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Observation on the Closure of Cranial Sutures to Estimate Age from Skull Bones in Jharkhand Population

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Abstract: *Identification is recognition of an individual by means of various physical features and biological parameters, which are unique to each individual. There are various established parameters for identification of an individual. These are external features (such as birth marks, scar, tattoo marks , occupational marks, malformations), personal features (such as clothes, speech, habits, intelligence, handwriting), assessment of age and sex, determination of race and stature, anthropometric measurements, finger prints, foot prints, lip prints, DNA finger printing and DNA profile, etc. Question of identification arises in every medico legal case be it civil or criminal. The determination of sex is a major criterion for the identification of an individual. It segregates lot of cases for easy and quick identification in a given sample. Age estimation is an integral part of the biological profile in achieving an identification of unknown deceased individual.*

Keywords: *age, dna ,identification ,race, sex*

I. Introduction

Identification of deceased is an essential part of the postmortem examination. Age is one of the important parameters for the identification of an individual whether the individual is alive, dead or human remains. The determination of age is needed for employment, marriage, majority, management of property, voting right, competency as witness and testamentary capacity. The significance of determination of age is most important in the criminal cases, such as rape, infanticide, juvenile delinquency and criminal responsibility. Age estimation can be done in various methods, including macroscopic examination of dental development and eruption, epiphyseal union of long bones, degeneration of pelvic articular surfaces and cranial sutures, as well as microscopic examination of long bones in histological analysis [1, 2]. Due to progressive development of bones, aging of skeletons under the age of 25 can be more easily accomplished utilizing the order of epiphyseal fusion in the long bones [3]. Dental eruption is also a reliable indicator of age between infancy and 17 to 25 years [4]. Cranial suture closure can be utilized to estimate age in living and death. Obliteration of skull sutures in late age, practically when all the teeth have erupted and epiphyses have fused i.e. after 21 years of age, gives fairly accurate idea. The idea of cranial bones fuse progressively with age has been in existence since at least the 16th century [5]; however, its utilization as a method of age assessment has been quite controversial since the mid 20th century. Only handful of studies has been reported in India. Today it is still utilized in the absence of other evidence or in conjunction with other methods.

II. Materials And Methods

The study was conducted on cases coming for medico-legal post-mortem examination in the Department of Forensic Medicine and Toxicology, Rajendra Institute of Medical Sciences, Ranchi. Total 100 such cases were taken up for the study. Age was confirmed by documentary evidences like birth certificates, identification cards, ration card etc. Unknown, unclaimed bodies and cases showing deformed or diseased or fractured skull excluded from the study. After reflecting the scalp, the calvarium was cleaned and made dry of soft tissues on both sides to make sutures more prominent and the coronal, sagittal, lambdoid sutures were studied applying Acsadi-Nemeskeri scale [6]. Photographs were taken in all the cases. The obliteration of the sutures was ascertained endocranially as well as ectocranially. In both cases degree of closure was scored. The coronal suture was studied in three parts on either side ; sagittal suture was studied in four parts and lambdoid sutures in three parts each on either side. Ectocranially, the different sections were distinguished by differences in the character of the suture. Consequently the endocranial sutures were simply divided in sections of equal length.

2.1Scale for closure: Acsadi-Nemeskeri complex method

- 0 = open. There is still little space left between edges of adjoining bones.
- 1 = incipient closure. Clearly visible as a continuous often zigzagging line.

- 2 = closure in process. Line thinner, less zigzags, interrupted by complete closure.
- 3 = advanced closure. Only pits indicate where the suture is located.
- 4 = closed. Even location cannot be recognised.

