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Solitary sutural bone at the left asterion and thirteen sutural bones in the lambdoid suture in an Indian neurocranium – a rare case report

Sreekanth Tallapaneni[1], Mohd Liyaqat Shareef[2], Srilakshmi Brahmandam[3], Shaik Haseena[3], Mohd Ansaruddin zoheb[4], Archana Yadav[5]

1. Associate professor, Department of Anatomy, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500008 Andhra Pradesh, India
2. Associate professor, Department of Forensic Medicine, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500008, Andhra Pradesh, India
3. Final Year PG, Department of Obstetrics and Gynecology, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500008, Andhra Pradesh, India
4. Assistant Professor, Department of Biochemistry, Dr. V.R.K Women's Medical College, Opp Deer Park, Aziznagar, R.R. Dist., 500 075. Andhara Praadesh, India
5. Final Year M.B.B.S Student, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500008, Andhra Pradesh, India
6. Final Year PG, Department of Obstetrics and Gynaecology, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500008, Andhra Pradesh, India

Corresponding author: Associate professor, Shadan Institute of Medical Sciences Teaching Hospital & Research centre, Hyderabad-500 008, Andhra Pradesh, India; E-Mail: anatomysreekanth18@yahoo.com

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ABSTRACT

The sutural bones/wormian bones are formations associated with insufficient rate of suture closure. They are regarded as epigenetic and hypostotic traits. Multiple wormian bones are the prominent features of various cranial dystosis. The asterion is the junction of parietal, temporal and occipital bones. During the routine osteology demonstration classes for first year medical undergraduate students, a series of sutural bones in the lambdoid suture were discovered. The neuro-cranium revealed a solitary sutural bone at the left asterion and 13 sutural bones within the lambdoid suture. In total there were 14 sutural bones. There were 6 sutural bones on the left half and 6 sutural bones on the right half of the lambdoid suture respectively. One sutural bone was seen at point of lambda and was numbered 8. All the sutural bones were irregular in shape. The second and third sutural bones

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were placed above and below the lambdoid suture. Occasionally the sutural bones may mimic fractures and may confuse the radiologist or neuro-surgeon. The awareness of sutural bones is essential for the neuroanatomists, neurosurgeons, orthopedicians, radiologists, anthropologists and morphologists. **A similar case report as not yet been reported in the world literature.**

Key words: (Lambdoid suture) (Lambda) (Neuro-cranium)

Abbreviations: SB-Sutural bones, WB-Wormian bones

1. INTRODUCTION

Sutural bones (SB)/Wormian bones (WB) are the intercalated bones discovered in the cranium incidentally, having no specific or regular relation to their normal ossification centers. The sutural bones occur more frequently in men and are seen occupying the sutures or filling fontanelles of the neonatal cranium (Fabrizo, 2008). Usually there are 2 to 3 sutural bones in single skull. Rarely, they occur in great numbers (Srivastava, 1992). In the skulls of hydrocephalic neonates they can be seen more in number as the cranium in these cases is associated with rapid expansion (Warwick, 1980). Sutural bones could be present in both normal and abnormal skulls. Radiologists have reported cases of SB associated with rickets, hypothyroidism, down syndrome, osteogenesis imperfect, pycnodysostosis and cleidocranial dysplasia (Frank Gaillard, 2008; Amit Tripathi, 2011). Conversely, the presence of WB in four fetuses, were reported without any associated anomalies (Philippe Jeanty et al., 2005). Asterion in greek means "star" or "starry". The Mercedes point is an alternative term for asterion. It is the junction of parietal, temporal and occipital bones Sutural bones can be discovered as normal variants and seem to be determined genetically in certain populations (Kaplal, 1991). The following are the factors predisposing for the formation of sutural bones.

Sutural bones/Wormian bones:

Isabare M defined the sutural bones as "They persisting within the suture and not incorporated into the adjacent bone during mineralization and maturation are called wormian bones after the Danish anatomist 'Olaus Worm'.

