

ORIGINAL ARTICLE

MORPHOLOGICAL STUDY OF VAULT SUTURE & ITS CORRELATION WITH AGE IN CENTRAL RAJASTHAN

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ABSTRACT

Introduction: The suture closure of skull has a time and sequence of their union and study of suture closure can be correlated to its age and the obliteration of sutures is affected by sex, race, climate, heredity and diet

Aims: To study the closure of vault sutures on both inner and outer surface of skull and its correlation with age.

Methods: Total 200 skulls in autopsy cases (157 males and 43 females) from all age groups were studied.

Results: In males the minimal age of fusion in endocranium were 40 years for both sagittal suture (SS) and coronal suture (CS) & 50 years for lambdoid suture (LS). In females it was 40, 33 and 53 years for SS, CS & LS respectively. The maximum age of non-union of suture on endocranium in males was 42, 45, 55 years for SC, CS & LS respectively. In females it was 45, 45 and 55 years for SC, CS and LS respectively. 2 males (1% of all cases) showed non-fusion of vault sutures at the age of 70 years at ectocranium. Among the females maximum age of non-union of ectocranium was observed to be 59, 58 and 69 years for SS, CS and LS respectively.

Conclusion: The fusion of endocranial vault sutures occurred 5-10 years earlier as compared to ectocranium and it is more reliable. The obliteration sets little early and proceeds more slowly in the females than in males.

Key words: Cranial suture, suture, skull suture, Age estimation, Vault suture

INTRODUCTION

The sutures are easily seen in the young adults but in the skull of old persons the sutures are more or less obliterated. Vault is arched roof of skull and has three main sutures i.e sagittal, coronal and lambdoid. Bregma is the point where sagittal and coronal sutures meet and it is the site of anterior fontanelle while lambda represents the site of junction of sagittal and lambdoid sutures and is represented by posterior fontanelles¹.

Growth of the skull and obliteration of vault suture depends upon brain development. The premature closure of fontanelle and sutures is common in microcephaly. The suture closure has a time and sequence of their union and study of suture closure can be correlated to its age.²

Vault sutures exhibits progressive closure from mid-twenties³. Any visible fusion will at least indicate that the skull is of mature individual and it is unlikely below the age of 20 year⁴. The obliteration of sutures is affected by sex, race, climate, heredity and diet⁵.

Suture closure begins at endocranium and then proceeds to ectocranium and sometime there may be a lapsed union⁶. Lapsed Union is characteristic of ectocranial sutures that tend to remain in a state of incomplete union, in some individuals it is of very high degree³. A

number of studies have been conducted abroad on closure of cranial suture as an indicator of age viz., Dwight T (1890)⁷, Frederic J (1906)⁸, Todd TW and Lyon DW (1924)³ and Singer R (1953)⁹. In India the available studies on the subject are of Yadav SS and Puri PR (1997)¹⁰, Pardeep et al (2001-2004)¹¹ and Parmar P et al (2012)¹².

As closure begins internally, without inspection from both sides observations are misleading⁹. As the present study is on autopsy basis, so vault sutures were observed with naked eye both externally and internally and it was also correlated with age of the person.

OBJECTIVES

Objective of the study was to study the closure of vault suture on both inner and outer surface and its correlation with age and compare the results with other studies in India and abroad.

MATERIAL AND METHOD

This study was done in the Department of Anatomy in association with Department of Forensic Medicine at JLN Medical College, Ajmer. A total of 200 skulls in bodies brought for autopsy (157 males and 43 females),

from all age groups, were studied. The age of subjects under study was enquired from police and relatives.

The calvarium was removed by sawing and chiseling along with its three sutures under study, i.e sagittal suture (SS), coronal suture (CS) and lambdoid suture (LS). Each suture was divided into its segments by marking pencil both on ectocranium and endocranium.

Stages of closure were scored according to Frederic Rating Scale (1906)⁸ and after modifying it as follows-

- A. : Non Union
- B. : Beginning of Union
- C. : Closure of suture

OBSERVATIONS

In the present study there were 78.5% male and 21.5% female and male to female ratio was 3:1. In all age groups male subjects dominated the female. 14.5% cases were from 26-30 years age group followed by 13.5% in 31-35 years, 11.5% in 36-40 years of age and 8% of 16-20 years. Remaining 7.5% individuals were from 46-

50 years and 51-55 years each and 2.5% of 56-60 years respectively (Table-I).

