Study of the Closure of Sagittal Suture in Relation with Age of the Individuals tn Native of Gujarat

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Abstract

Background: Age estimation is an integral part of the biological profile employed by forensic anthropologists in order to assist in achieving an identification of an unknown deceased individual. Its estimation is of paramount importance and requires special attention in cases where bodies are found in decomposed, mutilated state or only fragmentary remains are discovered.

Material and Method: The present study has been done on post-mortem cases referred to GMERS Medical College, Himmatnagar which is referral center. Very few studies have been conducted on sagittal suture closure in Himmatnagar region . Total 150 post mortem cases were taken and data collected.

Result: Present study reveal that Ectocranial obliteration of the various segments of the three main sutures of the skull is so inconclusive that neither does it help in estimating the age of the deceased nor does it provide any supportive evidence in determining the age of skeletal remain. Age was determined on the basis of endocranial suture fusion.

Conclusion: It was found that closure of Sagittal suture started in age of 20-29 yrs and closure completed at the age of 61 to 65 yrs.

***Key words**: Sagittal suture, Age, Relation*

Introduction

Age estimation can be done in several ways by macroscopic examination of dental development and eruption, epiphyseal union of long bones, degeneration of pelvic articular surfaces, sternal rib ends and cranial sutures, as well as microscopic examination of bone in histological analysis.[1] Since the bone resists putrefaction and destruction by animals, they can lead to the reliable determination of age, sex, race, stature in decomposed bodies.[2]

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Use of suture closure for age estimation is predicated upon the hypothesis that suture closure is part of the aging process. However, when suture closure patterns were first studied at the beginning of this century, there were two schools of thought (British and Italian) on this issue (Hershkovitz et. al. 1997:393). The British school maintained that sutural ossification and cranial immobility were normal conditions, whereas the Italian school maintained that they were pathologic in mature human adults (ibid.). In time, probably due to the increasing prominence of the English language in the scientific literature, the British approach toward suture closure became the dominant model in physical anthropology (without actually testing that hypothesis) (Hershkovitz et. al.1997:394).[3]

Reasonably a correct estimation of age in elderly people is essential in legal, medical, social and administrative matters i.e. to fixing of age for regularization of employment, superannuation, pension settlements, senior citizen benefits, old age and good behavior of the prisoner(Ullas shetty ref).[4]

This study was done to specify the relationship between progression of union of cranial suture and age of the subject. It also done to formulate practical method of estimation of age based on the status of the progression of the closure of sutures using the data collected and to establish a data base of fusion of cranial sutures for the population of Gujarat.

Materials and Method

The study was conducted on cases coming for medico-legal post mortem examination to the Department of Forensic medicine, GMERS Medical College, Himmatnagar, Gujarat during a period from November 2018 to November 2019.

Study design: A descriptive cross-sectional study.

Inclusion criteria:

1. The cases of known age coming for medico legal postmortem examination. Age was

confirmed by documentary evidences like birth certificate, identification cards, ration card..etc.

2. Subjects of more than 20 years of age were taken.

Exclusion criteria:

1. Unknown, unclaimed bodies where exact age cannot be confirmed.

2. Cases showing deformed or diseased or fractured skull, which may hamper the study of suture closure.

Method

150 cases of age 20 years and above were studied. After reflecting the scalp sagittal suture was studied by applying Acsadi□Nemeskeri scale ectocranially. For endocranial suture, same score system was applied after removing the calvaria by craniotome with taking due care to include complete sagittal suture. The calvarium was cleaned of soft tissues on both sides and was dried, which made the suture more prominent. Photographs were taken in all cases. The obliteration of the sutures was ascertained endocranially as well as ectocranially. In both cases degree of closure was scored in 16 parts of the main cranial sutures as has been done by Acsadi□ Nemeskeri scale.[5] We have studied the sagittal suture in four parts. Ectocranially the different sections were distinguished by differences in the character of the suture. Endocranially the sutures do not show these differences in character. Consequently the endocranial sutures were simply divided in sections of equal length.

Scale 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

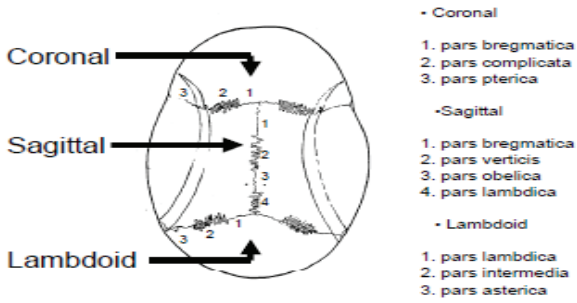
3 = advanced closure. Only pits indicate where the suture is located

4 = closed. Even location cannot be recognized.

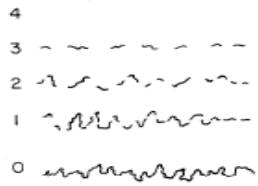
Mean ectocranial as well as endocranial closure stages were calculated for the Sagittal suture by adding the scored closure stages of the different sections and dividing the result by number of sections which compose the suture in question. Endocranially closure indices were calculated in similar fashion adding the closure stages of all the sections and dividing the result by 16[6,7] A detailed pre-designed Performa was completed for every case studied.

