Original Article

Incidence and Medicolegal Significance of Wormian Bones in Human Skulls in North India Region

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Abstract

Introduction: Wormian bones (Wbs) are small bones located in or near the sutures of the skull which are irregular in size, shape, and number. The present study is to look into the morphological details of such supernumerary bones of skull with regards to their incidence, number, and topography in skulls from the Haryana region. **Materials and Methods:** This observational study was carried out in the tertiary care hospital, in the region of Haryana and the total of 147 human skulls were examined during routine autopsy procedures with respect to sutures and topographic distribution of Wbs. The data were statistically analyzed. **Results:** In the present study, the overall incidence of Wbs was seen in 52 skulls (35.3%) with males having 23.8% and females having 11.5%. **Conclusion:** The knowledge of incidence and distribution of Wbs in the skull could be useful to radiologists, causality medical officers, and autopsy surgeons in successfully differentiating a skull fracture from normal suture with Wbs or exit gunshot wound from fractured small Wb and thus ruling out the possibilities of presence or absence of fractures due to physical abuse, brittle bones, and exit gunshot wounds. It is also helpful to neurosurgeons in timely diagnosis and management of diseases or fractures in relation to the Wbs.

Keywords: *Fontanelle, skull, sutures, wormian bones*

Introduction

The identification of skeletal remains is a usual problem faced by the anthropologists and forensic experts. The human skull is composed of several bones that fused together after birth in addition to the regular center of ossification of the skull. Accessory bones appear along with the regular center of ossification of cranium.[1]

Wormian bones (Wbs)/supernumerary ossicles/sutural bones/intercalated bones/accidental bones/pterion ossicle or epipteric bone or flower's bone are small bones located in the cranium near the sutures of skull vault which are irregular in size, shape, and number. Normally, they are present in or near the suture or occupy fontanelles of neonatal skull and commonly present in man.[2,3] The reasons of the development of Wbs is not been entirely known. Multiples theories have been suggested, but none of these has been universally accepted. Some authors believed that these bones are developed normally and genetically determined and other opined that they develop from external influences.[4-6]

A study reported that persons having Wbs are mostly showing cranial and central nervous system (CNS) disorder.[7] Wbs are also present in normal individuals and in various disorders, namely pycnodysostosis, osteogenesis imperfect, rickets, kinky hair, cleidocranial dysostosis, hypothyroidism and hypophosphatasia, otopalatodigital syndrome, primary acro-osteolysis, down syndrome represented by a mnemonic "PORKCHOPS." Therefore, they help in diagnosis and treatment of affected children.[8]

The Wbs are also observed in fetus ultasonographical in the prenatal period. However, the prenatal period remained uneventful and also the growth of these newborns remain normal.[9] A study reported that singular bregmatic Wb may be a result of either biomechanical-induced development or definitive nonadaptive genetic change.[2] There is no relationship between stress during infancy on deformed or normal cranium and Wbs formation.[10] The Chinese population show the highest

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incidence (80%) of Wbs as compared to different population groups across the world.[11]

The aim of the current study is to report the incidence and topographical distribution of Wbs in the natives of Haryana region and to compare with the various population groups across the word. The morphological and clinical importance was emphasized with a relevant review of literature.

Materials and Methods

During a routine autopsy procedure, a total number of 147 skulls of Haryana population were examined. These skulls were cleaned properly for the overlying scalp layers, including the periosteum covering, and meticulously observed for the presence of Wbs. The skulls with injury or fracture were not included in the current study. The following parameters were evaluated in the present study:

a. Percentage of skulls where Wbs were present
b. Incidence of Wbs with respect to sutures in the skull
c. Topographic distribution of Wbs in the skull.

The data were tabulated, analyzed and compared with earlier studies. The interparietal and preinterparietal bones which were seen at the lambda region were not considered as Wbs.

Results

In the present study, the overall incidence of Wbs was seen in 52 skulls (35.3%), with males having 23.8% and females having 11.5% [Table 1] and the highest number of Wbs is observed along the lambdoid suture [Table 2]. The data are statistically analyzed and Chi-square test is applied to the incidence of Wbs in male with respect to females [Table 1]. The *P* value obtained is 0.802 which is insignificant. Thus, we can conclude that there is no association of the presence of Wbs in males to the females.

Table 1: Overall Incidence of Wormian bones as observed

Wormian bones	Males	Females	Total (%)
Present	35 (36.08%)	17 (34%)	52 (35.37%)
Absent	62 (63.91%)	33 (66%)	95 (64.63%)
Total	97 (100%)	50 (100%)	147 (100%)

Table 2: Number and percentage of Wormian bones with respect to different areas of skull as observed

Sites	Number of skulls (%)
Lambdoid suture	41 (27.89)
Coronal suture	9 (6.12)
Sagittal suture	7 (4.76)
Asterion	3 (2.04)
Lambda	28 (19.04)
Pterion	1 (0.68)
Bregma	0
Total cases	147 (100)

Discussion

In the present study, maximum Wbs are observed along the lambdoid suture similar to previous studies [Table 2]. The *P* value obtained is 0.802 which is insignificant (>0.05%). Thus, we can say that there is no association between incidences of Wbs in males to the females. The incidence of Wbs in our study is 35.3% as compared to different population groups within India and in world, i.e., 7% to 77% [Table 3].