2.2Abbreviations:
S1: Pars Bregmatica (i.e. first part) of Sagittal Suture
S2: Pars Vertices (i.e. second part) of Sagittal Suture
S3: Pars Obelica (i.e. third part) of Sagittal Suture
S4: Pars Lambdica (i.e. fourth part) of Sagittal Suture
C1: Pars Bregmatica (i.e. first part) of Coronal Suture
C2 : Pars Complicate (i.e. second part) of Coronal Suture
C3 : Pars Pterica (i.e. third part) of Coronal Suture
L1 : Pars Lambdica (i.e. first part) of Coronal Suture
L2 : Pars Intermedia (i.e. second part) of Coronal Suture
L3 : Pars Asterica (i.e. third part) of Coronal Suture

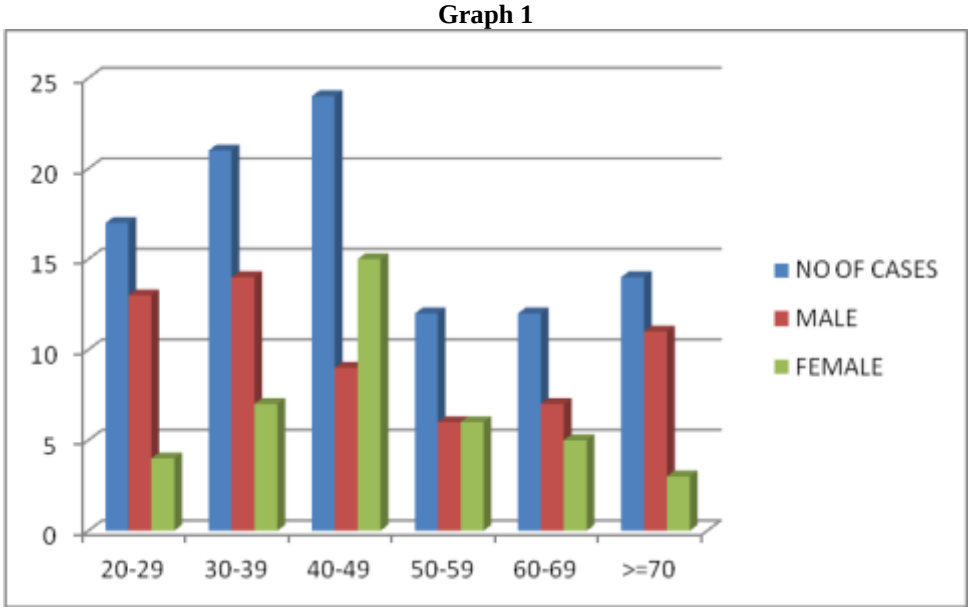
III. Observation

The age varied from 20 to 82 years. The age groups were classified into six groups at 10 years interval so as to compare with previous studies. The first age group is of between 20 to 29 years which consists of 17 (17%) cases of which 13 are males and 4 are females. The second group is of between 30 to 39 ages which has 21 (21%) cases of which 14 are males and 7 are females. The maximum number of cases, 24 (24%) belong to 40 to 49 age group which has 9 males and 15 females. There are 12 (12%) number of cases each in 50 to 59 (6 males, 6 females) and 60 to 69 (7 males, 5 females) age group. And the last age group is of >=70 years which has 14(14%) number of cases with 11 males and 3 females [TABLE1, GRAPH1].

Table 1

AGE GROUP	NO OF CASES	MALE	FEMALE
20-29	17	13	4
30-39	21	14	7
40-49	24	9	15
50-59	12	6	6
60-69	12	7	5
>=70	14	11	3
TOTAL	100	60	40

Graph 1



IV. Results

Table 2

Sagittal suture				
	S1	S2	S3	S4
Ectocranially(age group in yrs)	50-59	50-59	50-59	40-49
Endocranially(age group in yrs)	40-49	40-49	40-49	30-39

In our study, we found that the endocranial sagittal suture closure starts at 20-29 yrs and it completes at 40-49 yrs in S1, S2 and S3, while 30-39 in S4. These findings are in contrast with that of Todd and Lyon (1924) [7] and also with that observed by Shetty U. (2007) [8]. It is in support of the observation reported by Pommerol F. (1869) [9] and Topinard P. (1885) [10], who indicated that endocranial sagittal suture closure starts at age of about 40 yrs.

