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ORIGINAL ARTICLE

Gender Disparities in the Coronal Suture Closure of the Cranium – A tool for estimation of sex

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ABSTRACT

Background: Establishing the identification of a deceased at autopsy is one of the prime objective of medicolegal postmortem examination. The identification starts with determination of age and sex of the individual. The problem arise when completely decomposed dead body or just skeletal remains are brought for postmortem examination.
Methods: The study was conducted on 90 dead bodies of equal proportion from both the genders in the year 2016 for a period of nine months. The cases were selected for study after careful scrutiny through a pre-trialed questionnaire with certain selection criteria. After proper exposure of the inner and outer surface of the cranial vault the degree of coronal suture closure was assessed in three segments as C1, C2 and C3 as observed through Acsádi-Nemeskéri Scale.
Results: A grossly significant observation of possibility of determination sex both from ectocranial and endocranial suture closure of the coronal suture with 0.001 p value was noted, therefore establish the fact that determination of sex from closure coronal suture is established.
Keywords: Sex, Coronal, Suture, Closure

INTRODUCTION

Postmortem examination is an imperative exercise of execution in all unnatural deaths especially where foul play is suspected.[1,2] No autopsy is complete until preliminary data of sex and age is established as part of determination of individuality of a person.[3] Determination of sex in known and fresh dead bodies is no issue but is one of the most problematic concern in grossly decomposed bodies or in skeletal remains.[4] Therefore determination of sex in advanced putrefaction and skeletal human remains is one of the toughest task of an authorized medical examiner conducting autopsy and probably would be most skillful art to be exploited in order to determine the exact parameter of sex[1-4].

Sex like other components of identification on autopsy can be determined by different methods and techniques[5] Sex can be determined by external appearance of physical shape and characteristics.[6] Radiological examination to explore the ovaries and uterus could be another method of determination of sex.[7] Still there are other methods like forensic serology for determination of sex to look for Bar Bodies and Davidson Bodies to label the deceased sex as female or male respectively.[8] Importantly these all methods are applicable in fresh dead bodies and would not be possible to determine it on decomposed dead bodies or skeletal remains[3,5,8]

For that in skeletal remains or advanced decomposed dead bodies those are the bones one is left with to determine the sex of an individual on autopsy. Sex can be estimated from almost every single piece of skeleton[9]. All the elements of skeleton including the cranial vault sutures[10], sinuses of the skull bones[11], teeth[12], mandible[13], hyoid bone[14], scapula[15], sternum[16], innominate bones of hip girdle[17], sacrum[18] and bones of the limbs[19] are individually or collectively helpful for determining sex of the individual some time with 100% accuracy[10-19].

Estimating sex from cranial sutures is most convenient and conventional as its compulsory to remove the calvarium of the cranial vault in order to open.[20] So among all the skeletal elements, determining sex from the cranial suture would be relevant, easy, convenient and comfortable as for as restoration of body contours after autopsy are concerned and body readily available for burial by concerned agencies or legal heirs whatsoever the case may be.

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On usually terms and conditions the skeletal elements mature earlier in females than in males but reverse is the case when the same comes to cranial (coronal) suture closure. It commences earlier in males than in females, hence helping in determination of the sex of the deceased on postmortem examination even by naked eye assessment[21].

MATERIAL AND METHODS

The study was carried in the Department of Forensic Medicine and Toxicology, King Edward Medical University Lahore from January 2016 to September 2016 after approval from Ethical Committee. The sample composed of 90 dead bodies with equal distribution of gender for male and females. The cases were taken into consideration for study after informed consent from accompanying police official i.e. the competent authority for consent as per legislation of the law of land.

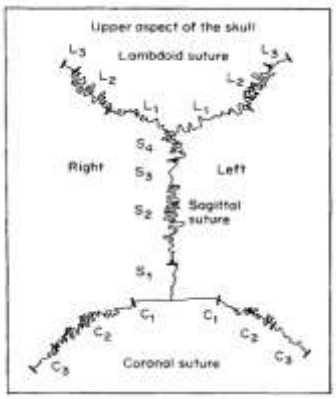
The dead bodies were thoroughly examined before choosing them to be included in the study sample to fulfill the inclusion and exclusion selection criterion. All the dead bodies with any skull fracture, anamolies or pathologies were excluded and those with intact skull and available source of reference age were included for study. After fulfillment of selection criterion dead bodies were autopsied as per protocol of autopsy. The dead bodies were taken from mortuary to autopsy table where those were made lie down supine and flat. The skull was made open with mastoid to mastoid incision and scalp flaps were retracted to either side for wide view of calvarium. The superficial facia and perisotium were diligently scrapped out. The outside or ectocranium coronal suture was carefully examined and observation were noted down. Then carefully the calvarium was cut out with manual bone saw and same exercise was repeated for examining the observations of interest.

