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DETERMINATION OF AGE BY STUDY OF SKULL SUTURES

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ABSTRACT

Objectives: The objectives of this study are to determine the age by study of skull sutures and comparing the age with standard data mentioned in different textbooks and previous studies.

Material and Method: Present study based on closure of skull sutures among 220 cases between age group of 15 - 70 years with age interval of 5 years and 20 cases from each age group were studied, who were exposed to digital X-ray of skull for closure of suture ecto-cranially for age estimation. The closure of sagittal, coronal, lambdoid, parieto-mastoid, parieto-temporal (squamous) and baso-occiput with baso-sphenoid sutures were studied and compared with standard data mentioned in different textbooks and previous studies. Age of each individual studied was confirmed from birth certificate, service record, driving license, passport, ration card or voter's card.

Result: Each suture was found to close at particular age group. Suture closure occurred for sagittal, lambdoid, coronal, parieto-mastoid, parieto-temporal and baso-occiput with baso-sphenoid at age group of 50-60 years, 45-55 years, 50-60 years, 55-70 years, 60-70 years and 18-25 years respectively.

Conclusion: Age of closure of sagittal, coronal, lambdoid, parieto-mastoid, parieto-temporal and baso-occiput with baso-sphenoid suture was matching with standard data given in most of the textbooks and other studies. Sutures closure occurred from their endo-cranial to ecto-cranial aspects. Closure of skull sutures occurred earlier in male than in females. The most successful estimate was done from sagittal suture, next lambdoid suture and then coronal suture.

Keywords: Skull sutures, Age estimation, Sagittal suture, Coronal suture, Lambdoid suture.

INTRODUCTION

Age estimation, either in living, dead or human remains, is a complex problem in medical justice in both civil and criminal matters such as identification, senior citizen concession, retirement benefits, competency as witness, attainment of majority, marriage, impotency, sterility, consent, juvenile offender, kidnapping, rape etc. In general, age estimation is done by team of forensic expert and radiologist. If proper opinion regarding the age is not given then injustice may occur to the patient. Age estimation by means of closure of

skull sutures is a very important tool to solve above mentioned cases. [1]

Age determination is a very difficult task as the age advances, with conventional methods. In adulthood and old age, opinion is given in the form of age range instead of any particular age. As the age advances, this range becomes wide. In order to decrease this wide age range, combined study of physical examination along with closure of skull sutures should be done. Other factors also affect the age like nutritional, hereditary, racial, endocrine etc. Epiphyses of bones unite and sutures of skull close at a particular age for a given

population. Determination of age from skull sutures has great medico legal importance as it is the most reliable evidence for estimating the age of person. [2]

MATERIAL AND METHODS

In this study, 220 cases (male and female both), between age group of 15 - 70 years with age interval of 5 years and 20 cases from each age group were studied who were exposed to digital X-ray of skull both antero-posterior and lateral view for closure of suture ecto-cranially. Age of each individual studied was confirmed from birth certificate, service record, driving license, passport, ration card or voter's card and compared with radiological findings for accuracy. In this study, we considered only complete union of the sagittal, coronal, lambdoid, parieto-mastoid, parieto-temporal (squamous) and baso-occiput with baso-sphenoid sutures instead of taking into account other scoring system of suture closure and compared with standard data mentioned in different text books and previous studies.

OBSERVATION

In our study, age of earliest union for sagittal, lambdoid, coronal, parieto-mastoid, parieto-temporal and baso-occiput with baso-sphenoid suture was 46 years, 38 years, 46 years, 43 years, 54 years and 17 years respectively and age group for sagittal, lambdoid, coronal, parieto-mastoid, parieto-temporal and baso-occiput with baso-sphenoid suture was 50-60 years, 45-55 years, 50-60 years, 55-70 years, 60-70 years and 18-25 years respectively as per Table – 1. Different sutures closure in different age groups were given in Table – 2. Comparison of time of closure of sagittal suture was given in Table – 3. [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13] Comparison of time of closure of lambdoid suture was given in Table – 4. [1, 2, 3, 4, 5, 6, 8, 14, 15] Comparison of time of closure of coronal suture was given in Table – 5. [1, 2, 3, 4, 5, 6, 7, 8, 14, 15, 16] Comparison of time of closure of parieto-mastoid suture was given in

Table – 6. [1, 2, 6, 14, 15] Comparison of time of closure of parieto-temporal (squamous) suture was given in Table – 7. [1, 2, 3, 4, 7, 14, 15] Comparison of time of closure of baso-occiput with baso-sphenoid suture was given in Table – 8. [2, 3, 4, 5, 6, 7, 8, 17, 18]