Table 1: Age and Sex Wise Distribution of Cases (N=200)

Age in Years	Male (%)	Female (%)	Total (%)
0-5	2 (1.0)	2 (1.0)	4 (2.0)
6-10	3 (1.5)	2 (1.0)	5 (2.5)
11-15	5 (2.5)	-	5 (2.5)
16-20	6 (3.0)	10 (5.0)	16 (8.0)
21-25	22 (11.0)	6 (3.0)	28 (14.0)
26-30	26 (13.0)	3 (1.5)	29 (14.5)
31-35	24 (12.0)	3 (1.5)	27 (13.5)
36-40	17 (8.5)	5 (2.5)	22 (11.0)
41-45	10 (5.0)	2 (1.0)	12 (6.0)
46-50	13 (6.5)	2 (1.0)	15 (7.5)
51-55	13 (6.5)	2 (1.0)	15 (7.5)
56-60	4 (2.0)	1 (0.5)	5 (2.5)
61-65	2 (1.0)	1 (0.5)	3 (1.5)
66-70	2 (1.0)	1 (0.5)	3 (1.5)
71-75	3 (1.5)	2 (1.0)	5 (2.5)
76-80	3 (1.5)	-	3 (1.5)
81-85	1 (0.5)	1 (0.5)	2 (1.0)
86-90	1 (0.5)	-	1 (1.0)
Total	157 (78.5)	43 (21.5)	200 (100)

Table 2: Minimum Age (in years) of Union of Vault Sutures

Suture	Male		Female	
	Endocranium	Ectocranium	Endocranium	Ectocranium
Sagittal(SS)	40	42	40	48
Coronal(CS)	40	45	33	48
Lambdoid(LS)	50	60	53	58

Table 3: Maximum Age (in years) of Non- Union of Vault Sutures

Suture	Male		Female	
	Endocranium	Ectocranium	Endocranium	Ectocranium
Sagittal(SS)	42	70	45	59
Coronal(CS)	45	70	45	58
Lambdoid(LS)	55	70	55	69

The minimal age of fusion on endocranium was 40 years each for SS and CS in males. Whereas for LS it was 50 years .Among the females the minimum age of fusion of CS, SS and LS on endocranium were 33, 40 and 53 years respectively (Table-II), (Fig-1).

The maximum age in male showing non-union of suture on endocranium was 42 years on sagittal, 45 years on coronal and 55 years on lambdoid suture (Table III). In female it was 45 years on SS and CS and 55 years on LS.In 2 males 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 59 years on SS, 58 years CS and 69 years for LS respectively (fig- 2).

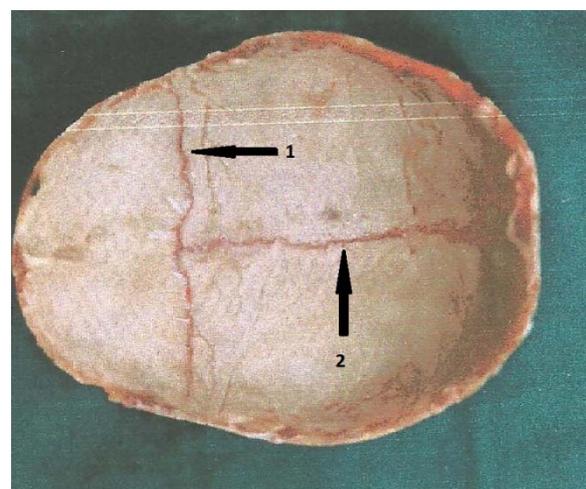


Figure-1: Showing Unfused Endocranial Sutures marked by arrows (1 showing CS & 2 showing SS)

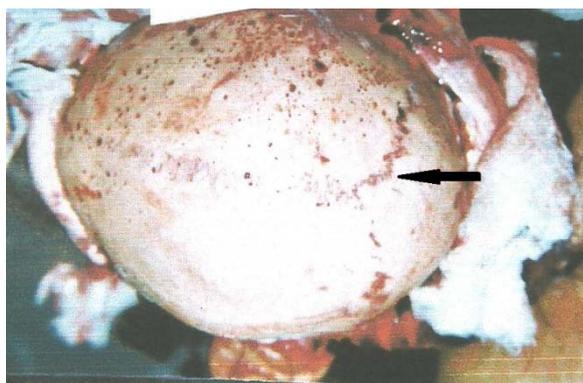


Figure-2: Ectocranium Showing Lapsed Lambdoid Suture (marked by arrow).

