International Journal of Anatomy and Research,
Int J Anat Res 2020, Vol 8(1.3):7390-94. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2020.110

Original Research Article

A PRELIMINARY STUDY ON INCIDENCE OF CRANIAL SUTURAL BONES BY 3D VOLUME RENDERING OF CT SCAN IN CURRENT POPULATION IN EASTERN INDIA

Bharati Yadav [1], Rohita Salam *[2].

[1] Assistant Professor, Department of Anatomy, MES Medical College, Perinthalmanna, Kerala, India.

[*2] Assistant Professor, Department of Anatomy, MES Medical College, Perinthalmanna, Kerala, India.

ABSTRACT

Background: Sutural bones are supranumary bones occurring along the sutures and completely surrounded by sutures of the skull. Their number, morphology and location 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. The studies on sutural bones have traditionally been based on the studies of dry calvaria which are unreliable for the homogeneity of the population studied. Hence, this pilot study was undertaken to evaluate the feasibility of 3D volume rendering of CT scan data for study of sutural bones.

Method: 3D volume rendering from 64-slice CT scan data from 64 patients was studied for incidence and location of occurrence of sutural bones.

Results: Overall incidence of sutural bone occurrence was found to be 29.69%. The most common sites for sutural bones, in descending order of occurrence, were found to be parieto-occipital suture, asterion, and lambda.

Conclusion: Sutural bone studies in concurrent populations such as this one are rare. The incidence of sutural bones in this study is similar to what another study on concurrent populations has reported. However, location of occurrence of sutural bones observed in this study was similar to all other sutural bone studies including those on dry skulls pointing to probable universality of this statistic. This preliminary study establishes the use of 3D volume rendering of CT scan data to be a valid means to acquire sutural bone data.

KEY WORDS: Sutural bones, incidence, CT scan, 3D, parieto-occipital, asterion, lambda

Corresponding Author: Dr. Rohit Salam, Assistant Professor, Department of Anatomy, MES Medical College, Perinthalmanna, Kerala, India. **E-Mail:** rohitasalam@gmail.com

Access this Article online	Journal Information
Quick Response code	**International Journal of Anatomy and Research**
	RG Journal Impact: 0.21*
	ISSN (E) 2321-4287 | ISSN (P) 2321-8967
	https://www.ijmhr.org/ijar.htm
	DOI-Prefix: https://dx.doi.org/10.16965/ijar
DOI: 10.16965/ijar.2020.110	**Article Information**
Received: 22 Jan 2020	Accepted: 20 Feb 2020
Peer Review: 22 Jan 2020	Published (O): 05 Mar 2020
Revised: None	Published (P): 05 Mar 2020

INTRODUCTION

Sutural bones, also known as intrasutural or wormian bones are accessory ossicles formed along sutures of calvaria, completely surrounded by sutures. Number, size and shape of the sutural bones vary widely. These miniature bones are formed because of additional ossification centres which appear along sutures during development [1]. Sutural bones should be differentiated from preinterparietal and interparietal bones, which are the result of incomplete fusion of occipital bone ossification centers, and not surrounded by normal suture lines of skull [2]. Although regarded as normal, non-metric, hypostatic, or epigenetic variants of cranium, their formation have been attributed

to sutural stress and gene mutation by some researchers [3].

Generally these intrasutural bones are few in number (0 – 10) and their presence in skull is considered as normal anatomical variant, but unusually more number (>10) of these bones serves as definite marker for diseases like osteogenesis imperfecta, cleidocranial dysostosis, craniosynostosis, rickets and hydrocephalus [4]. In radiological studies sutural bones, especially if these bones are large in size, can mimic signs of trauma or child abuse [5].

The knowledge of sutural bones is imperative for the medical practitioners as well as anthropologists. Important cases where it becomes essential to keep this knowledge in mind are those of skeletal dysplasia, a child with multiple cranial fracture, a medicolegal case with head injuries and a patient who has to undergo a skull surgery [5,6]. Anthropologists on the other hand utilize such knowledge in establishing identification of an individual or a population [7].

Till now, the predominant method of studying sutural bones is through the study of dry crania. However, the major drawback of this method is the unreliability of the temporal and geographical homogeneity of the population studied. With a view to overcome these impediments, this pilot study was undertaken in current population by 3D volume rendering of CT scan of head of patients undergoing such scanning to ascertain the feasibility of such method of data acquisition.

MATERIALS AND METHODS

This study was undertaken for a period of one month in adult patients attending the Radiology Department for CT scan head and neck in a tertiary care teaching hospital in Eastern India. Due permission from these patients for using their data and clearance by Institutional Ethics Committee were obtained.