1. **Genetic factors**: The sutural bones are inherited as a dominant trait with incomplete penetrance (50%) and variable expression (Torgeson,J, 1951). their formation might be under the control of a number of genes with additive action (polygenic complex) and their phenotypic expression is conditioned by developmental thresholds (Barberini et al, 2008).
2. **Adaptation to cranial enlargement**: The number of sutural bones increases with the capacity of the skull, regardless of the cause of enlargement (Philippe Jeanty et al., 2005).
3. **Metabolic disorders**: The formation of sutural bones could result from metabolic disorders of the mesoderm (Hess, 1946).
4. **Artificial cranial deformation**: The incidence was found to be high among the artificially deformed skulls (Wilczak, 2009).
5. **The sutural length**: Longer the sutural length of a skull more the number of sutural bones. He suggests that sutural diastasis induces the formation of ectopic ossification centres. The formation and distribution of supernumerary ossicles may reflect different stress types (tension, pressure, etc.), acting on the cranial vault during late prenatal and early postnatal periods of bone growth (Barberini et al, 2008).

Comparison

1. The incidence of the wormian bones is variable ranging from 80% in Chinese skulls, 40% in Indian skulls and 10% in Caucasian. Occurrence of wormian bones is more common in male skulls than in female skulls (Fabrizo, 2008). According to the latest reports after observing 180 adult human dry skulls of known age and sex the incidence of sutural bones is more common in females (64.8%) than in males (40.2%) (Manjula patil, 2012).
2. The lambdoid suture is the most frequent site of occurrence of sutural bones. In the coronal, sagittal and squamosal sutures their occurrence is rare.

Content

The nomenclature of "sutural/wormian bones" is derived from a 1643 description of the intersutural bones by Olaus Worm to Thomas Bartholin. However, wormian bones had been described in the past with the first description attributed to Paracelsus (1460 to 1541 CA) (Parker 1905; Pryles, 1979). Sutural bones have been recognized in an Australopithecine skull. In the 16th century, the anatomists Andemach and Vesale were the first to associate wormian bones with cerebral disorders (Parker, 1905; Pryles, 1979). Several synonyms were mentioned in the monograph for the sutural bones which are used according to the discoverer- ossicula Andemaci, ossa Goethiano, according to the shape-ossa triquetra, ossa triangularis, ossa quadratum, according to the localization- suturaux, fontanellaires, insules, intercalaria, raphogeminantia, apicis, according to the function-complementaria, ossa accessorii, recently, wormian bones are also called ossa wormiana, intersutural bones and inca bones (Parker, 1905).

2. SCOPE OF THE STUDY

Occasionally the sutural bones may mimic fractures and may confuse the radiologist or neuro-surgeon. If the fracture of the skull is misinterpreted as a sutural bone making the patient loose the appropriate treatment on dot can lead to iatrogenic injury. Hence the basic knowledge of these sutural bones is indispensable to the traumatologists frequently dealing with head injuries. Also the awareness of sutural bones is essential for the neuro-anatomists, neurosurgeons, orthopedicians,

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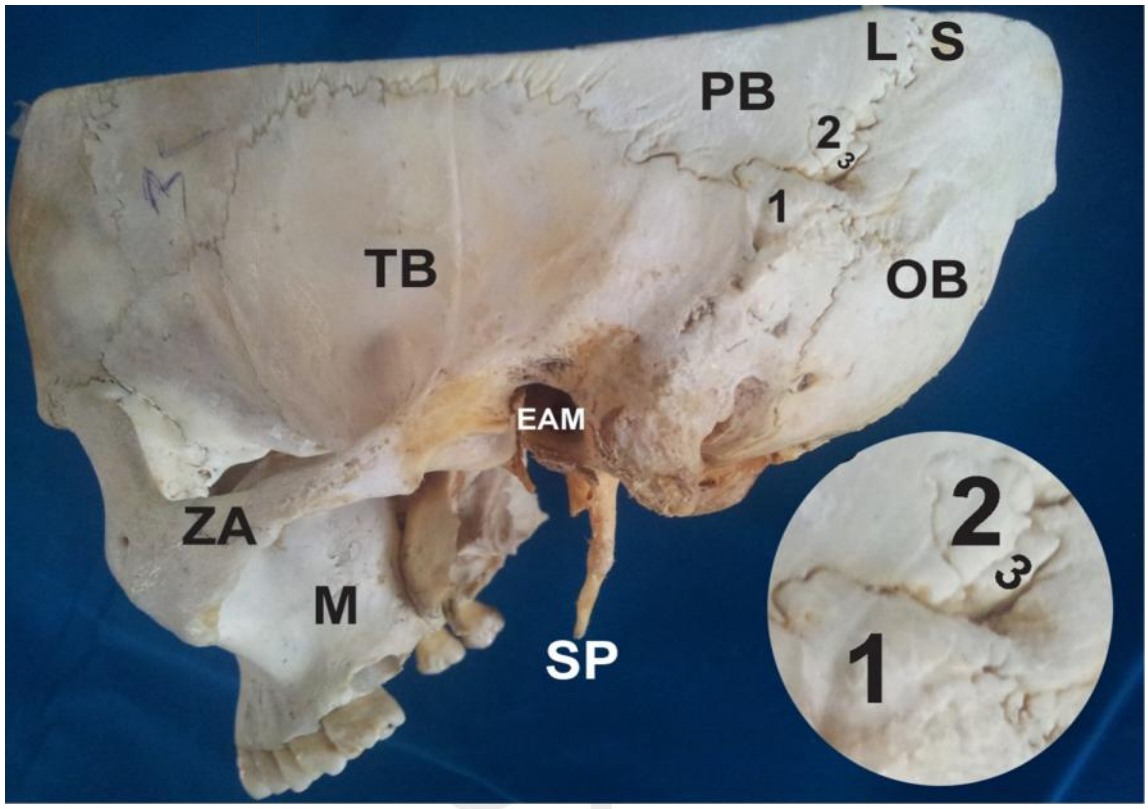