DISCUSSION

The cases in the present study ranged from a new born to the age of 89 years of which maximum belong to middle age group.

The commencement of the sutural obliteration on the endocranium of sagittal was observed at the age of 25-30 years in both sexes which completed by the age of 46-50 years. The study showed that fusion of endocranium began first on pars lambdica & last on pars bregmatica in both sexes. On ectocranium it started five years after endocranium, in males at 31-35 years, whereas in females it started at the age of 36-40 years i.e 10 years after endocranium. The completion of sutural obliteration in present study occurred at the same age i.e (51-55 years) in both sexes.

Table 4: Comparison of Time of Closure of Sutures with Other Studies in India & Abroad

Author	Region	Method	Age of closure of Sutures		
			Sagittal	Coronal	Lambdoid
Reddy K.S.N ((2007) ¹⁶	Andhra Pradesh	X-ray	40 to 50 years	50 to 60 years	45-50 years
Nandy A.(2001) ⁵	West Bangal	X-ray	45 to 50 years	45 to 50years	50 to 55 years
Pradeep et al(2001-2004) ¹¹	Punjab	CT Scan	45 to 50 years	45-50 years	45-50 years
Parmar P et al(2012) ¹²	Pondicherry	X-ray	50 to 60 years	50 to 60 years	50 to 60 years
Present Study	Ajmer, Rajasthan	Autopsy study			
		Ecto suture	46-50 years	46-50 years	56-60 Years
		Endo suture	46-50 years	46-50 years	46-50 years

In males, 16.6% cases there was delayed union on pars lambdica, par obelica and pars verticis and in 33.33% in pars bregmatica. Females did not represent any incidence of non- union, delayed union on ectocranium of SS at any part. Parikh CK (2010)¹³ 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)¹⁰ 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).

In our study commencement and completion of the sutural fusion on SS and CS was noted simultaneously among the male whereas in females the completion of union of CS lagged behind five years as compared to SS. The age of CS obliteration in various Western studies mainly Todd and Lyon (1924)³, McKern and Stewart (1957)¹⁴ were earlier as compared to our study and other

studies in India (Table IV). This difference of few years is because our is a autopsy study while others were radiological studies. The radiological appearance of union appears earlier than union indicated by gross examination (Reddy KSN 2007)¹⁶.The sequence of obliteration at various parts of suture in our study is similar to other studies.

The sequence of obliteration on endocranium is more reliable than ectocranium. The same was observed by Patil TL et al (1981)¹⁵ during his study on vault sutures in 150 skulls and by Todd and Lyon (1924)³ and Mckern and Stewert (1957)¹⁴.

Lapsed union in the present study has been observed in 1% case only, where there was no obliteration on any part of ectocranium of all three vault sutures. The obliteration of SS and CS in our study have been observed simultaneously followed by LS in the last. The obliteration of vault sutures was noticed earlier in male than in female at all three vault suture.

CONCLUSION

In males age of commencement of obliteration at endocranial suture was 25-30 years for both SS and CS and 31-35 years for LS whereas as completed at the age of 46-50 years on SS and CS and at 56-60 years on LS. In female age of commencement of obliteration on endocranial suture was 25-30 years on both SS and CS and 31-35 years on LS, whereas its completion was at the of 46-50 years on both SS and CS, 56-60 years on LS.

In males obliteration started on ectocranium of SS and CS at 46-50 years of age while on LS it started at 51-55 years, The completion of fusion took place at the age 51-55 years on both SS and CS and above the age of 60 years on LS. In females on ectocranial suture obliteration started at the age 46-50 years on SS, 51-55 years on CS and above the 60 years. It completed on SS. 35 years on CS and 51-55 years on LS while completion of obliteration was observed at

In males the fusion started and completed simultaneously on SS and CS, whereas it occurred in the end on LS both on endocranium and ectocranium. In females the endocranium showed obliteration simultaneously both at SS and CS whereas at ectocranium it started earlier on SS.

The fusion occurred 5-10 years earlier on endocranial as compared to ectocranium on all vault sutures. The obliteration on endocranial suture is more reliable than the ectocranial suture, where the delayed union or lapsed union is more. Incidence of lapsed union was 1%. The sequence of fusion of vault sutures started first on the part near to lambda and away from the bregma. The fusion of vault suture sets little early and proceeds more slowly in the females than in males.

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