Considerable genetic variations have also been documented among population groups residing in different regions of India.[21] A study from south India studied 78 skulls and noticed Wbs in 57 (73.1%), which is significantly higher as compared to the present study.[12]

A Malaysian study also reported the occurrence of Wbs in the coronal, squamosal, and sagittal sutures in 6 out of 25 dried human skulls.[13] A study from Vidarbha region, India, reported 34.22% incidence of Wbs. Among them, in the male skulls incidence rate is 39.13%, whereas in female, it is 21.87% and the most common site for the occurrence of Wbs is the lambdoid suture.[14]

A retrospective French study on 605 CT brain scans from normal child population excluding constitutional bone diseases cases, had found Wbs in 53% of population, two to three Wbs were found in 43%. The maximum incidence of Wbs is seen along with lambdoid suture.[15] The Turkey-based study examined 300 skulls and found 9% having Wb, with maximum incidence at lambdoid.[16] In another study in West Anatolian Population on 150 skulls, rate of skulls with Wbs were found as 59.3%. The left lambdoid suture was having maximum rates of suture having Wbs as 40.7%.[17]

In another study from India's eastern region on 120 unknown adult skulls found the incidence of Wbs being 45%. The maximum incidence of Wbs was also observed in lambdoid suture.[18] A similar study in Greek revealed 124 skulls (74.7%) having Wbs out of total 166 skulls, with no difference of gender and age.[19] In Nigeria based study, 22 skulls were examined, with incidence of Wbs in 45.46% and maximum incidence in lambdoid suture.[20] The orifices due to small Wbs may sometimes be medico-legally misinterpreted as gunshot wound or vice versa.[22]

Conclusion

In the current study, we observed an incidence rate of 35.57% Wbs in North Indians skulls, which is comparable with previous studies, and thus, the present study also confirmed that Wbs are not so uncommon. Furthermore, the incidence of Wbs is more frequent at the lambdoid suture which is in correlation with the studies done by previous authors. The nonsignificant *P* value also indicates that there is no association of the incidence of Wbs and gender.

The present study also comes across Wbs in coronal and sagittal suture which shows that the Wbs are also present in these sutures in addition to lambdoid suture [Figures 1-4]. The knowledge of sutural bones, their incidence and features are helpful for the treating doctors to arrive at an early diagnosis and timely management of disorders associated with it. The knowledge of Wbs in the skull is also helpful to radiologists, causality medical officers and autopsy surgeons in successfully differentiating a skull fracture from normal suture with Wbs and thus ruling out the possibilities of presence or absence of fractures due to physical abuse and brittle bones.

Figure 1: Wormian bone at pterion

Figure 2: Wormian bone in coronal suture

Figure 3: Wormian at the right lambdoid suture

Figure 4: Multiple Wormian bones at both lambdoid sutures

Table 3: Overall incidence and maximum incidence as per anatomical location of Wormian bones in the present and previous studies

Authors	Year, place of study	Sample size	Overall incidence (%)	Maximum incidence as per anatomical location
Murlimanj *et al*.[12]	2011, South India	78	57 (73.10)	Lambdoid suture
Khan *et al*.[13]	2011, Malaysia	25	6 (24)	Lambdoid suture
Walulkar *et al*.[14]	2012, Western India	225	77 (34.22)	Lambdoid suture
Marti *et al*.[15]	2013, France	605 (CT scan analysis in 0-3 years	320 (53)	Left lambdoid suture
Govsa *et al*.[16]	2014, Turkey	300	27 (9)	Right and left lambdoid suture
Cirpan *et al*.[17]	2015, West Anatolian	150	59.3%	Left lambdoid suture
Ghosh *et al*.[18]	2017, Eastern India	120	54 (45)	Left lambdoid suture
Natsis *et al*.[19]	2018, Greek	166	124 (74.7)	Lambdoid suture
Uchewa *et al*.[20]	2018, Nigeria	22	45.46%	Lambdoid suture
Present study	2018, Haryana, India	147	52 (35.37)	Lambdoid suture

Small Wbs at various sutures may fall during putrefaction and thus gives appearance of entry or exit gunshot wound. Thus its knowledge is important for labelling a small bony skull defect as due to gunshot wound or fall of small Wbs in the cranial cavity. Sometimes, the Wbs looks like fractures and may confuse the radiologist or surgeon. Sometimes, fractures at these sites may be misdiagnosed as normal Wbs and thus timely treatment for the fracture is not given. This results in fatal health complications and legal implications for the concerned doctors.

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Conflicts of interest

There are no conflicts of interest.

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