia, including rickets, congenital hypothyroidism, pycndysostosis, and cleidocranial dysostosis.

Wormian bones considered to form from extra ossification centers as the skull develops. Wormian bones allied to a number of illnesses, but they can also happen to healthy people quite a little. As usual, less and smaller in number countered. Although primarily based on adult dry skulls, the data regarding the topographical placement and abundance of wormian bone is rather extensive. They named according to their topographical location such as bregmatic bone, sagittal ossicles and Inca bone at the lambda, all of which are seen in the midline and pterion ossicles, epipteric bone or flower’s bone at the pterion, squamous suture ossicles, ossicles at the asterion, lambdoid ossicles are seen bilaterally in the cranium. Wormian bone prevalence in the general kid population is not well documented, which is particularly crucial for the differential diagnosis of child abuse.

Aim of our study is to identify the prevalence, presence, topography location shape and number of wormian bone in dry skull. This will help frame an accurate prognosis and thence increase the evidence of the pinpointing in case of abuse.

MATERIAL AND MATHODS

One hundred (110) adult dried skull of unknown age and sex obtained from anatomy department of subharti medical college and dental department of subharti were used to evaluate the localization of intrasutural bones. The skulls' precise ages and sexes remained unknown.

We took note of every suture and fontanelle in the orbit, neurocranium, and viscerocranium. By visually inspecting the presence, shape, geographic position, and quantity of Wormian bones. One can ascertain which area of the skull had the highest incidence of Wormian bones. Commonly we found the Sutural bones at the sagittal suture, both lambdoid sutures, posterior and anterior fontenelles, and Posterolateral or mastoid fontanelle, as illustrated in figures.

For measurements we used digital caliper, which is sensitive to 0.01 mm (standard parameter), had been used. Protractor and flexible metric is necessary to use for aspect measurements.

ETHICAL ASPECTS: - This project was approved by a constitute ethics committee of the institute within which the work was undertaken.

