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Original Article

The study of wormian bones in human skulls in Vidarbha region

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Abstract:

Additional ossification centers may occur in or near sutures, giving rise to isolated sutural bones. Usually irregular in size and shape, and most frequent in lambdoid suture, they sometime occur at fontanelles. There are often only two or three, but they appear in great numbers in hydrocephalic skull. In present study, we aimed to find out the gross incidence and percentage frequency, and to differentiate whether it is wormian or fracture skull as seen in medicolegal cases. The study included 225 adult human skulls collected from various medical colleges of Vidarbha region. The parameters were observed and were tabulated for male and female skulls separately. Average values of maximum length and breadth were calculated. Out of 225 adult human skulls, 161 were male skulls and 64 were female skulls. The data regarding gross incidence and percentage frequency, sexual dimorphism, incidence at various sites of the skull, shapes and size of wormian bones were noted. The gross incidence of wormian bones in the present study is found to be 34.22%, in the male skulls incidence rate is 39.13%, whereas in female it is 21.87%.The most common site for the occurrence of wormian bones is the lambdoid suture. The variable numbers of wormian bones are found in skull. The most common shape of wormian bones is found to be irregular followed by oval and least common shape of wormian bones being triangular.

Keywords: Sutural bone, Wormian bone, Lambdoid suture, Ossicles, Sexual dimorphism.

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Introduction:

Sutural bones or Wormian bones also known as ossicles or supernumerary bones of the skull are multiple, small and irregularly shaped bones that develops as extra islands of bones within the calvarial sutures of skull. These bones rarely appear in the basicranial synchondrosis or facial suture (1,2,3). Sutural bones represent independent centers of ossification and usually penetrate both outer and inner tables of cranial vault. The wormian bones are “Stopgaps” develops in coronal suture as a response to the stressful conditions of artificial cranial deformation (4). Occurrence of such ossicles in the human crania is relatively common and therefore these are considered as normal morphological variants in human crania. Hooton (5) noted 79.5% incidence of wormian bones in the Pecos population. Torgerson (6) reported that wormian bones are inherited as autosomal dominant traits with about 50% penetrance and variable expression. Berry and Berry (7) stated in their study, wormian bones are most commonly present in lambdoid suture and second common site for wormian bones being lambda with least incidence at bregma. The sutural bones are compensatory ossific inclusions occurring in sutures and arising as separate ossifying centers between the main cranial elements. They vary in size from being mere normal serrations cut off from the denate edge of one of the main bones to being considerable contribution to a cranial vault, several inches in diameter. In number, they vary from complete absence to scores in a case of the enormously enlarged crania of hydrocephalus. The facts that they are present in such a large number in the rapidly enlarging cranium of hydrocephalus and that they occur regularly in cranium deformation, deliberately practice on the skulls of new born babies are evidence that their presence is largely due to demands of unusual cranial growth that cannot be fulfilled by the normal increase in size of regular cranial bones (8). Wormian bone can be seen as an isolated sonographic finding in a healthy fetus or can be associated with multiple congenital anomalies. The sonographic detection of a fetus with wormian bone indicates the need for a very thorough examination and genetic counseling for the parents regarding prognosis and risk of recurrence. Sutural bones as one of several discontinuous morphological characteristics are observed in human crania. Since in the latter part of the nineteenth century various workers have observed these variants and have tried to explain their development in different ways. Little effort has been made towards the interpretation of factors responsible for the appearance. Hence this study is undertaken to find out for gross incidence, sexual dimorphism, morphology and commonest site of occurrence of wormian bones in Vidarbha region.

Aims and Objectives:

1) To find out the gross incidence and percentage frequency of wormian bones.
2) To find the ossicles either at the sites of various fontanelles or along the different cranial sutures.
3) To differentiate whether it is wormian or fracture skull as seen in medicolegal cases.
4) To find out the various shapes and sizes of the wormian bones.
5) To study variation of ossicles in their occurrence, shapes, sizes and sites in the skull for teaching purpose.

Material and Methods:

After obtaining Institutional EthicsCommittee approval, the present study was carried out in 225 adult human skulls in the Department of Anatomy and Forensic Medicine of various medical colleges. All the skulls were serially numbered from 1 to 225. In each skull the following points were made.

1) Presence of wormian bones.
2) Gross incidence and percentage distribution.
3) The occurrence of these bones at different sites of fontanelles and in different sutures.
4) At sites like Asterion, Coronal suture and Lambdoid sutures, the occurrence of these bones were observed separately with respect to their unilateral or bilateral presence.
5) Their occurrence at mentioned sites was tabulated for male and female skulls separately.
6) Incidence of various shapes of wormian bones was noted.
7) Average values of maximum length and breadth were calculated using vernier caliper (Fig. 1).