Statistical Method

To estimate the possible relation between suture closure and age at death, analysis was done in excel and Epi info software.



Ectocranial sutures



Scoring system

Results

Table 1: Age and sex wise distribution of subjects

Sr.No	Male	Female	Total
20-29	31(46.5%)	19(12.66%)	50(33.33%)
30-39	25(16.66%)	10(6.66%)	35(23.33%)
40-49	14(9.33%)	11(7.33%)	25(16.66%)
50-59	21(14%)	6(4%)	27(18%)
60-69	6(4%)	0(0%)	06(4%)
70-79	3(2%)	0(0%)	03(2%)
80-89	0(0%)	4(2.66%)	04(2.66%)
Total	100(66.66%)	50(33.33%)	150(100%)

Above table describes age wise distribution of subjects in this study. Out of Total 150 subjects, 33.33% were females and 66.66% were males. Majority of subjects(33.33%) were in 20-29 years age group and fewer(4.66%) were above 70 years. The minimum age was 20 years and maximum was 90 years and range was 70.Median was 40 , standard deviation for age was 15.43 and standard error of mean was 1.26.

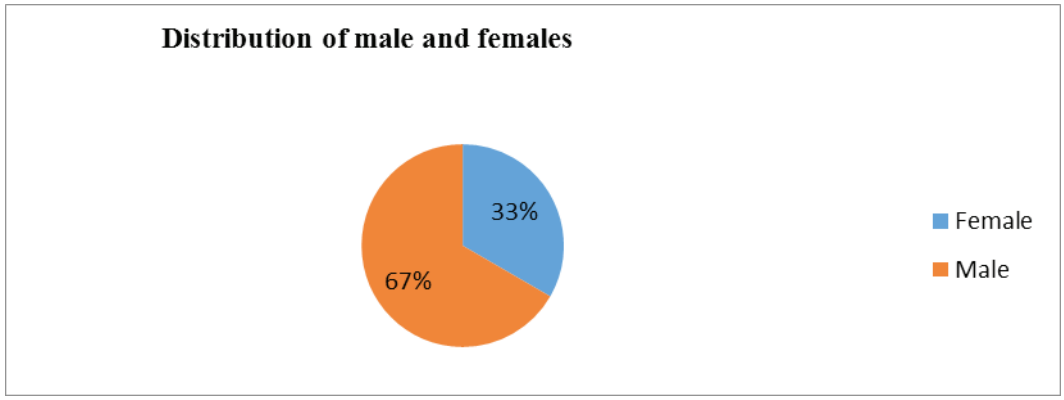


Figure 1 : Showing distribution of male and female in study

Table 2 : Ectocranial sagittal suture grade 1 and grade 4 distribution among subjects

Ectocranial sagittal suture grade 1 distribution among subjects									
Sr.no	**Age group**	**S1**		**S2**		**S3**		**S4**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	**20-29**	4	10	11	5	13	0	11	4
2	**30-39**	1	0	2	1	1	1	0	2
3	**40-49**	00	0	0	0	0	0	0	0
4	**50-59**	0	0	0	0	0	0	0	0
5	**60-69**	0	0	0	0	0	0	0	0
6	**>=70**	0	0	0	0	0	0	0	0
Ectocranial sagittal suture grade 4 present among subjects									
	Age group	**S1**	**S2**		**S3**	**S4**			
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	**20-29**	0	0	0	0				
2	**30-39**	0	5	2	0	1	0	8	2
3	**40-49**	2	2	4	2	3	3	4	8
4	**50-59**	2	7	7	3	4	4	17	5
5	**60-69**	3	0	3	0	3	0	3	0
6	**>=70**	1	4	0	4	0	4	3	4

Ectocranial sagittal suture by Ascadi Nemeskeri complex incipient closure - grade 1, seen in 20-29 years age.

Ectocranial sagittal suture by Ascadi Nemeskeri complex closure in process - grade 2 seen in 40—49 years of age group. Advanced closure that is grade 3 seen in 50-59 years of age group.

Ectocranial sagittal suture Ascadi Nemeskeri complex closure that was grade 4 seen in 50-59 years age.

Table 3: Endocranial sagittal suture grade 1 and grade 4 present among different age group subjects

Endocrnial sagittal suture grade 1 present among different age group subjects									
Sr.no	**Age group**	**S1**		**S2**		**S3**		**S4**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	20-29	12	6	12	7	16	8	12	5
2	30-39	00	0	0	0	1	2	0	0
3	40-49	0	0	0	0	0	0	0	0
4	50-59	0	0	0	0	0	0	0	0
5	60-69	0	0	0	0	0	0	0	0
6	>=70	0	0	0	0	0	0	0	0
Endocrnial sagittal suture grade 4 present among different age group subjects									
	Age group	**S1**	**S2**	**S3**	**S4**				
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	**20-29**	0	0	0	0	0	0	01	01
2	**30-39**	10	4	10	3	6	3	11	4
3	**40-49**	11	9	10	11	10	9	11	12
4	**50-59**	16	7	17	5	14	7	17	7
5	**60-69**	6	0	6	0	6	0	6	0
6	**>=70**	4	4	4	4	4	3	4	4

Endocranial sagittal suture grade 1 that is incipient closure found in 20-29 years age group.