Figure 1 showing wormian bone in spheno maxillary suture

Figure 2 showing WB in fronto nasal suture

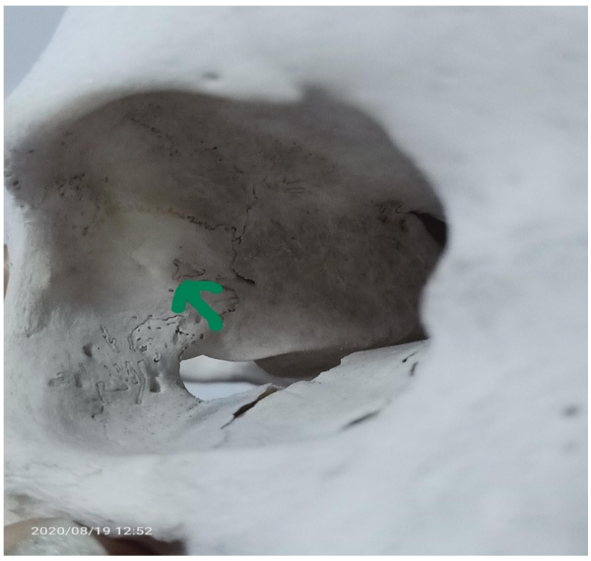

Figure 3 showing wormian bone in sphenopalatine suture

Figure 4 showing wormian bone in pterion

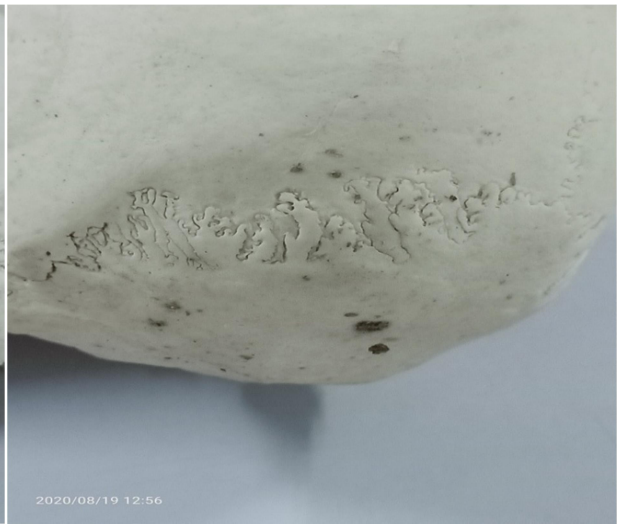

Figure 5 showing WB in rt lambdoid suture

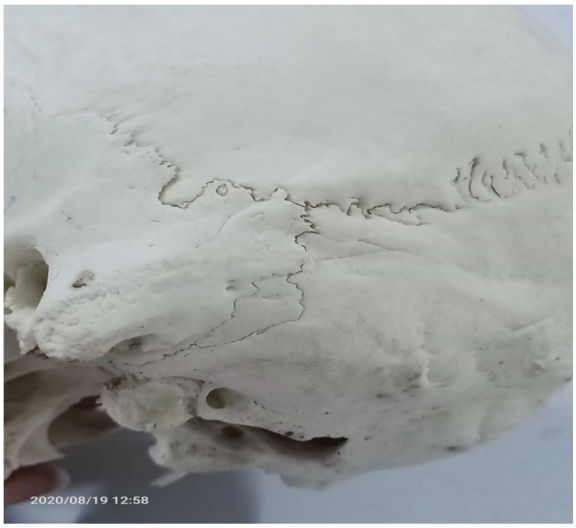

Figure 6 showing WB in lt lambdoid suture

Figure 7 showing WB in occipitomastoid suture

Figure 8 showing WB in pterion

Figure 9 Sowing WB in lambdoid suture

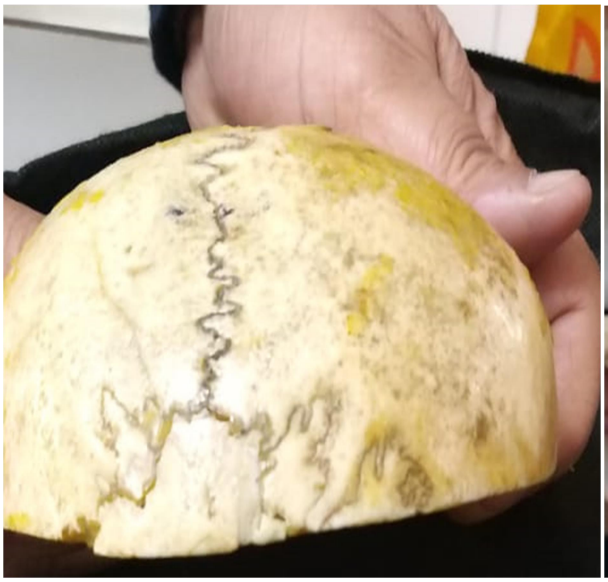

Figure 10 showing WB in pterion

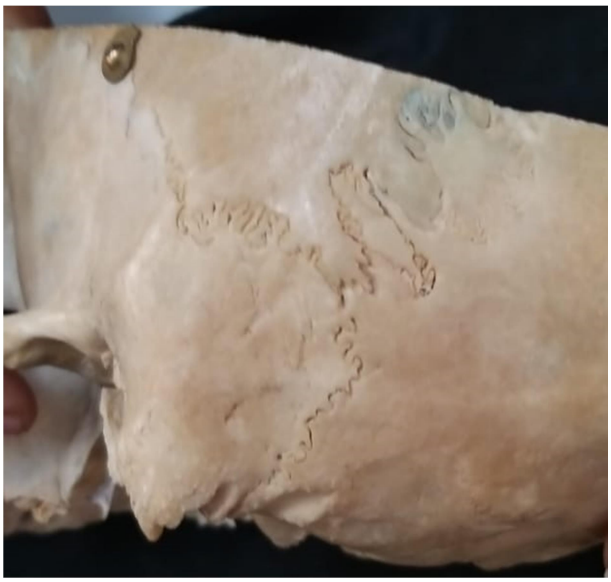

Figure 11 showing WB in lambdoid suture

Figure 12 showing Wb in lt lambdoid suture

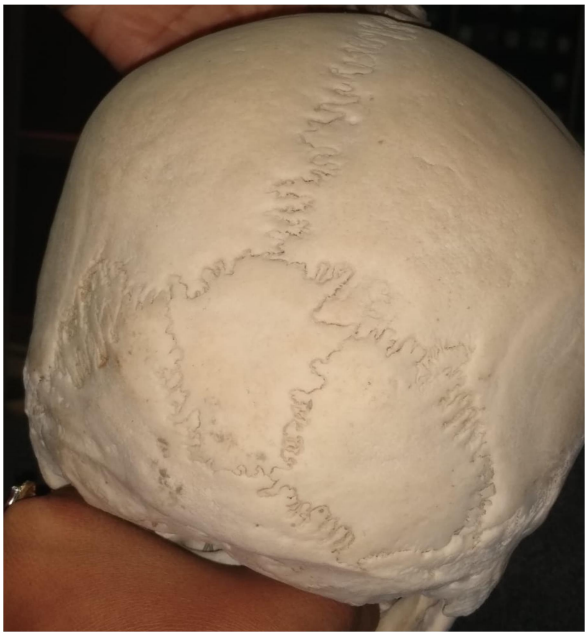

Figure 13 showing WB in lt lambdoid suture

Figure 14 showing WB in rt lambdoid suture

RESULT

In our study, Wormian bones observed in 110 dried skulls.

According to their position, these bones were classified into three types: interperital, preinterperital, and Sutural bones. Wormian bones are highly observed in the sutures and the fontenelles of neurocranium

showed. a less number of Wormian bones present in the orbital cavity and at face. Commonly Sutural bones are located in lambda followed by in order of frequency by lambdoid suture, pterion and asterion. Wormian bones also detected in the occipito-mastoid, sagittal, squamosal, zygomaticosphenoid, front nasal and frontozygomatic sutures. Besides, the rate of wormian bone on left side is abt 66% and 34 % on right side of the skulls. Only Two skulls are present with more than 5 wormian bones.

Shape of Sutural bones	Number of Skulls	odds