Observations and Results:

In the present study of 225 adult human skulls, 161 are male skulls and 64 are female skulls. Observations are made under the following heads in sequence.

a) Gross incidence and percentage frequency. (Table I)
b) Sexual dimorphism.(Table II)
c) Incidence at various sites of the skulls.(Table III)
d) Incidence at various sites in male skulls. (Table IV)
e) Incidence at various sites in female skulls.(Table V)
f) Shapes of wormian bones. (Table VI)
g) Size (maximum length and maximum breadth) of wormian bones (Fig. 2 & 3).

Discussion:

The present study consists of 225 (Two hundred and twenty five) normal adult human skulls. Various findings regarding the Wormian bones are discussed in reference to similar types of observations recorded by earlier workers.

Fig. 1: Measurement of wormian bone

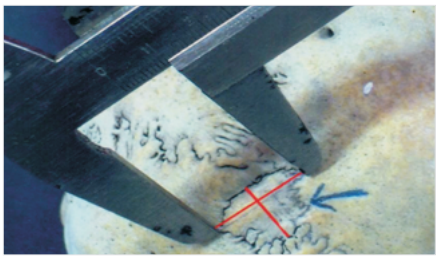

Fig. 2: Wormian bone at lambdoid suture

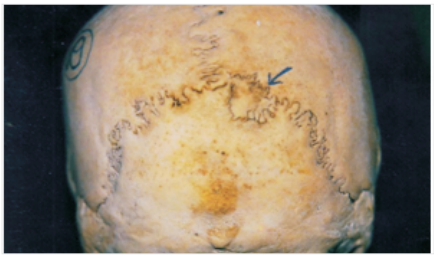

Fig. 3: Wormian bone at asterion

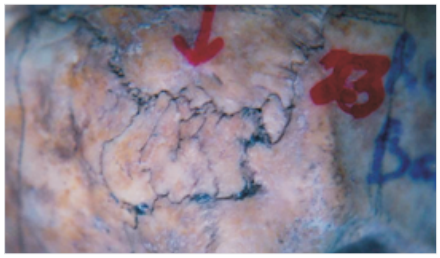

Table I:
Gross Incidence and Percentage Frequency of Wormian Bones

Total No. Of Skulls Examined	Skulls Showing Wormian Bones	Percentage
225	77	34.22

The percentage incidence calculated is 34.22%.

Table II:
Sexual Dimorphism in Incidence of Wormian Bones.

Sex	Skulls Examined	Skulls showing Wormian Bones	Percentage
Male	161	63	39.13
Female	64	14	21.87

The percentage incidence of these bones is calculated as 39.13 and 21.87 in male and female skulls respectively.

Table III:
Incidence at Various Sites of Skull.

Cranial Sites	No. Of Skulls	Incidence			Total No.	Percentage
		Unilateral		Bilateral		
		Right	Left			
Coronal Suture	77	01	-	-	01	1.29
Sagittal Suture	77	04		-	04	5.19
Lambdoid Suture	77	16	25	16	57	74.2
Bregma	77	-		-	-	-
Lambda	77	08		-	08	10.38
Asterion	77	04	02	01	07	9.09

It is also evident from Table III; the lambdoid suture is the commonest suture for the occurrence of the Wormian bones unilaterally on the left side, as well as bilaterally. Percentage frequency for the occurrence of the Wormian bones at Lambdoid suture, Lambda, Asterion, sagittal suture and coronal suture are 74.2, 10.38, 9.90, 5.19 and 1.29 respectively.

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Table IV: Incidence at Various Cranial Sites in Male Skulls.

Cranial Sites	No. Of Skulls	Incidence			Total No.	Percentage
		Unilateral		Bilateral		
		Right	Left			
Coronal Suture	63	01	-	-	01	1.29
Sagittal Suture	63	04		-	04	5.19
Lambdoid Suture	63	12	19	14	45	71.42
Bregma	63	-		-	-	-
Lambda	63	07		-	07	11.11
Asterion	63	03	02	01	06	9.52

The commonest site of occurrence of Wormian bones is Lambdoid suture (71.42%), second commonest appears to be Lambda (12.69%) followed by Asterion (9.52%). Male skull shows the presence of 6.34% these bones in sagittal sutures and 1.58% in coronal sutures.

Table V: Incidence at Various Cranial Sites in Female Skulls.

Cranial Sites	No. Of Skulls	Incidence			Total No.	Percentage
		Unilateral		Bilateral		
		Right	Left			
Coronal Suture	14	-	-	-	-	-
Sagittal Suture	14	-		-	-	-
Lambdoid Suture	14	04	06	02	12	85.71
Bregma	14	-		-	-	-
Lambda	14	01		-	01	7.14
Asterion	14	01	02	01	01	7.14

It can be observed from the Table IV and V that percentage of Wormian bones at lambdoid suture is higher in female (85.71) than in male skulls (71.41).

Table VI: Shapes of Wormian Bones

Shapes	Oval	Triangular	Irregular
No. Of Wormian Bones (Total 173)	69	24	80
Percentage	39.88	13.87	46.24

From Table VI, it is evident that 173 wormian bones are observed in total 77 skulls. 80 Wormian bones have irregular shape with percentage frequency of 46.24, 69 bones have oval shape with percentage frequency of 39.88 while 24 wormian bones have triangular shape with percentage frequency of 13.87%. Most commonly wormian bones are of irregular shape.