Inclusion criteria: All adults attending the Radiology Department for CT scan Head and neck in the scans of whom, sutures were well visible.
Exclusion criteria: Patients with malformed, deformed or fractured skulls. Sutural bones with faint or obliterated sutures around it were disregarded. Interparietal and pre-interparietal bones (Inca bones) were not counted as sutural bones.

Methodology: The CT scan data of the head region was performed with GE Optima CT 660, a 64 slice scanner and its 3D volume rendering was accomplished and recorded with the software accompanying the CT scanner. This data was tabulated and analyzed using Microsoft Excel 2007 software.

RESULTS

Incidence (Figure 1): A total of 64 patients (36 males and 28 females) attended the Radiology department for CT Scan head and neck during the study period, who fulfilled the inclusion criteria as outlined in Materials and Methods section.

Of these, sutural bones were found in 19 patients of whom 11 were males and 8 females. The incidence of sutural bone occurrence was 29.69% overall, 30.56% in males and 28.57% in females.

45 (70.31%) out of 64 patients had no sutural bones, 13 (20.31%) had 1-3 sutural bones, 5 (7.81%) had 4-10 sutural bones and 1 (1.56%) had >10 sutural bones.

Site-wise Incidence (Figure 2): Parieto-occipital suture was found to be the most common site for sutural bone occurrence in sutural bone positive patients wherein it occurred in 15 out of 19 patients (78.95%) (Figure 3). Second most common site was found to be asterion at which 8 (42.11%) patients showed occurrence of sutural bones (Figure 3). 4 (21.05%) cases were positive for sutural bones at lambda (Figure 4) while 1 case of sutural bones was found in each of sagittal, coronal and temporoparietal sutures respectively. No other sutures showed presence of sutural bones in this study.

Fig. 1: Frequency distribution of sutural bones in the current study (n=64). As currently accepted, subjects with 0-3 sutural bones (90.62% in this study) comprised majority of the cases (See Discussion).

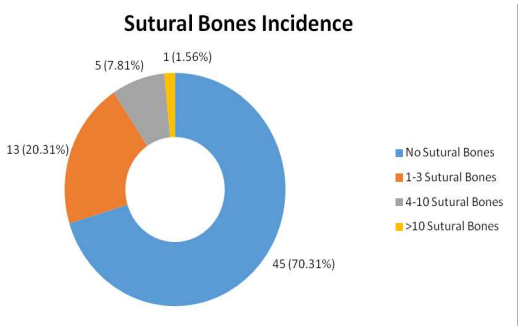


Fig. 2: Sitewise incidence of sutural bones (%) in suture bone positive subjects in the current study (n=19). Parieto-occipital suture was the most common site of occurrence followed by Asterion and Lambda respectively.

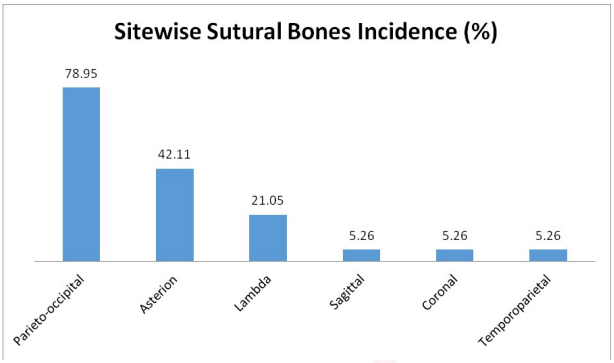


Fig. 3: 3D volume rendering of CT scan head showing sutural bones at asterion (solid arrow) and parieto-occipital suture (dotted arrow)

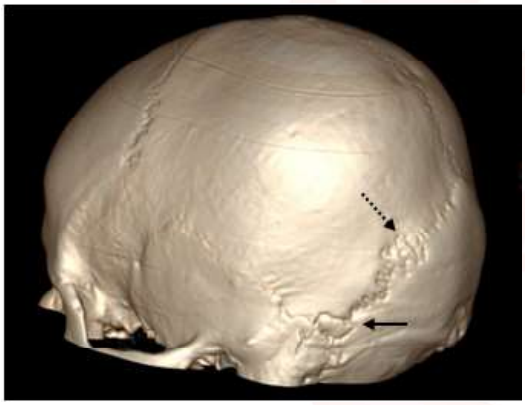
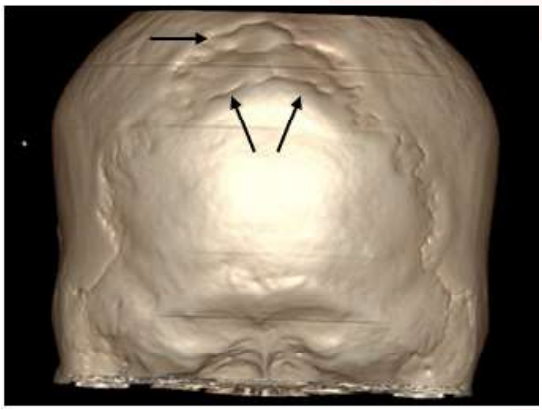


Fig. 4: 3D volume rendering of CT scan head showing sutural bones at lambda (solid arrows).