Figure 1

Left lateral view of the skull. Inset showing all the first three sutural bones.

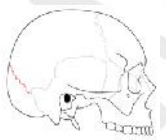
1 – TRIANGULAR SUTURAL BONE AT THE LEFT ASTERION
2 & 3 – ARE SUTURAL BONES OCCURING WITH IN THE LAMBDOID SUTURE.
NOTE: INSTEAD OF BEING PLACED SIDE BY SIDE, THEY ARE PLACED ABOVE & BELOW THE LAMBDOID SUTURE.

L – LAMBDOID SUTURE	SP – STYLOID PROCESS
OB – OCCIPITAL BONE	TB – TEMPORAL BONE
ZA – ZYGOMATIC ARCH	PB – PARIETAL BONE
M – MAXILLA	S – SQUAMOUS PART OF OCCIPITAL BONE
EAM – EXTERNAL ACOUSTIC MEATUS	

Asterion:
It is a visible craniometric, point where the lambdoid, parieto-mastoid, and occipito-mastoid sutures meet. It is also defined has the craniometric point where the three cranial bones namely, Parietal bone, Occipital bone and Mastoid portion of the Temporal bone meet.

Lambda:
It is the point of intersection between the sagittal and lambdoid sutures.

Lambdoid suture:



The suture which is placed between the occipital bone and the two (2) parietal bones is called the lambdoid suture.

radiologists, anthropologists and morphologists.

2.1. Materials

A dried adult human skull was obtained from the bone bank of Department of Anatomy, Shadan Institute of Medical Sciences, Teaching Hospital and Research Centre. Peerancheru, Hyderabad, Andhra Pradesh, India.

2.2. Methodology

All the bones of cranium and the sutures present between them were examined systematically for the presence or absence of sutural bones. Also the associated cranial lesions, if any, were searched for over the surfaces of the bones. The photographs of different essential views of the cranium with relevance to the sutural bones of the cranium were taken. The numbering of the sutural bones was done digitally from left side to the right side.

3. RESULT / OBSERVATION

During the routine osteology demonstration classes for first year pre-clinical medical students, a series of sutural bones in the lambdoid suture was discovered. All together there were 14 sutural bones in the skull. The sutural bone present at the left asterion was numbered 1 (Figure 1). The sutural bones occurring in the lambdoid suture were numbered from 2 to 14. The second sutural bone was extending upwards into the parietal bone. The third sutural bone was extending downwards into the squamous part of the occipital bone. Thus, both the second and third sutural

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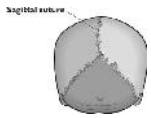
Figure 2

Left postero-superior view of the skull.