DISCUSSION

Identification means determination of individuality of a person. Study of closure of skull sutures is a very important tool for age estimation in adult. The most commonly studied aspect of cranial sutures is the degree of their obliterations as an indicator of age. Suture closure scoring system as per Buikstra and Ubelaker [19] was given in Table – 9. Meindl and Lovejoy scoring system (1985) [20] was given in Table – 10. Acsadi and Nemeskeri scoring system (1970) [21] and Perizonius (1984) [22] scoring system was given in Table – 11. In our study, we considered only complete union of sutures instead of taking into account other scoring system of suture closure. Observations of cranial suture closure were first observed as far back as the 1st century in the work of Hippocrates, but were not utilized as an 'identification tool' with relation to age until a much later date. [11, 12, 13] Vesalius and his pupil Fallopius were credited for the first noting the apparent progression of suture obliteration with age in 1542. [11, 12, 23, 24, 25, 26] Despite some early descriptions of the variability of cranial suture closure, scientific studies addressing its relationship with age have been published in great number from the 19th century to present [10]. This continued popularity has survived not due to its validity but rather the idea that, if it has been studied for so long, surely there has to be something to it, and thus it becomes a traditional research obsession. [26]

CONCLUSION

Age of closure of sagittal, coronal, lambdoid, parieto-mastoid, parieto-temporal and baso-occiput with baso-sphenoid suture was matching

with standard data given in most of the textbooks and other studies. Sutures closure occurred from their endo-cranial to ecto-cranial aspects. Closure of skull sutures occurred earlier in male than in females. The most successful estimate was done from sagittal suture, next lambdoid suture and then coronal suture. Studies of the ecto-cranial suture closure have the potential to underestimate age and to overcome this, study of both endo-cranial and ecto-cranial suture closure should be done.

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Table - 1: Ages for suture closure

Sr. no	Name of suture	Age of fusion in majority of cases (Age group)	Age of earliest union in years
1	Sagittal	50 to 60	46
2	Lambdoid	45 to 55	38
3	Coronal	50 to 60	46
4	Parieto-mastoid	55 to 70	43
5	Parieto-temporal (squamous)	60 to 70	54
6	Baso-occiput with baso-sphenoid	18 to 25	17

Table - 2: Suture closure in different age group

Age group (in years)	Sagittal		Lambdoid		Coronal		PM		PT		BO - BS	
	20	%	20	%	20	%	20	%	20	%	20	%
15-20	---	---	---	---	---	---	---	---	---	---	11	55
20-25	---	---	---	---	---	---	---	---	---	---	17	85
25-30	---	---	---	---	---	---	---	---	---	---	18	90
30-35	---	---	---	---	---	---	---	---	---	---	19	95
35-40	---	---	2	10	---	---	---	---	---	---	20	100
40-45	---	---	9	45	---	---	---	---	---	---	20	100
45-50	4	20	15	75	6	30	---	---	---	---	20	100
50-55	15	75	15	75	18	90	7	35	2	10	20	100
55-60	14	70	17	85	18	90	16	80	8	40	20	100
60-65	18	90	18	90	17	85	18	90	16	80	20	100
65-70	18	90	18	90	18	90	18	90	18	90	20	100

[PM – Parieto-mastoid, PT – Parieto-temporal, BO - BS – Baso-occiput baso-sphenoid]

Table – 3: Comparison of time of closure of sagittal suture (in years)

Author	Year	Race	Method	Time of closure
Reddy K.S.N. [2]	2007	Indian	X-ray	Posterior 1/3 – 30 to 40 Anterior 1/3 – 40 to 50 Middle 1/3 – 50 to 60
Dikshit P.C. [3]	2007	Indian	X-ray	Start – 25 Complete – 35 to 40
Nandy A. [4]	2001	Indian	X-ray	Start – 24 to 25 Complete – 45 to 50
Mukherjee J.B. [5]	2011	Indian	X-ray	35 to 40
Karmakar R.N. [6]	2010	Indian	X-ray	Start – 25 Complete – 30 to 35
Pillay VV [7]	2008	Indian	X-ray	30 to 40
Vij K. [8]	2011	Indian	X-ray	Posterior 1/3 – 30 to 40 Anterior 1/3 – 40 to 50 Middle 1/3 – 50 to 60
Dwight T. [9]	1890	USA	X-ray	Start – 22 Complete – 35
Parsons FG and Box CR [10]	1905	USA	X-ray	Start – 22 Complete – 35
Todd TW and Lyon DW [11, 12]	1924-1925	USA	X-ray	Start – 22 Complete – 35
Mckern TW and Stewart TD [13]	1957	USA	X-ray	Start – 18 Complete – 31 to 40
Present	2012	India	X-ray	50 to 60

Table – 4: Comparison of time of closure of lambdoid suture (in years)

Author	Year	Race	Method	Time of closure
Krogman [14]	1962	USA	Gross skeletal	31
Parikh C.K. [15]	1990	Indian	X-ray	45 to 50
Vij K. [8]	2011	Indian	X-ray	Start – 25 to 30 Complete – 55
Pradeep et al [1]	2001 - 2004	Punjab	CT scan	45 to 50
Dikshit P.C. [3]	2007	Indian	X-ray	Start – 25 to 35 Complete – 45 to 50
Reddy K.S.N. [2]	2007	Indian	X-ray	45
Nandy A. [4]	2001	Indian	X-ray	Start – 25 to 27 Complete – 50 to 55
Mukherjee J.B. [5]	2011	Indian	X-ray	Upper part – 30 to 35 Lower part – 45 to 50
Karmakar R.N. [6]	2010	Indian	X-ray	Start – 30 Complete – 45 to 50
Present	2012	Indian	X-ray	45 to 55

