

Age Estimation from Cranial Sutures – A Postmortem Study

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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.

Methods: The study was conducted on 100 cases coming for medico-legal post-mortem examination to the Department of Forensic Medicine, S.P. Medical College & Associated group of P.B.M. Hospital, Bikaner, Rajasthan.

Results: The minimal age of fusion on endocranium was 41 years each for SS and CS in males. Whereas for LS it was 51 years .Among the females the minimum age of fusion of CS, SS and LS on endocranium were 36, 41 and 53 years respectively. The maximum age in male showing non-union of suture on endocranium was 44 years on sagittal, 48 years on coronal and 55 years on lambdoid suture. In female it was 47 years on SS and 45 years in CS and 56 years on LS. In 1 male i.e. 1% there was no fusion of any of the vault suture even at the age of 70 years on ectocranium. Among the female maximum age of non-union of ectocranium was observed to be 60 years on SS, 58 years CS and 68 years for LS respectively.

Conclusion: Suture obliteration starts earlier on endocranial surface than on the ectocranial. 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.

Keywords: Coronal Suture, Lambdoid Suture, Sagittal Suture.

Introduction

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.

The method of determining age by cranial suture closure has always been more generally used, but because the cranium is frequently the best preserved portion of the recovered skeleton¹. Cranial sutures generally fuse with increasing age, although there is considerable variability in closure rates and patterns². The idea of cranial bones fuse progressively with age has been in existence since at least the 16th century ³; 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.

The present study has been done on post-mortem cases referred to mortuary of Department of Forensic medicine Sardar Patel Medical College & P.B.M. hospital, Bikaner which is a tertiary referral centre. Very few studies have been conducted on cranial suture closure of Rajasthan Subjects.

Material & Methods

Source of data

Data was collected from autopsies conducted at Forensic Medicine Department, S. P. Medical College & P.B.M. Hospital, Bikaner, Rajasthan.

Method of collection of data (including sampling procedure, if any)

A. Methodology and type of data collected

The study was conducted on 100 cases coming for medico-legal post-mortem examination to the Department of Forensic Medicine, S.P. Medical College & Associated group of P.B.M. Hospital, Bikaner, Rajasthan.

The calvaria was removed by craniotome taking care to include complete coronal, Lambdoid and sagittal sutures. The calvarium was then be cleaned of soft tissues on both sides which was make the sutures more prominent. Coronal, Lambdoid and sagittal sutures of 100 deceases aged above twenty years studied according to Acsadi and Nemeskeri scoring method for both endo and ectocranial sutures. Radiographs will be taken in all cases and comparison with naked eye observation.

All cases was studied with reference to ectocranial and endocranial closure of sagittal, Lambdoid and coronal sutures using Acsadi and Nemeskeri scoring method which is as follows:

- 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.

B. Inclusion criteria

1. The cases of known age coming for medicolegal postmortem examination. Age will be confirmed by documentary evidences like birth certificate, identification cards, (like Adhar Card, Voter ID, Pan Card, Ration card) etc.
2. Deceased persons of age group above 20 years.

C. 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.

D. sample size-100 cases of known age

E. Sampling design- Purposive sampling

F. Study design- Descriptive Study

G.Place of study- Department of Forensic Medicine, S.P. Medical College & Associated group of P.B.M. Hospital, Bikaner, Rajasthan

H. Statistical methods involved- The data collected in this study was analysed statistically using descriptive statistics like mean, standard deviation and percentages.

Observations

The hospital based prospective study was conducted on 100 cases coming for medico-legal post-mortem examination to the Department of Forensic Medicine, S.P. Medical College & Associated group of P.B.M. Hospital, Bikaner, Rajasthan.

Out of 100 cases maximum (30.00%) were 40-49 Yrs age group followed by 22.00% cases were 30-39 Yrs age group, 18.00% cases were 20-29 Yrs age group, 16.00% cases were 50-59 Yrs age group, 8.00% cases were 60-69 Yrs age group and 6.00% cases were more than 70 Yrs age group. 66.00% were male and 34.00% cases were female.