Table 3

Coronal suture			
	C1	C2	C3
Ectocranially (age group in yrs)	50-59	>70	50-59
Endocranially (age group in yrs)	40-49	40-49	50-59

In our study, the endocranial coronal suture closure starts at 20-29 yrs and completes at 40-49 in C1 and C2 while 50-59 in C3 which is according to workers like Pommerol F. (1869) [9], Topinard P. (1885) [10], Ribbe's (1885), who reported closure between 40-50 yrs [TABLE 5]. But their study doesnot indicate whether it was ectocranial or endocranial or it was commencement or termination. Moondra A. K. (2000) reported endocranial closure between 46-50 for males and 56-60 for females [TABLE 5]. According to Schmidt (1988) and Modi's (1988), complete closure occurs in between 40-60 yrs [TABLE 5]. While A. Nandy (1995) states closure is between 25-45 yrs and U. Shetty (2000) demonstrates lapsed union in ectocranial coronal suture [TABLE 5].

Table 4

Lambdoid suture			
	L1	L2	L3
Ectocranially (age group in yrs)	50-59	50-59	Lapsed union
Endocranially (age group in yrs)	50-59	50-59	50-59

Lambdoid suture closure endocranially, starts fusing at age of 20-29 yrs in our study and it is a year earlier than that reported by Todd & Lyon (1924) [7], while closure completion occurs by 50-59 yrs in L1 and L2 but ectocranial L3 shows the lapsed union. This is in according with the study of Modi's (1988) and Parikh (1990) by whom complete closure occurs in between 50-70 yrs [TABLE 5]. Moondra A. K. (2000) demonstrates endocranial closure above 60 yrs both in males and females [TABLE 5]. Vyas P. C. Also stated that lambdoid suture closes at the age group of 60 yrs [TABLE 5].

Our Indian data compare well with those of the male whites (Todd & Lyon 1925) [11,12,13]. Negro skulls however show an earlier date of commencement and closure. From the present study (see tables) it is clearly evident that endocranial union is a far better parameter for age determination than is the ectocranial union as also established by Todd & Lyon (1924 & 1925) [7,11,12,13], Dwight (1890) [14]. All the previous work was done in France, Germany and United States of America, under different climatic conditions and in diverse racial groups. In our study, in this geographical area, the obliteration of the skull sutures is earlier in males than the females except the ectosagittal suture in 40-49 age groups in which closure was earlier in the females.

Table 5

S.No.	Workers/Authors			Sagittal	Coronal	lambdoid
1.	Todd and Lyon (1924)			20-29	26-50	26-31
				20-32	23-25	23-31
2.	Ribbe's (1885)			Closure 21-50 years frequent between 44-45 years. Ectocranially sagittal closes first then lambdoid,coronal suture.		
3.	Schmidt (1988)			Closure between 25-40 and completed 40-60 years		
4.	Modi's (1988)			30-50	40-60	50-70
5.	Reddy (1990)(2)			25-35	40	45
6.	Parikh (1990)(35)			30-50	40-60	50-70
7.	Apurva Nandy(1995)(33)			25-45	25-45	27-50
8.	Robert Shapiro and Janzen(1960)			22-35	24-38	26-42
9.	Werner and Fisher's text book			25-40	25	35-45
10.	Vyas P. C.(34)			50-55	45-60	60
				50-55	50-60	60
11.	Moondra A. K.(32)	Endo	m	46-50	46-50	56-60
			F	46-50	56-60	56-60
		Ecto	m	51-55	51-55	Above 60
			F	40-60	56-60	Above 60
12.	Shetty U.(2007)	Ecto		>70	Lapsed union	>70
		Endo		60-69	40-49	40-49

V. Conclusion

Suture obliteration starts earlier on endocranial surface than on the ectocranial. Ectocranially : sagittal suture closes early followed by coronal and lambdoid. Endocranially : sagittal suture closes early followed by coronal and lambdoid. Although cross-sectional in nature, suture obliteration patterns (totally open, totally closed, partially open, and partially closed) are not temporary progressive stages on an age scale, but rather independent permanent phenomena. There is difference in suture closure in males and females. Females showed earlier union than males in the age group 40-49, while in the other age groups suture closure occurred earlier in males. Metopism was observed in 3% of cases. Lapsed union is a major deterrent for age estimation. It is more pronounced in lambdoid suture. There is the fundamental problem of using a method based on a structure which as yet is simply poorly understood. But whatever the underlying biological factors are for suture closure, and even if these in the future should be better understood, it is still important to refine the methods of quantifying these structures, in order to render the methods of quantification as unbiased as possible.

