The Pharma Innovation Journal 2015; 4(8): 144-146

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2015; 4(8): 144-146

www.thepharmajournal.com
Received: 21-07-2015
Accepted: 23-08-2015

Dr. MP Ambali
Department of Anatomy KIMS, Karad, Maharashtra, India

Dr. S Mohithe
Department of Anatomy KIMS, Karad, Maharashtra, India

Corresponding Author:
Dr. MP Ambali
Department of Anatomy KIMS, Karad, Maharashtra, India

Sexual dimorphism of adult human skull

Dr. MP Ambali and Dr. S Mohithe

Abstract
Aim: Present study aims to evaluate sexual dimorphism of skull and purpose to enhance the accuracy of sexing the skull which will be useful in anthropometric and medicolegal studies.
Material and Method: First all the foramina of the skull were blocked by cotton and the cranial cavity was filled through the foramen magnum by means of a funnel with mustard seeds. The skull was shaken from time to time to fill the cavity entirely. When the skull was filled entirely, then the seeds were poured into a 2000 cubic centimetre measuring cylinder through a funnel. The measuring cylinder was then agitated until it was thoroughly packed and the reading was taken directly. The procedure was repeated for three times for every skull.
Result: the average breadth of right as well as left sided orbit of male and female skull is not statistically significant. Differences in the height of right as well as left sided orbit of male and female skull are not statistically significant. Right as well as left sided mastoid process breadth is significantly higher in male skull than that of female skull. No statistical difference in the gnathic index of male and female skull. No statistical difference in the foramen index of male and female skull.
Conclusion: In total seventeen parameters were taken and analyzed statistically. We have derived six indices from them. All these parameters and indices were subjected to routine statistical methods by applying student's't' test (unpaired) and getting the 'p' values. Demarcating points were obtained for each parameter and index and also the percentage of bones crossed the demarcating points were determined.

Keywords: Adult Human Skull, Sexual Dimorphism

Introduction
Identification of the deceased from bones is the most common and critical problem faced by anatomist, forensic science experts and anthropologist. Skeletal remains have been used forsexing the individual as bones of the body are last to perish after death, next to enamel of teeth [1]. Almost all bones of the skeleton show some degree of sexual dimorphism therefore various parts of a skeleton are useful insex determination such as the pelvis, skull, femur, tibia, humerus, radius, mandible etc. [2] Sexual differences are marked in pelvis and skull but not equally in all population.
It is not possible with any degree of reliability to determine the sex of the skull until after puberty. In general the female skull is smaller and lighter than the male skull [3]. It presents a more infantile appearance; the bones are smoothers [4], more gracile and more delicately fashioned. The supraorbital and temporal ridges are little if at all developed, the mastoid processes are small and supramastoid crests scarcely developed, while the occipital muscle markings are weakly developed [5]. The facial skeleton, teeth, mandible, zygomatic arches and cheekbones are smaller and more delicate, and the margins of the orbit are sharper in the female [6].
Skull is one of the commonest parts of the skeletonused to opine on the sex of an individual next to pelvis. In India, studies on sexual dimorphism of skull were very few; we have taken this study to enhance the accuracy of sexing the skull which will be helpful in anthropometric and medico legal studies. Present study aims to evaluate sexual dimorphism of skull and purpose to enhance the accuracy of sexing the skull which will be useful in anthropometric and medicolegal studies.

Material and Method
For the present study, adult human skulls of known sex were collected from different Medical Colleges of Maharashtra in the Department of Anatomy of each college. 100 male and 100 female bones were taken for the study. All the bones were fully ossified, dry and without any damage or deformity. In order to avoid observer's error all the parameters were measured,

and recorded single handedly. For each of the parameters three readings were taken and then their mean was taken as the final reading. For each skull, the metrical data and measurements were recorded. Weight was taken by weighing machine. It was recorded in grams first all the foramina of the skull were blocked by cotton and the cranial cavity was filled through the foramen magnum by means of a funnel with mustard seeds. The skull was shaken from time to time to fill the cavity entirely. When the skull was filled entirely, then the seeds were poured into a 2000 cubic centimetre measuring cylinder through a funnel. The measuring cylinder was then agitated until it was thoroughly packed and the reading was taken directly. The procedure was repeated for three times for every skull. Mean of the three observations was taken as a reading of cranial capacity of each skull. It was recorded in cubic centimetre.

The data was summarized into range (minimum-maximum), mean and standard deviation sex wise. Comparison of each study factor was done by applying Student's 't' test (unpaired). To determine the demarcating point that is the point which will find whether the skull is of male or female, mean ± 1.96 SD (Standard Deviation) range was obtained. Considering the range of male, female demarcating point was determined while considering the range of female, male demarcating point was determined. Correlation coefficient (r) has been worked out in respect of various craniometric indices. Difference assessed by 't' test and correlation coefficient (r) was said to be significant when p was less than 0.05. All the analyses were carried out using standard computer program. When the formula "mean ± 3 SD" was applied, very less percentage of bones could be sexed correctly. So we apply the formula "mean ± 1.96 SD".