Table VII: Range and the Average Sizes (Maximum Length and Maximum Breadth) of Wormian Bones

Range of maximum length	Range of maximum breadth	Average maximum length	Average maximum breadth
5 mm to 25 mm	2 mm to 12 mm	11 mm	6 mm

Gross Incidence: The percentage frequency of the Wormian bones in the present study is found to be 34.22. This rate of occurrence of Wormian bone in present study is significantly lower from the incidence of frequency of Wormian bone noted by Hooton (5). He noted 79.5 percentage incidences of Wormian bones in the Pecos population. This percentage frequency of Wormian bones is much higher than the percentage frequency of these bones in the present study. Bass(9)found that the percentage incidence of Wormian bones was only about 26% in the population such as the Arikara. It is also significantly different and lower than incidence rate observed in the present study. As an indication of population variability of this parameter, Brothwell (1), studied and listed the percentage frequency of Wormian bones in the various population groups (55.56 to 80.32). It is observed that the incidence rate of Wormian bones in the present study is significantly lower.

Sexual Dimorphism: The percentage incidence of the Wormian bones in the male and female skulls in the present study is found to be 39.13 and 21.87 respectively which appears to be quiet higher in the males. Hooton (5) noted 82 and 77 percentage incidence of wormian bones in male and female respectively. This percentage frequency of Wormian bones is much higher than the percentage frequencies of these bones in the present study. Quantitatively the present data is similar to the observations of Berry (10) who noted a higher incidence of the Wormian bones in male skulls especially at Asterion in the different population groups including the Indian Punjabis.

The present study shows the incidence rate of

occurrence of Wormian bones on Lambdoid suture in the female (85.71%) is higher than male (71.42%) while incidence rate of Wormian bones at Coronal suture, Sagittal suture, Lambda and Asterion is higher in male as compared to the female. However earlier workers had not reported the sexual dimorphism in relation to different cranial sites.

Incidence Rate at Different Sites in Cranium: The percentage frequencies of the Wormian bones at various sites of fontanelles and in different suture are tabulated in Table III. This shows that the most common site of Wormian bones in skull vault is the Lambdoid suture (74.2%). The second common site is Lambda (10.38%) followed by Asterion (9.09%) and the sagittal suture (5.19%). The least frequent site for the Wormian bones occurrence is the coronal suture (1.29%). The Wormian bones are not observed in Bregma in the present study. Wood (8) stated that lambdoid suture being always the most complicated suture of all the cranial sutures is by far the commonest site for the development of Wormian bones. This observation is similar in the present study. Berry and Berry (7) mentioned the similar frequencies in the occurrence of the Wormian bones at the different cranial sites of human skulls. They stated in their study in different groups of the population, Wormian bones are most commonly present in lambdoid suture and second common site for Wormian bones being the Lambda with least incidence at the bregma. Findings in the present study are closely coincides with the findings of Berry and Berry (7) showing higher incidence of Wormian bones in Lambdoid suture.

Shapes of Wormian Bones: The most common shape of Wormian bones in the present study is found to be Irregular with percentage incidence 46.24% followed by Oval shape with percentage incidence of 39.88%. The least common shape of Wormian bones is being the Triangular with percentage incidence 13.87%. Gray (12) mentioned that Wormian bones are usually irregular in shape. This is the similar observation with most common shape observed in the present study, being irregular.

Size of Wormian Bone: In the present study, Wormian bones have observed various sizes ranging from minimum 5mm x 2mm to a maximum 25mm x 20mm dimensions. Wood(8) stated that Wormian bones vary in size from being mere normal serrations cut off the dentate edge of one of the main bones to being considerable contributions to the cranial vault several inches in diameter. He also mentioned that it is of no true morphological significance although its size of 15mm x 8mm is fairly constant.

Conclusion:

1) Gross incidence of wormian bones in the present study is found to be 34.22%, which is quantitatively significant.
2) Incidence rate of these bones is higher in the male skulls than the female skulls. In the male skulls incidence rate is 39.13%, whereas in female it is 21.87%.
3) The most common site for the occurrence of wormian bones is the lambdoid suture. The second most common site is lambda followed by Asterion and then by the sagittal suture. The least common site for the occurrence of these bones is the coronal suture.
4) Wormian bones are not encountered at bregma.
5) These bones frequently occur unilaterally.
6) These bones are encountered predominantly on the left side of the skull.
7) The incidence rate of wormian bones on lambdoid suture in female is higher than that of male, while occurrence of wormian bones on remaining site is higher in male as compared to female. Male skull shows presence of these bones in sagittal and coronal suture. However surprisingly in females these features are not observed.
8) Variable number of wormian bones is found in skull.
9) Wormian bones observed in the present study have various sizes of minimum of 5mm x 2mm to a maximum of 25mm x 20mm.
10) The most common shape of wormian bones is found to be irregular followed by oval and least common shape of wormian bones being triangular.

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