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Fig.1 skull of 28 yr male showing score of 1 in ectocranial surface of sagittal suture (PM No-1071/15)

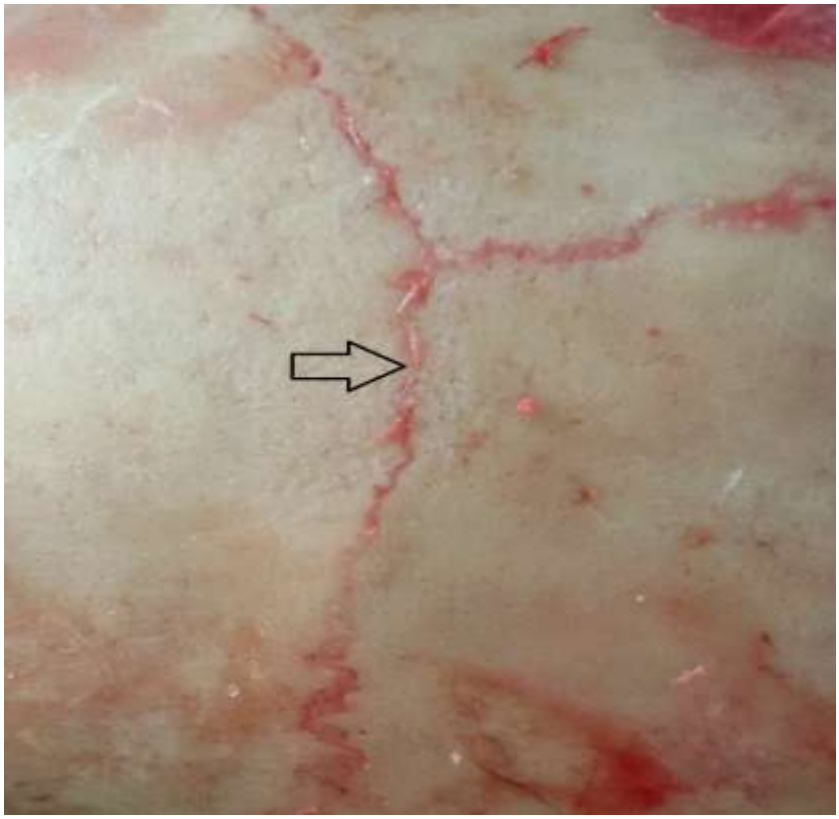

Fig.2 skull of 50 yr female showing score of 2 in ectocranial surface of coronal suture (PM No-707/15)

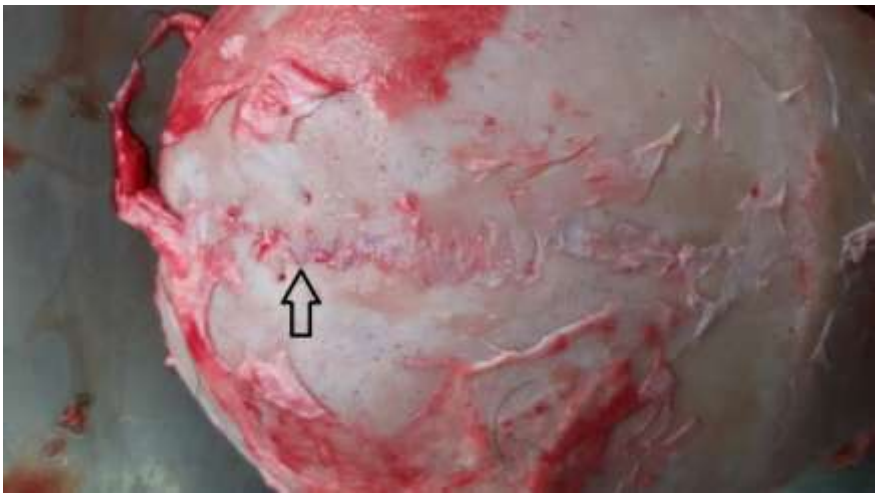

Fig.3 skull of 28 yr male showing score of 1 in ectocranial surface of lambdoid suture (PM No-804/15)