Special emphasis was made in selection of the dead bodies' age. All the cases below 21 years of age was not taken into consideration as all the suture below this age always invariably remain open. So to avoid such discrepancies the cases below the age of 21 years were not selected. Similarly the upper age limit was set for a maximum of 70 years of age because after that under normal physiological condition there would have been no suture of skull that could be left unfused or unclosed.

The degree of coronal suture closure was observed in three segment of equal proportions as C1, C2 and C3 as per Acsádi-Nemeskéri Scale on either side where the suture joins the central sagittal suture (Fig. 1). The early closure in males and late closure in female is taken as standard for determination of sex. The Acsádi-Nemeskéri Scale[21] is graded as follows

0 - Open
1 - Incipient closure in the form of a dotted line
2 - Closure in process as if the dotted lines getting close to each other
3 - Advanced closure with a few pits lying unclosed
4 - Closed as if it was never open

Fig. 1: The segmentatization of the Coronal Suture as envisaged by Acsádi-Nemeskéri Scale[21]



RESULTS

Sexing from coronal suture of the cranium a tidy and time consuming task although it is considered as convenient and conventional one. The observations recorded from the degree of coronal suture closure for determination of sex in 90 dead bodies with equal distribution of gender was analyzed and results were produced, are elaborated in following sections.

Age and Gender Distribution: There were 90 dead bodies of equal participation from male and female sexes. All the included cases remained within the age bracket of 21 years to 70 years (Table 1).

As shown in table 1 above the first age bracket of 21 to 30 years consisted of total 32 (35.5%) cases with 10 males and 22 females. Similarly the age group of 31 to 40 years comprised of a total of 15(16.7%) having 8 males and 7 females. The third age group of 41 to 50 years contained a total of 18 (20%) cases consisting of 10 males and 8 females. The next age group of 51 to 60 years had a total of 14(15.6%) cases encompassing 8 males and 6 females. The final age bracket of 61 to 70 years gathered a total of 11(12.2%) cases producing 9 males and 2 females.

The table 2 shows completion of the stage 4 of suture closure in all the segments of coronal suture in the last age group ranged from 61 to 70 years in all males and females sparing the C2 segment on endocranial surface among the case of above mentioned age bracket. The complete closure was also observed on endocranial surface of segments of C1 and C3 in age group of 51 to 60 years, however advanced closure was observed in C2 coronal suture segment in cases of ages 41 to 50 years. Ectocranial coronal suture closure in figure 02 and endocranial suture closure (Fig. 1).

Table 1: Age and gender distribution (n-90)

Age Group	Male (*n*=45)	Female *n*=45)	Total	Valid %age
21-30 years	10	22	32	35.5%
31- 40 Years	08	07	15	16.7%
41- 50 Years	10	08	18	20%
51-60 Years	08	06	14	15.6%
61-70 Years	09	02	11	12.2%

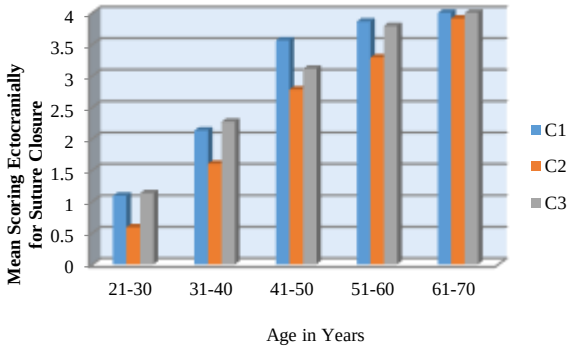
Assessment of coronal suture closure in sex estimation:

Table 2: Ectocranial and Endocranial closure of Coronal Suture in Total Population (*n*=90)

Age group	*n*	Ecto -C1	Endo-C1	Ecto-C2	Endo-C2	Ecto-C3	Endo-C3
		Mean ± SD		Mean ± SD		Mean ± SD	
21-30 years	32	1.09±0.466	1.72±0.634	0.59±0.499	1.09±0.588	1.13±0.609	1.66±0.602
31-40 Years	15	2.13±0.516	2.60±0.507	1.60±0.507	2.13±0.516	2.27±0.594	2.40±0.632
41-50 Years	18	3.56±0.511	3.67±0.485	2.78±0.548	3.00±0.485	3.11±0.583	3.61±0.502
51-60 Years	14	3.86±0.363	4.00±0.000	3.29±0.469	3.50±0.519	3.79±0.426	4.00±0.000
61-70 Years	11	4.00±0.000	4.00±0.000	3.91±0.302	4.00±0.000	4.00±0.000	4.00±0.000