Table 1. Age of complete fusion of coronal sutures

	C1		C2		C3	
	Male	Female	Male	Female	Male	Female
Ectocranially (age group in yrs)	50-59	52-60	42-46	47-50	53-56	55-60
Endocranially (age group in yrs)	50-55	49-53	46-55	40-50	50-55	50-55

In our study, complete fusion of ectocranial coronal suture was observed at the age of 50-59 yrs in C1 in male and 52-60 yrs in C1 in female. The endocranial coronal suture fusion was observed at 46-55 yrs in C2 in male and 40-50 yrs in females. The endocranial coronal suture fusion was observed at 50-55 yrs in C3 in male and 50-50 yrs in females.

Table no.2 Age of complete fusion of sagittal sutures

	S1		S2		S3		S4	
	Male	Female	Male	Female	Male	Female	Male	Female
Ectocranially (age group in yrs)	51-53	52-56	50-55	55-60	40-46	42-47	41-47	42-49
Endocranially (age group in yrs)	52-59	51-57	54-59	52-58	41-47	40-46	42-48	41-47

In our study, complete fusion of ectocranial sagittal suture was observed at the age of 42-49 yrs in female S4, in 41-47 yrs in male. The endocranial sagittal suture fusion was observed at 52-59 yrs in male S4, 51-57 yrs in female.

Table no.3 Age of complete fusion of lambdoid sutures

Suture	L1		L2		L3	
	Male	Female	Male	Female	Male	Female
Ectocranially (age group in yrs)	57-65	60-65	52-60	53-61	50-59	51-60
Endocranially (age group in yrs)	61-65	60-64	50-59	50-55	50-59	50-55

In our study, complete fusion of ectocranial lambdoid suture was observed at the age of 50-59 yrs in male and 51-60 yrs in female L3. The endocranial lambdoid suture fusion was observed at 50-59 yrs in male and 50-55 yrs in female.

Table 4 Minimum Age (in years) of complete Union of Sutures

Suture	Male		Female	
	Endo-cranium	Ecto-cranium	Endo-cranium	Ecto-cranium
Coronal suture (CS)	41	45	36	48
Sagittal suture (SS)	41	43	41	47
Lambdoid suture (LS)	51	60	53	58

The minimal age of fusion on endocranium was 41 years each for SS and CS in males. Whereas for LS it was 51 years. Among the females the minimum age of fusion of CS, SS and LS on endocranium were 36, 41 and 53 years respectively.

Table no.5 . Maximum Age (in years) of non union of Sutures

Suture	Male		Female	
	Endo-cranium	Ecto-cranium	Endo-cranium	Ecto-cranium
Coronal suture	48	70	45	58
Sagittal suture	44	70	47	60
Lambdoid suture	55	70	56	68

The maximum age in male showing non-union of suture on endocranium was 44 years on sagittal, 48 years on coronal and 55 years on lambdoid suture. In female it was

47 years on SS and 45 years in CS and 56 years on LS. In 1 male i.e. 1% there was no fusion of any of the vault suture even at the age of 70 years on ectocranium. Among the female maximum age of non-union of ectocranium was observed to be 60 years on SS, 58 years CS and 68 years for LS respectively.

Discussion

This hospital based prospective study was conducted on 100 cases coming for medico-legal post-mortem examination to the Department of Forensic Medicine, S.P. Medical College & Associated group of P.B.M. Hospital, Bikaner, Rajasthan.

In our study out of 100 cases maximum (30.00%) were 40-49 Yrs age group followed by 22.00% cases were 30-39 Yrs age group, 18.00% cases were 20-29 Yrs age group, 16.00% cases were 50-59 Yrs age group, 8.00% cases were 60-69 Yrs age group and 6.00% cases were more than 70 Yrs age group. Out of 100 cases 66.00% were male and 34.00% cases were female.

Ajay Bhengra et al⁴ was observed that The age varied from 20 to 82 years. Maximum (24.00%) were 40-49 Yrs age group followed by 12.00% cases were 30-39 Yrs age group. Out of 100 cases 60.00% were male and 40.00% cases were female.

William F Masih et al⁵ was observed that there were 78.5% male and 21.5% female and male to female ratio was 3:1.

Naked eye examination of all cases were done with reference to ecto & endocranial closure of sagittal, coronal and lambdoid suture using Acsadi and Nemeskeri scoring and simultaneously radiological confirmation was also done of all cases. Whereas this criterion was not considered by Yadav S.S. and Puri P.R. (1971)⁶ Patil T.L. (1981),⁷ Bhagwat S.S.(1983)⁸ and Chandrashekharan P. (1985).⁹ The fusion process of cranial suture at autopsy

has been modified as 0, 1 and 2 by Moondra A.K. (2000)¹⁰ in contrast to Acsadi and Nemeskeri scoring as 0, 1, 2, 3, 4.