DISCUSSION

Sutural bones, when present without any clinical findings, are considered as normal variants in human cranium [8]. However, their presence may pose challenges, both diagnostic, as in radiology where they may be confused with fractures or signs of child abuse in skull radiographs [9], and therapeutic as in surgeries involving skull bones where they may pose difficulties in landmark identification [10] or may induce complications by breaking away during the procedure [11].

The above mentioned clinical importance assumes greater significance if the incidence of the sutural bones in the normal local population is high.

Generally, the normal population is considered to exhibit zero to three sutural bones [1] and this study was no exception to this statement as 58 out of 64 skulls studied (90.63%) fell in the category of 0-3 sutural bones (Figure 1).

The incidence of sutural bones in the normal population varies with the population under study and is considered a population characteristic [12]. The worldwide incidence has been reported from as low as 10% in Caucasians to as high as 80% in the Chinese population [13].

The incidence of sutural bones found in this pilot study was 29.69%. Notable in this statistic is that it is in stark contrast with similar study done on dry crania from the same region where the incidence of sutural bones was found to be 72.28% [14]. It may be pointed out that studies on dry crania have two major flaws. One, that these studies cannot assure that the dry crania used in the study belong to the homogenous population representative of the geographic region. Two, these studies also cannot assure that the dry crania used in the study represent the concurrent population or a population limited to a time frame. Both these flaws are generated because the dry crania used in these studies may usually have been collected from populations of dissimilar regions and may belong to dissimilar time periods. This may be the reason that the reported sutural bone incidence from study of dry crania is quite varied too. For example, William F. Masih [15], from his study of dry crania, reported an incidence of 4.7% while Muralimanju BV et al, [16] who also studied dry skulls reported the incidence to be 73.1%.

Therefore, to compare our results with the study on dry crania would be meaningless. However, incidence of sutural bones reported by authors whose works sampled concurrent adult population would be appropriate yardstick to compare our work with. Unfortunately, such works on concurrent adult population are rare and hard

to find. The work by Goyal N et al [17] is the only one which we could find which studied skulls of the concurrent population during autopsy and their reported sutural bones incidence of 35.37% is reasonably close to that reported in this study.

In the 19 cases positive for sutural bones in this study, the site for maximal occurrence of sutural bones was found to be at parieto-occipital suture (78.95%) followed by asterion (42.11%) and lambda (21.05%) (Figure 2). This data, despite being from very small dataset, reflects the general trend seen in most reports on sutural bones in dry crania wherein parieto-occipital suture is the commonest site for sutural bone occurrence and whereas asterion and lambda are common sites too [1,2, 16, 18-20]. Therefore, in contrast with observation of incidence, the predilection of sutural bone occurrence at specific sites seems to be independent of geographic and temporal homogeneity of population and probably a wide variety of population can be expected to have similar sitewise pattern of sutural bone occurrence despite having dissimilar incidence rates amongst populations. This proposition can, however, be verified only with further such studies on various populations.

This study was conducted as a pilot study for evaluating the feasibility of the use of CT scan data by 3D volume rendering for study of sutural bones. The study seems to have met its objective as the overall results are in concordance with similar studies, hence approving this method of data acquisition. However, the limitation, as expected from a pilot study, was the small amount of data which could not be to put through the scrutiny of statistical analyses.

We expect, that this study would motivate other authors for the use of CT scan for fresh wave of suitably powered studies on sutural bones from various geographical regions. The data generated from these studies would not only overcome the drawbacks of the studies on dry crania viz. probable heterogenous population but also bring in a lot of specificity to anthropometric characterization of populations on basis of sutural bones and co-relations of sutural bone occurrence with disease processes. And since, the current machines have a high resolutions, the quality of data generated is expected to be satisfactorily reliable.

CONCLUSION

This study concludes the following: Most of the persons have zero to three sutural bones in their cranium and are essentially normal variations. Commonest site of sutural bone occurrence is the parieto-occipital suture. Asterion and lambda are also common sites. 3D volume rendering of CT scan image data seems to be reliable and acceptable way of studying these traits in concurrent population. Rate of incidence of sutural bones appears to be population specific and hence discrepancy might be observed between CT based and dry crania based sutural bones study from the same region as dry crania do not represent homogenous populations. Sites of incidence of sutural bones seem to be independent of homogeneity in populations.