Results

A **B**

Fig 1: A Male Skull B Female Skull

A study of 200 skulls (100 Male and 100 Female) has been done in the Department of Anatomy, Krishna Institute of Medical Sciences, Karad. In total 17 parameters were studied. Those then were analyzed statistically using a standard computer programme. The analyzed data was summarized into range (minimum – maximum), mean, standard deviation sex-wise. Comparison of each study factor was done by applying student's't' test (unpaired). Cranial capacity is significantly higher in male skull as compared with that in the female skull. Mean length of skull is significantly higher in male skull as compared with that in female skull. Average breadth of male skull is significantly higher in male skull than that of female skull. Average bizygomatic diameter is significantly higher in male skull than that of female skull. Differences in the average palate length of male and female skull are not statistically significant. Average palate breadth of male and female skull is not statistically significant.

Basion-Prosthion length is significantly higher in male skull than that of female skull. Basion-Nasion length is significantly higher in male skull than that of female skull. Mean length of foramen magnum is significantly higher in male skull as compared with that in female skull. Mean breadth of foramen magnum is significantly higher in male skull as compared with that in female skull. Difference in the length of right sided as well as left sided foramen ovale of male and female skull is not statistically significant. Differences in the breadth of right sided as well as left sided foramen ovale of male and female skull are not statistically significant. Difference in the length of right as well as left sided carotid canal of male and female skull is not statistically significant. In the breadth of right as well as left sided carotid canal of male and female skull are not statistically significant. The average breadth of right as well as left sided orbit of male and female skull is not statistically significant. Differences in the height of right as well as left sided orbit of male and female skull are not statistically significant. Right as well as left sided mastoid process breadth is significantly higher in male skull than that of female skull. No statistical difference in the gnathic index of male and female skull. No statistical difference in the foramen index of male and female skull.

Discussion

Skull is one of the commonest part of the skeleton used to opine on the sex of an individual. Sexual dimorphism is insignificant in the prepubertal age group. Although adult skulls show a few non-metrical and metrical differences, there is paedomorphic tendency in the human skulls of either sex. Further, hormones, nutritional status, cultural differences and environmental factors affect these variations; skulls from different geographical areas vary much. Skull shapes may also vary within a population and even among the closely related. We studied 100 male and 100 female skulls. Foramen ovale, cranial capacity, orbit, mastoid process, in these parameters, we had taken Right and Left side separately and these readings were compared with Right side of male and female skulls similarly on Lt side in male and female skulls. No other workers studied these parameters separately on Right and Left side in male and female skulls.

Similarly some researcher have taken mean of Right and Left side of orbital index and mastoid process index as they do not found significant difference in Right and Left side. In present study, the difference was also not significant [7]. However as there is always variation in indices of Right and Left side, the mean of Right and Left is not taken into consideration [10]. And it is always better to give separate findings for Right and Left side as they independently give more accurate prediction than that of predicted on the basis of average of Right and Left side.

The present study consists of routine statistical methods where student's 't' test (unpaired) is applied to all 17 parameters. Statistical significance between male and female skull was studied. Demarcating points were obtained for the parameters which are significant statistically. The percentage of skull sexed accurately by using demarcating points was noted for each of them. Correlation coefficient (r) has been worked out in respect of various craniometric indices to reveal correlation between various craniometric indices. By taking in account the various parameters of skull, limitation and utility of each of them is discussed by considering the mean values for male and female skull, their statistical

significance and comparing them with the findings of other workers.
It was not possible to give comparative tables for all parameters as they were not available

1. Weight: The mean value of weight for male and female is 572.90 gm and 502.35 gm respectively. The weight is statistically very highly significant, with higher values in males than in females. The demarcating point for male skull is 623.78 gm and that for female skull is 424.43 gm. That means, any skull having weight more than 623.78 gm is definitely a male skull and one measuring below 424.43 gm is definitely a female skull.
The percentage of bones sexed correctly by using this method is in males 23% and in female 7%. The findings of our study do not coincide with Deshmukh and Devershi (2006)1 study. According to them, weight is not a statistically significant parameter. But our study goes in favour of Sahana (1993)68. According to Sahana, size and weight of skull is larger in size and heavier in male and smaller in size and lighter in female.