The development and consolidation of the bones of the skeleton, which ossify in cartilages occurs, as a rule, about two yrs earlier in females than in males, but obliteration of sutures of vault of skull sets in a little later and proceeds slowly in females than in males i.e. the obliteration of vault suture occur earlier in males than in females. In our study also the fusion of cranial sutures was observed earlier in males as compared to females ectocranially whereas endocranially it was found marginally earlier in females.

In our study ectocranially coronal suture complete fusion was observed earlier in males as compared to females but similar findings were not observed endocranially where complete fusion of C3 was observed at the same age in both gender whereas it was observed earlier in female in C1 & C2 as compared to males.

In our study ectocranially lambdoid suture complete fusion of L1, L2 & L3 was observed earlier in males in comparison of females but it was observed earlier in female endocranially.

In our study ectocranially sagittal suture complete fusion was observed earlier in males as compared to females but similar findings were not observed endocranially where complete fusion of sagittal suture was observed slightly earlier in female as compared to males.

Similar observation were also made by Rentoul and Smith H.(1963),¹¹ Yadav S.S., Puri R.R. (1971), Vyas, P.c.(1996),⁶ Moondra A.K.(2000).¹⁰ We too are in agreement with their observation.

According to Nandy A.(1995)¹² skull sutures start their fusion activity by 24-25 years of age, which usually starts at the ectocranial surface but start in the endocranial

surface occurs late, the progress at this level is speedy, more uniform and more complete than at the ectocranial level, the present study findings are also in accordance with it.

The worker who has studied the autopsy specimen for study of process of ossification and suture fusion Krogman(1978).¹³ Rentoul & Smith (1973)¹⁴ has concluded that the study of ectocranial fusion is less significant than endocranial fusion viz. Dwight (1890),¹⁵ Patil (1981)¹⁶ Robert Shapiro (1960),¹⁷ because suture along the outer table are more or less serrated while at inner table they are combatively straight, whereas the process is speedy and more uniform and complete in the endocranial surface. The phenomenon of lapsed union is more common in the ectocranial surface, Todd & Lyon¹⁸, which is in accordance with our observations.

The commencement of the sutural obliteration on the endocranium of sagittal was observed at the age of 20- 30 years in both sexes which completed by the age of 40-50 years. The study showed that fusion of endocranium began first on pars lambdica& last on pars bregmatica in both sexes. The minimal age of fusion on endocranium was 41 years each for SS and CS in males. Whereas for LS it was 51 years .Among the females the minimum age of fusion of CS, SS and LS on endocranium were 36, 41 and 53 years respectively. The maximum age in male showing non-union of suture on endocranium was 44 years on sagittal, 48 years on coronal and 55 years on lambdoid suture. In female it was 47 years on SS and 45 years in CS and 56 years on LS. In 1 male i.e. 1% there was no fusion of any of the vault suture even at the age of 70 years on ectocranium. Among the female maximum age of non-union of ectocranium was observed to be 60 years on SS, 58 years CS and 68 years for LS respectively in our study.

Parikh CK (2010)¹⁹ has reported fusion on posterior 1/3 of sagittal suture by the age of 30-40 years and anterior 1/3 by the age of 40-50 years. It could probably be because of climate, dietetic and racial factors influencing the sutural fusion.

In India study by Yadav SS and Puri PR (1971)²⁰ on 100 skulls in Uttar Pradesh had reported finding parallel to our study as regards to obliteration of SS. Commencement of fusion of endocranium on CS and its completion in either sex was simultaneous to the fusion of endocranium on SS in both sexes. It started by the age of 25-30 years and was completed at the age of 46-50 years .The fusion of endocranium on CS occur first on the lower half and then on the upper half i.e it was early on sutural part away from the bregma. The age of commencement of fusion of ectocranium in both male and females was 31-35 years, whereas completion of obliteration occurred five years earlier in male (51-55 year) than female (56-60 years).

Conclusion

Suture obliteration starts earlier on endocranial surface than on the ectocranial. 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.

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