4, 5, 6, 7, 8 & 9 – ARE ALL SUTURAL BONES OCCURING IN THE LAMBDOID SUTURE.
4, 5, 6 & 7 ARE OCCURING IN THE LEFT HALF THE LAMBDOID SUTURE.
8 – IS THE SUTURAL BONE OCCURING AT THE POINT OF LAMBDA.
SS – SAGITTAL SUTURE

Sagittal suture:



The suture which is placed in between the two parietal bones, limited anteriorly by the coronal suture and posteriorly by the lambdoid suture is called the sagittal suture. It divides the skull into right and left halves.

Coronal suture:

The suture which is placed between the frontal bone and the two (2) parietal bones dividing the skull into an anterior and posterior part is called the coronal suture.

bones were sharing a small common strip of the lambdoid suture (Figure 1). There were 6 sutural bones on the left half of the suture (Figure 2) and 6 sutural bones on the right half of the suture (Figure 3). One sutural bone was seen at the lambda numbered 8 (Figure 2 & 3). All the sutural bones were irregular in shape. There were no other associated lesions.

4. DISCUSSION

Fourteen wormian bones in an adult Indian skull was reported earlier having six sutural bones on the left half and two sutural bones at the right half the lambdoid suture with six interparietal bones. All the sutural bones were irregular in shape. There were multiple lesions (blisterings) of different sizes noted on the frontal bone, both the parietal bones, and at the left half of the coronal suture (Sreekanth, 2013). In the present case fourteen wormian bones were discovered in an adult Indian skull but 13 of them were discovered in the lambdoid suture. There was a single sutural bone at the asterion. All the sutural bones were irregular in shape but no multiple lesions (blistering) of skull were noted. After examining 55 human adult dry skulls the incidence of sutural bones was found to be 16.36%. Most of them were triangular in shape and had irregular margins. In the present case the sutural bone at the asterion was triangular with irregular margins (Rajani Singh, 2013). Multiple wormian bones at the lambdoid suture in an Indian skull were reported in an Indian skull. Six bones were on the left side of lambda and the rest were on the right side.

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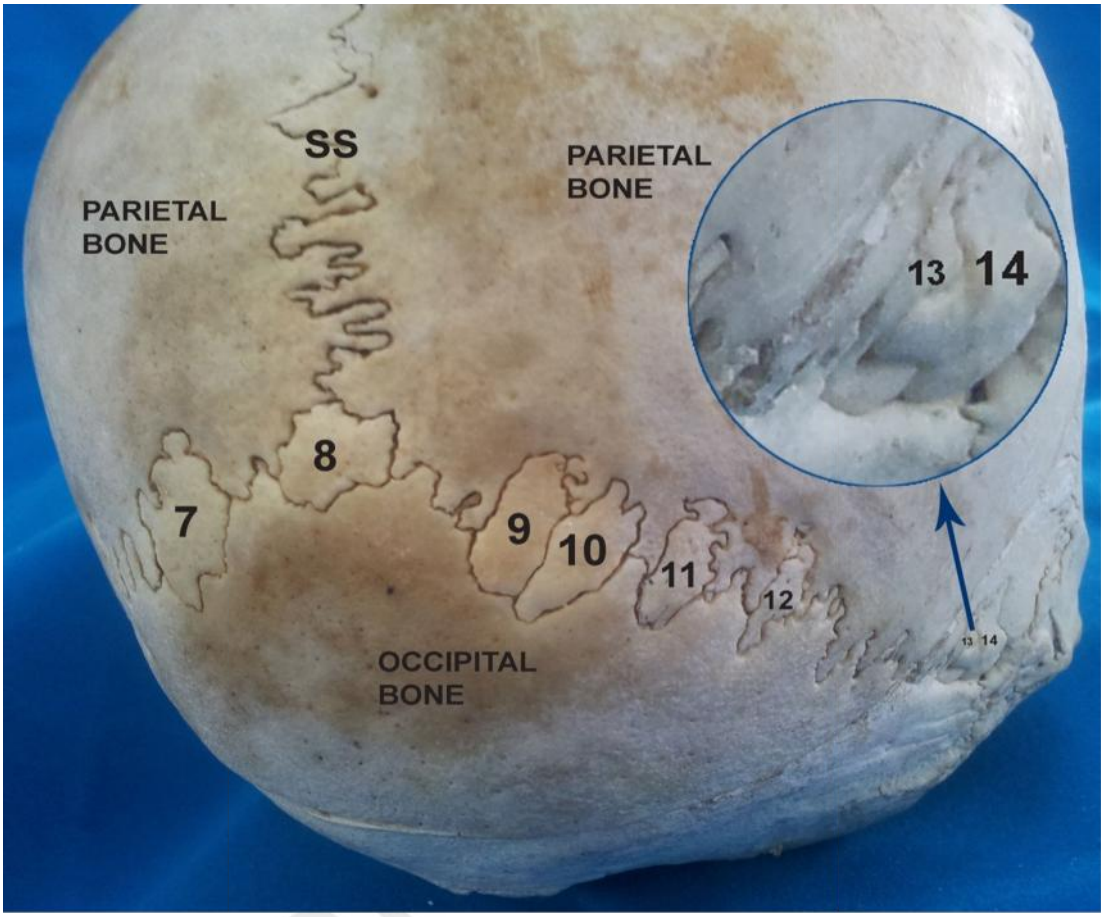