2. Cranial Capacity: The measurement of cranial capacity is of both anthropological and clinical interest. Such measurements are necessary as they indicate indirectly the brain volume. It is observed that the cranial capacity is a statistically highly significant parameter in sexing the skull. In our study, its mean value for males and females is 1192.20cc and 1170.10cc respectively. Skull with the value measuring above 1222.86cc is definitely a male skull and the one measuring below 1047.99cc is a female skull. The findings in present study are nearer to the findings of Hwang *et al*. (1995)33, who found that cranial capacity is significant [9].
Percentage of bones identified by demarcating point in males is 29% and in female it is 4%.
The maximum skull length is statistically significant. The mean values are 171.04 mm for male skull and 162.98 mm for female skull. The demarcating point tells as that any skull measuring more than 175.70 mm is a male skull and the one less than 157.62 mm is a female skull. The percentage of bones identified by using demarcating point in males is 23% and in females 15%.The means values of maximum skull breadth are 128.33 mm males and 124.12 mm in female respectively. It is seen significant statistically with higher values in males. Demarcating point for males is above 132.64 mm and for females is below 124.12 mm. That means any skull having maximum skull breath above 132.64 mm is a male skull and that measuring below 124.12 mm is a female skull. Percentage of bones identified by using demarcating point in males is 15% and in females it is 11%.This parameter is statistically highly significant with higher values in males than the females [10]. The mean value for male is 125.11 mm and that for female is 118.27 mm. The demarcating point for males is more than 126.10 mm that for females is less than 17.20 mm. The mean value of maximum palate length for male is 45.13 mm and that for female is 44.32 mm. No demarcating point can be applied as it is insignificant statistically.
The demarcating point for male skull is 95.72 mm and that for female skull is 84.73 mm. That means, any skull having Basion-Prosthion length more than 95.72 mm is definitely a male skull and the one measuring below 84.73 mm is definitely a Female skull. The percentage of bones sexed correctly by using this method is in males 13% and females 16%. In our study, we observed Basion – proshion length which is statistically significant but this finding is not in favour of Deshmukh and Devershi (2006) [1, 9].
Demarcating point tells us that any skull with a value of less than 31.22 mm of this parameter is definitely a female skull and the one measuring above 39.80 mm is definitely a male skull. The percentage of bones identified by using demarcating points is 1% in males and in females it is 8%.
We have added mastoid process breadth as new parameter [8]. We have calculated it on Right and Left side separately. This parameter is statistically highly significant with higher values in males than the females. The mean value for male is 41.19 mm and for Female is 39.19 mm on Right side. On Left side it is 41.42 mm for males and 39.25 mm for females. The demarcating point on Right side for males is more than 46.33 mm and for females it is less than 34.74 mm. while on Left side demarcating point for males is more than 46.02 mm and for females is less than 34.36 mm.

Conclusion
In the present study we have studied 100 male and 100 female skulls gathered from various medical colleges in Maharashtra. In total seventeen parameters were taken and analyzed statistically. We have derived six indices from them. All these parameters and indices were subjected to routine statistical methods by applying student's 't' test (unpaired) and getting the 'p' values. Demarcating points were obtained for each parameter and index and also the percentage of bones crossed the demarcating points were determined.

References
1. Deshmukh AG, Devershi DB. Comparison of cranial sex determination by un vicariate and multivariate Analysis. Journal of Anatomical Society of India. 2006; 55(2):1-5.
2. Sangvichien S, Boonkaew K, Chuncharunee A, Komoltri C, Piyawinijwong S, Wongsawut A *et al*. Sex determination in Thai skulls by using craniometry: Multiple Logistic Regression Analysis. Siriraj Medical Journal. 2007; 59(5):216-221.
3. Gray H. Osteology. In: Williams PL, Warwick R, Dyson M, Bannister LH, editors. Gray's Anatomy. 37th ed. Edinburg London Melbourne and New York: Churchill Livingstone, 1989, 395.
4. Krogman WM, Iscan MY. Determination of sex and parturition. The human skeleton in forensic medicine. 2nd ed. Springfield. Illinois. USA: Charles C Thomas, 1986, 189.
5. Hooton EA. The individual life cycle. Up from the ape. 2nd ed. New York; Macmillan Company. 1931; 6:246-247.
6. Ashley Montagu MF. Methods of measurement. A handbook of anthropometry. 3rd ed. Springfield. Illinois. USA: Charles C Thomas, 1960, 63.
7. Frayer DW, Wolpoff MH. Sexual Dimorphism. Ann Rev Anthropol. 1985; 14:429-473.
8. Scheuer L. Application of Osteology to Forensic Medicine. Clinical Anatomy. 2002; 15:297-312.110
9. Armitage P, Berry G. Statistical methods in medical research. 3rd ed. Oxford London: Blackwell scientific publications, 1994.
10. Gapert R, Black S, Last J. Sex determination from the foramen magnum: discriminant function analysis in an eighteenth and nineteenth century British sample. Int J Legal Med. 2009; 123:25-33.