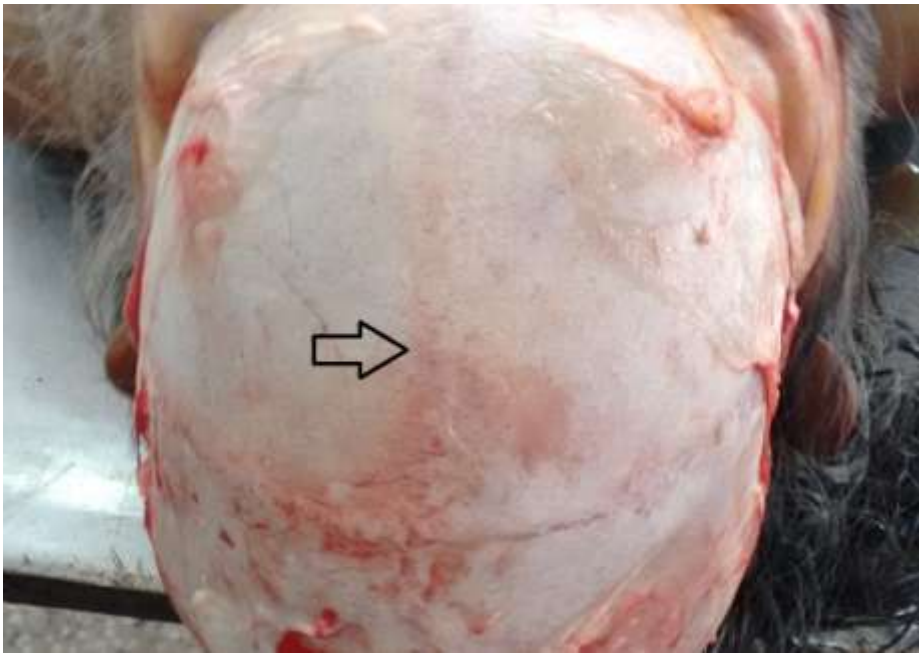

Fig. 4 metopism as seen in 52 yr female (PM No-2165)

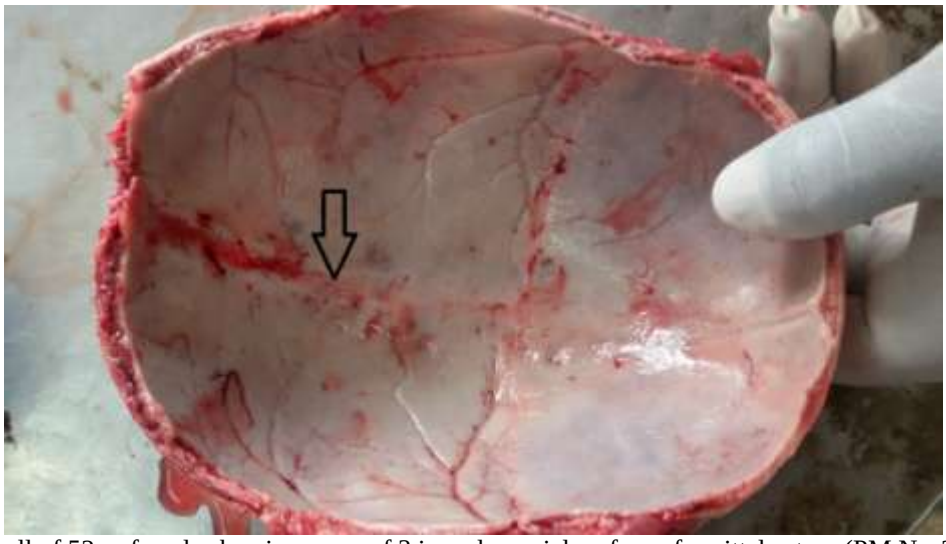

Fig. 5 skull of 52 yr female showing score of 3 in endocranial surface of sagittal suture (PM No-2165/15)