Endocranial sagittall suture grade 2 that is closure in process is found in 20-29 majority but fewer subject found in 30-39 years age group during analysis.

Endocranial sagittal suture grade 3 that was advanced closure found in 40-49 years age group in majority subjects during analysis.

Endocranial sagittal suture grade 4 that closed found in 50-59 age groups in majority of subjects.

Table 4: Endocranial and Ectocranial suture relations with age

		S1(Age in years)	**S2(Age in years)**	**S3(Age in years)**	**S4(Age in years)**
Endocranial	Grade 1	20-29	20-29	20-29	20-29
	Grade 2	20-29	20-29	20-29	20-29
	Grade 3	40-49	40-49	40-49	40-49
	Grade 4	50-59	50-59	50-59	50-59
Ectocranial	Grade 1	20-29	20-29	20-29	20-29
	Grade 2	30-39	40-49	40-49	30-39
	Grade 3	50-59	50-59	50-59	40-49
	Grade 4	50-59	50-59	50-59	50-59

Discussion

In this study, Age range can be given in range of 5 years. Whereas age from suture closure of skull can be given only in a range of decades.[8] Study by Dr. S. V. Khandare et all range has been given in range of 5 yrs.[9] According to J.B.Mukherjee, estimation of age from suture closure of skull can be given in a range of 5-10 yrs in age of 30-60 yrs, the range may even be more in higher age groups.[10] In our study at Himmatnagar, we have observed that the sagittal suture, endocranially fusion started in first part at 20-29 years and completion at age of 50-59 years age group. In second, third and fourth part , fusion started in 20-29 years age group and completion in 50-59 years age group. This finding was compared with study by Dr.S.V. Khandare et all found that the sagittal suture, endocranially, started fusing at the end of 26 years and completion at the age of 61-65 years in Ist part of sagittal suture, 46-50 yrs in IInd part of sagittal suture, 41-45 yrs in IIIrd part of sagittal suture and 26-30 yrs in IVt^{h} part of sagittal suture.[9] In study by Ullas Shetty have found that the sagittal suture, endocranially, starts fusing at the end of 20-29 years and completion is perfected at the age of 60-69 years. Similar finding also found in observation with that reported by Todd & Lyon (1924). [11] It was in contrast to the observation reported by Pommerol (1869), and Topinard (1885), who indicated endocranial commencement of sagittal suture at a much later age at about 40 years. These latter workers have reported on very few specimens so it could not be considered as authentic.[12,13] The other study for cranial suture closure of skull was done by Krogman(1978), Rentoul & Smith (1973) , T LPatil (1981) & Robert Shapiro (1960), had concluded that the study of ectocranial fusion was less significant than endocranial fusion because suture along the outer table were more or less serrated while at inner table they were comparatively straight, whereas the process was speedy and more uniform and complete in the endocranial surface.[14,15,16,17] The phenomenon of lapsed union was more common in the Ectocranial surface, Todd & Lyon (1924). [13] From this study we concluded that endocranial was more important than ectocranial fusion, similar finding also found from the study by Dr.S.V.Khandare et all it was evident that endocranial union was far betterparameter for age determination than ecotocranial union as also had been established byTodd & Lyon (1924 & 1925).[9,11]

Conclusion

Ectocranial suture closure cannot be used for age estimation. Lapsed union is a major deterrent for age estimation. Suture obliteration starts earlier on endocranial surface than on the ectocranial. There is some correlation between endocranial suture closure and age upto 40 years, but then after there is no significant correlation. Any attempt to derive a reliable formula to estimate the age from score of suture closure was met with failure for the following reasons: 1) the trend of correlation is neither increasing nor decreasing with age, 2) the sample size is too small to derive a formula, 3) unequal distribution of males and females in the study sample. 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. Ectocranially: Within the sagittal suture segments, pars lambdica (S4) closes earlier followed by pars bregmatica(S1), pars vertices(S2) and pars obelica(S3).

Endocranially: Within sagittal suture segments, pars lambdica (S4) closes earlier followed by pars bregmatica(S1), pars vertices(S2) and pars obelica(S3). Endocranial union started at 20-29 age groups but progression is not uniform. Complete closure (mean value > 3.5) of sagittal suture occurs in the age group of 50-59 years. Ectocranial union started in 20-29 age group, but its progression is very erratic. Complete closure (mean value > 3.5) never occurred in ectocranial sutures. Maximum closure occurred in the above 70 years age group.

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