Figure 3

Right postero-superior view of the skull. Inset showing 13th and 14th sutural bones.

7 – IS THE SUTURAL BONE OCCURING AT THE LEFT HALF OF THE LAMBDOID SUTURE.
8 – IS THE SUTURAL BONE OCCURING AT THE POINT OF LAMBDA.
9, 10, 11, 12, 13, & 14 – ARE ALL THE SUTURAL BONES OCCURING WITH IN THE RIGHT HALF OF THE LAMBDOID SUTURE.
NOTE: THE 13TH AND 14TH SUTURAL BONES ARE OCCURING ALMOST AT THE END BUT WITH IN THE LAMBDOID SUTURE.
SS – SAGGITAL SUTURE

They were irregular in shape. There were no other notable abnormalities in the skull (Nayak, 2008). In the present case also there were 13 sutural bones were discovered in the lambdoid suture of an adult Indian skull. Six bones were on the left side and six bones were on the right half of the lambdoid suture and one wormian bone was present at the lambda respectively. A single bone numbered one was at the asterion. Similarly there were no other abnormalities noted in the skull. After observing 225 adult human skulls it was opined that the most common shape of sutural bones was irregular followed by oval shape. Also quadrangular, triangular and circular shapes were reported (Walulkar et al., 2006). In the present case all the wormian bones had irregular shape. After observing 180 adult human dry skulls of known age and sex it was opined that the incidence of sutural bones were more frequent at lambdoid suture was up to 60%.. They were more common in females was 64.8% than in males skulls [40.2%] (Manjula patil, 2012). In the present case all the sutural bones were seen in the lambdoid sutures. There were no sutural bones in the other sutures of the skull. Occurrence of sutural bones in great numbers is rarity (Srivastava, 1992). In the present case fourteen sutural bones were discovered at the lambdoid suture hence making this case report first of its kind in the world literature.

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5. CONCLUSION

At times, the sutural bones look like fractures and may confuse the radiologist or surgeon. It is more problematic if the fracture of skull is misinterpreted as a Wormian/Sutural bone and the patient may lose the appropriate treatment at a right time. Hence the basic knowledge about these accessory bones is important for the doctors in day to day clinical practice. The neurosurgeons use the asterion to orientate themselves in order to plan for safe entry into the skull. The wormian bones, in themselves, do not carry a pejorative prognosis, and thus the prognosis will depend on the type and severity of the associated diseases. The knowledge of WBs is enlightening for the neuroanatomists, neurosurgeons, radiologists, anthropologists and morphologists.

SUMMARY OF RESEARCH

The surgical skill of the operating neuro-surgeons could be challenged while performing craniotomies posteriorly or postero laterally for resection of cerebellar and cerebello pontine tumors. The presence of series of sutural bones/wormian bones with in the cranium can mislead the radiologists interpreting roentgenogram's, CT scans with bone windows in cases of head injuries.

FUTURE ISSUES

The occurrence of central nervous system abnormalities in a population with sutural bones ranges from 93-100% in a random group and can reach up to 100% in a mentally retarded group (Pryles and Khan, 1979; Khan, 2011). The presence of sutural bones is almost invariably associated with a deviation in the normal development of central nervous system. It may serve as useful marker for early identification and treatment of the affected child. The Presence of sutural bones at asterion may complicate the surgical orientation (Oguez et al., 2004). Sutural morphology of asterion is essential in surgical approaches to the posterior cranial fossa (Ersoy et al, 2003).

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