Table – 5: Comparison of time of closure of coronal suture (in years)

Author	Year	Race	Method	Time of closure
Krogman [14]	1962	USA	Gross skeleton	Type 1, 2 – 24 to 38 Type 3, 4 – 26 to 41
Parikh C.K. [15]	1990	Indian	X-ray	35 to 40
Reddy K.S.N. [2]	2007	Indian	X-ray	Lower half – 40 to 50 Upper half – 50 to 60
Nandy A. [4]	2001	Indian	X-ray	Start – 24 to 25 Complete – 45 to 50
Vij K. [8]	2011	Indian	X-ray	Lower half – 40 to 50 Upper half – 50 to 60
Ramachandran C. [16]	2003	Indian	X-ray	Lower half – 40 to 60 Upper half – 50 to 60
Pradeep et al [1]	2001-2004	Punjab	CT scan	45 to 50
Dikshit P.C. [3]	2007	Indian	X-ray	Start – 25 to 30 Complete – 40
Mukherjee J.B. [5]	2011	Indian	X-ray	Lower half – 25 to 30 Upper half – 40 to 45
Karmakar R.N. [6]	2010	Indian	X-ray	Start – 25 to 30 Complete – 30 to 40
Pillay VV [7]	2008	Indian	X-ray	40 to 50
Present	2012	Indian	X-ray	50 to 60

Table – 6: Comparison of time of closure of parieto-mastoid suture (in years)

Author	Year	Race	Method	Time of closure
Krogman [14]	1962	USA	Gross skeletal	50
Parikh C.K. [15]	1990	Indian	X-ray	55
Pradeep et al [1]	2001-2004	Punjab	CT scan	55 to 60
Reddy K.S.N. [2]	2007	Indian	X-ray	40 to 50
Karmakar R.N. [6]	2010	Indian	X-ray	60 to 70
Present	2012	Indian	X-ray	55 to 70

Table – 7: Comparison of time of closure of squamous (parieto-temporal) suture (in years)

Author	Year	Race	Method	Time of closure
Krogman [14]	1962	USA	Gross skeletal	50
Parikh C.K. [15]	1990	Indian	X-ray	60
Pradeep et al [1]	2001-2004	Punjab	CT scan	60 to 65
Reddy K.S.N. [2]	2007	Indian	X-ray	60
Dikshit P.C. [3]	2007	Indian	X-ray	70
Nandy A. [4]	2001	Indian	X-ray	70
Pillay VV [7]	2008	Indian	X-ray	60 to 65
Present	2012	Indian	X-ray	60 to 70

Table – 8: Comparison of time of closure of baso-occiput with baso-spheoid (in years)

Author	Year	Race	Method	Time of closure
Dikshit P.C. [3]	2007	Indian	X-ray	18 to 20
Reddy K.S.N. [2]	2007	Indian	X-ray	18 to 21
Nandy [4]	2001	Indian	X-ray	Female – 18 to 20 Male – 20 to 22
Mukherjee J.B. [5]	2011	Indian	X-ray	Female – 19 to 22 Male – 19 to 24
Karmakar R.N. [6]	2010	Indian	X-ray	Female – 19 to 22 Male – 19 to 24
Vij K. [8]	2011	Indian	X-ray	Female – 18 to 20 Male – 20 to 22
Pillay VV [7]	2008	Indian	X-ray	18 to 21
David Dolinak [17]	2005	USA	X-ray	18 to 23
Bernard Knight [18]	2004	USA	X-ray	20
Present	2012	Indian	X-ray	18 to 25

Table – 9: Suture closure scoring system as per Buikstra and Ubelaker

Score	Suture
0	Open
1	Minimum closure
2	Significant closure
3	Completely obliterated

Table – 10: Meindl and Lovejoy suture scoring system (1985)

Score	Description
0	Open, there is no evidence of any ecto-cranial closure at site.
1	Minimal closure, Some closure has occurred. This score is given for any minimal to moderate closure, i.e. from a single bony bridge across the suture to about 50% synostosis at the site.
2	Significant closure, there is a marked degree of closure but some portion of the site is still not completely fused.
3	Advanced closure. Only pits indicate where the suture is located.

Table – 11: Acsadi and Nemeskeri (1970) and Perizonius (1984) scoring system

Score	Description
0	Open suture. There is little space left between the edges of adjoining bones.
1	Incipient closure. Suture is closed, but clearly visible as a continuous, often zigzagging line.
2	Closure in process. Suture line becomes thinner, has fewer zigzags and may be interrupted by complete closure.
3	Advanced closure. Only pits indicate where the suture is located.
4	Closed suture. Suture completely obliterated, even its location can't be recognized.