Quadrangular	30	23.07
Irregular	76	58.46
Triangular	14	10.76

As regards the craniotomies skull (64 out of 110) an incidence of 70.4% detected with Wormian bones intracranial. Besides this, the incidence of a single intrasutural bone is in the front nasal, zygomatosphenoid and frontozygomatic.

WBs locations	Observed Range of WBs (min- max)
Lambdoid suture	0-18
Parietomastoid suture	0-20
Occipitomastoid suture	0-24
Sagittal suture	0-4
Coronal suture	0-8
Squamosal suture	0
Frontonasal suture	0-2
Asterion	0-21
Pterion	0-24
Anterior fontanelle	0
Posterior fontanelle	0-16
Zygomaticosphenoid suture	0-2
Frontozygomatic suture	0-2
Fronto lacrimal suture	0-1

Lacrimomaxillary suture	0-1
Zygomatico maxillary suture	0-2
Total no of bones	145

The percentage distributions of shape of each bone were shown in table 1. Demonstrate the number of Sutural bones in lambdoid, sagittal suture as well as in the lambda (post fontenelles).

We evaluate the location of the Sutural bones. As observed total 145 wormian bones which includes 24 in occipito-mastoid suture, 21 and 24 in asterion and pterion respectively, 18 were found in lambda(posterior fontanelle), 4 and 8 in sagittal and coronal suture, 6 in right lambdoid and 12 in left lambdoid sutures. Whereas we also found 1 or two wormian bones in zygomatosphenoid, frontozygomatic, fronto lacrimal , fronto nasal, spheno maxillary and spheno zygomatic sutures.

DISCUSSION

The term Wormian bone has been around for a very long time; intrasutural bone it comes from a letter written in 1643 to Thomas Bartholin by Danish anatomist Ole Worm (1588-1654), who described intrasutural bones.