CT scan based studies should become the norm for study of sutural bones as they offer advantages over dry crania based studies, population homogeneity being most important given that the current data on homogenous populations is largely lacking.

Conflicts of Interests: **None**

REFERENCES

[1]. Standring S, Gray H, editors. Head and Neck - External Skulls. In: Gray's anatomy: the anatomical basis of clinical practice. 40. ed., reprinted. Edinburgh: Churchill Livingstone Elsevier; 2009. p. 409–15.

[2]. Scheuer L, Black SM. The Head, Neck and Dentition. In: Developmental juvenile osteology. San Diego, CA: Academic Press; 2000. p. 36–66.

[3]. Kague E, Roy P, Asselin G, Hu G, Simonet J, Stanley A, et al. Osterix/Sp7 limits cranial bone initiation sites and is required for formation of sutures. Dev Biol. 2016 15;413(2):160–72.

[4]. Cremin B, Goodman H, Spranger J, Beighton P. Wormian bones in osteogenesis imperfecta and other disorders. Skeletal Radiol. 1982;8(1):35–8.

[5]. Marti B, Sirinelli D, Maurin L, Carpentier E. Wormian bones in a general paediatric population. Diagn Interv Imaging. 2013 Apr;94(4):428–32.

[6]. Govsa F, Ozer MA, Bayraktaroglu S, Aktas EO. Anatomoradiological identification of intrasutural bones for importance of cranial fracture. Turk Neurosurg. 2014;24(3):357–62.

[7]. Hanihara T, Ishida H. Frequency variations of discrete cranial traits in major human populations. I. Supernumerary ossicle variations. J Anat. 2001 Jun;198(Pt 6):689–706.

[8]. Jeanty P, Silva SR, Turner C. Prenatal diagnosis of wormian bones. J Ultrasound Med. 2000 Dec;19(12):863–9.
[9]. Pandya NK, Baldwin K, Kamath AF, Wenger DR, Hosalkar HS. Unexplained fractures: child abuse or bone disease? A systematic review. Clin Orthop Relat Res. 2011 Mar;469(3):805–12.
[10]. Natekar PE, DeSouza FM, Natekar SP. Pterion: An anatomical variation and surgical landmark. Indian Journal of Otology. 2011 Apr 1;17(2):83.
[11]. Ersoy M, Evliyaoglu C, Bozkurt MC, Konuskan B, Tekdemir I, Keskil IS. Epipteric bones in the pterion may be a surgical pitfall. Minim Invasive Neurosurg. 2003 Dec;46(6):363–5.
[12]. Hauser G, DeStefano GF. Epigenetic variants of the human skull. Stuttgart: Schweizerbart'sche Verlagsbuchhandlung; 1989. 301 p.
[13]. Bergman RA, editor. Skeletal systems: Cranium. In: Compendium of human anatomic variation: text, atlas, and world literature. Baltimore, Md: Urban & Schwarzenberg; 1988. p. 197–215.
[14]. Purohit K, Yadav B. Sutural Bones: A Study on Incidence, Laterality and Co-relation with Cephalic Index in Dry Crania of East Indian Ethnicity. IJAR. 2019 Sep 5;7(3.3):6944–57.
[15]. F.Masih W, Gupta S, E.Chand A, Jaiswal P, P.K. S. Incidence of wormian bones in human skulls in Rajasthan. Journal of Evolution of medical and Dental Sciences. 2013 Feb 27;2:1001–4.
[16]. Murlimanju BV, Prabhu LV, Ashraf CM, Kumar C, Rai R, Maheshwari C. Morphological and topographical study of Wormian bones in cadaver dry skulls. Journal of Morphological Sciences. 2011 Jan 1;28:176–9.
[17]. Goyal N, Garg A, Kumar Y. Incidence and medicolegal significance of wormian bones in human skulls in North India Region. Int J App Basic Med Res. 2019;9(3):165.
[18]. Patil M, Sheelavant S. Sexual dimorphism among the wormian bones in adult human skulls. Journal of Indian Academy of Forensic Medicine. 2012 Apr 1;34:124–7.
[19]. Pal GP, Bhagwat SS, Routal RV. A study of sutural bones in Gujarati (Indian) crania. Anthropol Anz. 1986 Mar;44(1):67–76.
[20].Shivaleela C, Kumar GV, Malipatil SB, Sandhya K. Morphological study of wormian bones in dried human skulls. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2013 Apr 1;4:584–9.

How to cite this article:

Bharati Yadav, Rohita Salam . A PRELIMINARY STUDY ON INCIDENCE OF CRANIAL SUTURAL BONES BY 3D VOLUME RENDERING OF CT SCAN IN CURRENT POPULATION IN EASTERN INDIA. Int J Anat Res 2020;8(1.3):7390-7394. **DOI:** 10.16965/ijar.2020.110