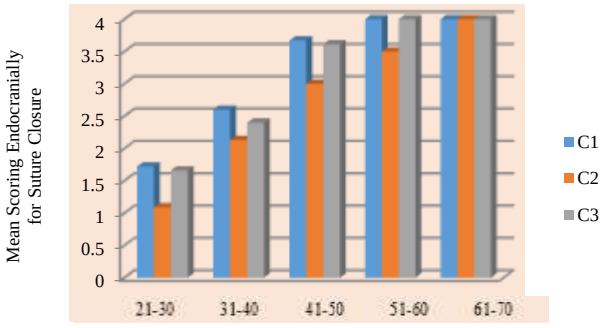
Where *'n'* is number, Ecto – C1 = Ectocranial Coronal Suture Segment 1, Endo – C1 = Endocranial Coronal Suture Segment 1, Ecto – C2 = Ectocranial Coronal Suture Segment 2, Endo – C2 = Endocranial Coronal Suture Segment 2, Ecto – C3 = Ectocranial Coronal Suture Segment 3, Endo – C3 = Endocranial Coronal Suture Segment 3.

Fig. 2: Ectocranial Closure of Coronal Suture



Gender determination from closure of coronal suture: As a rule the cranial suture closure starts from inner side i.e. endocrnail surface followed by closure on the outer surface ectocranial surface. This pattern of closure first takes place in males followed by closure in females, these basis of differences serve as template for determining the sex of the individual by examination the closure of the coronal suture in current study.

Fig. 3: Endocranial Closure of Coronal Suture



Usually all the skeletal elements fuse or close earlier in females than that of males like the closure of epiphysis with diaphysis of long bones but the scenario turns out to be opposite

when it comes to the closure of the cranial sutures. Therefore it act as an element of sexual difference between the two genders as shown in table 3.

As shown in table 03 above there is the difference of means are evident enough to determine the sexual disparity. In the closure of ectrocranial (surface) sutures the female closure is almost in a stage of 'closure in process' while for the same standards in the males the closure was in stage of 'advanced closure'. Hence it is established that the degree of closure difference helps in determining sex of the deceased individual.

The degree of coronal suture closure in the endocranial (surface) suture in males is in the stage of 'advanced closure' i.e. 3.0 while for the same it is lagging behind a little i.e. 2.2 hence making it possible to establish the sex of the deceased individual on autopsy table.

Table 3: Gender differences in closure of coronal suture

Ectocranial Sutures				
Gender	***n***	**Mean**	**P value**	**Significance**
Male	45	2.7178	0.001	significant
Female	45	1.9022		
Endocranial Sutures				
Male	45	3.0111	0.001	significant
Female	45	2.2733		

DISCUSSION

Like estimation of age from cranial (coronal) suture is conventional, it goes the same for the determination of sex. The determination of sex from the closure pattern in terms of the fact that coronal suture closure takes place earlier in males than in females establishes the truth that it is possible. Hence determination of sex from inner surface or endocranial surface of the coronal suture as well as outer surface or ectrocranial surface the pattern of suture closure in comparison to opposite makes it possible to determine the sex of the individual on postmortem examination.

Although it is true that the reason why this closure pattern in the cranial (coronal) suture is earlier in males than in females is not known but the fact is; yes it helps in determining the sex of the deceased on autopsy table when compared with standard or reference value available in the documents provided in autopsy file. The study findings are in consistence with those of O'Donnell 2011)[4], (Rao 2009)[10], (Mall 2001)[19] and (Sahni 2005)[21] and there was no report contradictory to the findings of the current study.

CONCLUSION

The study findings established that determining the sex of a deceased individual on autopsy table can be determined by assessing the degree of cranial coronal suture closure in comparison to that of the opposite gender as it is earlier in males as compared to that of females. The exact cause could not be established yet but it has been found true that the closure is earlier in males. The study included the age bracket of those above 20 years and lesser than 70 years and just the coronal suture of the cranium which should better have included other sutures as well for expected different outcomes. Up till now the determination of sex is possible by observing naked eye examination of the cranial coronal suture.

Conflict of interest: Nil

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