As earlier, We have known of Wormian bone for a very long time, with the name deriving from the description of intrasutural bones given by Ole Worm (1588-1654), who was a Danish anatomist, in a letter addressed to Thomas Bartholin in 1643, a Sutural bone.

Some study says that Embyologically, large intrasutural bones were higher in craniosynostosis. It augmented the consideration that Sutural bone found highly at sagittal and metopic suture due to mechanical force (Sanchez-Lara *et al*.). This leads “a relationship between wormian bones and osteogenesis imperfecta” (Cremin *et al*.). Previous studies represent with variations in the shape, number, location and prevalence of Sutural bones. A Study, declared that intrasutural bone prevalence was higher in adults rather than in fetuses. The fact was the association between artificial deformation and incidence of wormian bone. (El- Najjar & Dawson, 1977).

Wormian bones are the unusual ossification centers of cranium that forms normal adult skull (Bellary *et al*.). Patil & Sheelavant, examined the main causes of appearance of wormian bones may be adaptation to cranial enlargement, artificial cranial deformation, hereditary and metabolic disorders. As reported in the research, presence of multiple Sutural bones plays crucial function for central nervous system or skeletal pathology. Identification of these bones will be helpful for clinicians (Himabindu & Rao, 2015).

100-dried skull assessed in which 10 skulls include wormian bones. It founded one Sutural bone in four skulls, 2 Sutural bones in two skulls, four Sutural bones in 1 skull, 5 wormian bones, and more than five in only 2 skulls, at the Department of Anatomy, Andhra Medical College which are less than to our study. Proposed, most of them were tetrahedral-shaped stated by (Vasanthi *et al*., 2015).

In our study, incidence of Sutural bone is 78% and most of them are presented on lambdoid suture (44.61 %). The number of wormian bones on lambdoid suture is 58, 4 on occipitomastoid suture, 16 at lambda, and 18 on asterion. A study also reported the number of wormian bones as follows: 0 (47.8 %), 1 (14, 4 %), 2 (9.4 %), 3 (9.4 %), 4 (5 %), 5 (3.9 %), more than five (9.44 %) (Patil & Sheelavant) .

Sutural bones observed at lambda 8.10 %, pterion 1.80 %, asterion 2.7 %, parieto-temporal suture 4.5 %, occipito-mastoid suture 0.9 %, sagittal suture 0.9 %, and bregma 0.9 %. He also observed greatest wormian bones at lambdoid suture 53.15% which are nearby to our study (Sreekanth & Samala). Murlimanju et al [10] is also observed the highest no of WB at lambdoid suture (56.4%) and Walulkar Sanjay et al[11]assessed alike is 74.2% in their specimens. So many studies complain that WB were frequently observed in lambdoid suture. A.A Khan stated [12], out of 25 skulls they did not found any Wormian bone.

Table 2 : represents the percentages of incidence of Wormian bones in various studies.

Marti et al [2]	53%
Murlimanju et al [10]	73.10%
Walulkar Sanjay [11]	34.22%
A.A Khan [12]	28%
SibelCirpan et al [15]	59.30%
M. Venkateshwar Reddy	48%
In present study	78%

Some studies examined intrasutural bones according to their shapes, locations and incidence. After observation reported that 52.70 % were quadrangular, 37.83 % were irregular and 9.45 % were triangular-shaped wormian bones. In our study, we analyzed that 58% were irregular, 23.07% were quadrangular and 10.76% triangular shaped wormian bone. An investigation in South Indian, the skulls revealed the presence of wormian bones as 32 % (12 % right, 20 % left) (Ahad & Thenmozhi, 2015). Singh was also conduct study in Indian skulls, evaluated 14.81 % wormian bones at asterion.

Walulkar Sanjay et al[11],also evaluate three shapes of WBs in his study and these are irregular, oval and triangular [Fig 7] in decreasing percentage incidence respectively. Study by M. Venkateshwar Reddy's (2018), the most frequent type was irregular bone followed by triangular and then quadrangular.

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