A STUDY ON THE NORMAL VALUES OF INNER CANTHAL, OUTER CANTHAL, CANTHAL INDEX, INTERPUPILLARY DISTANCE AND HEAD CIRCUMFERENCE OF 23 - 42 YEARS IGBOS.

E. A. OSUNWOKE, A. ELEKWA, I. F. BOB-MANUEL AND S. O. OJEKA

ABSTRACT

Inner intercanthal distance is the measurement of the distance between the two medial canthi of the eyes, while outer intercanthal distance is the measurement of the distance between the lateral canthi of the eyes. Interpupillary distance is the distance between the pupils, measured from the center of one eye to the centre of the other eye when the eyes are focused on infinity. A study on the normal values of outer intercanthal, inner intercanthal distance, canthal index, head circumference, near and far interpupillary distance was conducted in 23-42 years old Igbos. A total number of 1000 subjects comprising 500 males and 500 females were recruited for this study. Measurements were obtained by using a vernier caliper on the medial and lateral angles of the eyes, while a non stretchable tape was used to measure the head circumference. Canthal index was derived by dividing the inner intercanthal distance by the outer intercanthal distance and multiplying by 100. Near and far interpupillary distances were derived by the use of a meter rule. Results showed that there was change of means with advancing age for the measured dimensions. The mean for the outer intercanthal distance was 102.06±4.43mm and 102.09±4.54mm for males and females respectively. Canthal index was 36.72±3.65 and 36.75±4.90 for males and females respectively. The head circumference, near and far interpupillary distance were 59.25±6.45 cm and 59.44±4.98 cm, 68.28±5.08mm and 68.45±5.12mm, 74.9±4.11mm and 74.5± 4.03mm respectively for males and females. There was no significant difference ($p < 0.05$) between the males and females in the measured parameters and the canthal index. This study has provided a database for this Igbo population and may assist craniofacial surgeons during surgery.

KEYWORDS: Normal values, outer and inner intercanthal distance, head circumference, Igbos.

INTRODUCTION

Craniofacial anthropometry is a technique used in physical anthropology comprising precise and systematic measurement of bones of the human skull (Juberg and Sholte, 1975). Craniofacial dimensions may be determined by a single gene, gene groups or environmental factors (Poswillo, 1963). For effective comparison with other population means, groups must be matched at each age, sex and ethnic origin (Evereklioglu *et al,* 2002). In diagnosing certain anomalies and syndromes, abnormal facial features such as telecanthus, ocular hypertelorism or hypotelorism are taken into consideration by many clinicians, geneticists and maxillofacial surgeons. Measurements become stable once it has reached adult level in

E. A. Osunwoke, Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt. Rivers State, Nigeria.
A. Elekwa, Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt. Rivers State, Nigeria.
I. F. Bob-Manuel, Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt. Rivers State, Nigeria.
S. O. Ojeka, Department of Physiology, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria.

the mid to late twenties (Fledelius and Stubgaard, 1986). Dysmorphologist employs canthal measurements in evaluating the degree of hypertelorism while dentist employs inner canthal distances as a reliable predicator of maxillary canal incisor width when it is multiplied by a decreasing function value of the geometric progression term and then divided by two (Abdullah, 2002). Standard values of inner intercanthal, outer-intercanthal, and inter-pupillary distances have been described to be very useful in the diagnosis of neural crest migration anomalies such as Waardenburg syndrome (Kitaoka *et al*, 2001).

Hofstertter, (1972) carried out a study of adult white males from the United States of America. The mean interpupillary distance for his sample set was between 65 and 66mm, 90% of the subjects lie between 60 and 70mm, 98% between 55 and 75mm. He asserts that the mean for the adult white American female will be 2 to 3mm less than the mean for the males, and probably about 20%of adult white American females have an eye separation less than 55mm. Bray *et al.,* (1969), have shown that the occipitofrontal head circumference accurately reflects the intracranial volume and therefore can be taken as a reliable indicator of brain size. Foetal weight estimate can be obtained with head circumference measurement, though for more accurate results two parameters namely abdominal circumference and head circumference should be utilized.

Omotode (1990) carried out a research on facial measurements in newborn to access syndrome delineation. Inner and outer intercanthal distances, palpebral fissure length, occipitofrontal circumference, and canthal index values were determined and compared between 252 white newborns in Cardiff and 256 black newborns in Ibadan, Nigeria. The study showed that the white and black newborns had the same inner intercanthal distance while the outer intercanthal distance and palpebral fissure length were significantly smaller in the white newborns than in their black counterparts.

This study is aimed at determining the normal values of these craniofacial measurements and the canthal index in a South Eastern Nigerian adult population.

MATERIALS AND METHODS

A total number of one thousand (1000) subjects from Igbo (500 males and 500 females) were selected for this study. The subjects were within the age range of 23-42 years with normal craniofacial configuration and no known history of neurologic disease, developmental disability, oculofacial trauma, craniofacial congenital anomaly, strabismus and clinically manifest telecanthus and also if their parents up to the second or third generation are of the same tribe. This was determined by physical observation and by personal interview. Those found to have one form of disability or the other were excluded from this study. The age of each subject was determined according to the nearest birthday. Subjects were recruited from Federal University of Technology Owerri, University staff school Owerri, Imo State polytechnic, Umuagwo-ohaji, Abia State polytechnique Aba and University of Enugu teaching hospital Enugu.

After informed consent was obtained from the subjects, measurements of inner and outer intercanthal distance, head circumference and interpupillary distance was performed. The mean values for each parameter was noted at each age from 23- 42 years and analyzed to statistically assess the anthropometric variation patterns of each parameter with advancing age. Measurements were carried out using a millimeter ruler, a vernier caliper and calibrated tape. This is because this study is primarily designed to observe the anthropometric variation pattern of measured parameters with advancing age. Each subject was seated comfortably in a chair with the subjects head at the same level as and 40 cm in front of the examiner's head. The subject's face was well illuminated. A digital vernier caliper was used for the measurement of the intercanthal distances. Each measurement was carried out twice to ensure accuracy. The inner inter-canthal distance was measured by having the subject look straight at the examiner while the digital vernier caliper was placed in between the bridge of the subject's nose. The subject was instructed to look upward for the outer intercanthal distance to be measured. This is to maximize the contrast between the sclera and the skin. The canthal index (inner intercanthal / outer intercanthal distance in centimeters × 100) was calculated from the data. (Evereklioglu *et al.,*2001). For near interpupillary distance, the examiner's right eye is closed, while the subject had to binocularly fixate a finger held up to the open left eye of the examiner. The zero mark on the ruler was placed at the outer (temporal) limbus margin of the subject's right eye while the examiner sighted with his open left eye the point of the ruler that corresponded to the inner limbus of the subject's left eye. Then the examiner had to close his left eye and ask the

subject to look at the examiner's opened right eye moving the fixation finger to the open right eye. This made both eyes to move to the right and as a result, "O" is no longer aligned with the outer (temporal) limbus of the subject's right eye. Measurement of the new position of the nasal limbus of the subject's left eye was taken. This was the measurement of the far/ distant interpupillary distance. Head circumference was obtained by placing the tape just on the external occipital prominence and the supraorbital ridges. Subjects with fashionable hair styles had their hair compressed as much as possible and the tape tightly drawn. In girls with braids, the tape was placed against the skin and not over the lump of hair.

Statistical analysis was done using SPSS for windows and multiple comparisons were made between the measured parameters, groups and sex by using students T-test (Daniel, 1987).
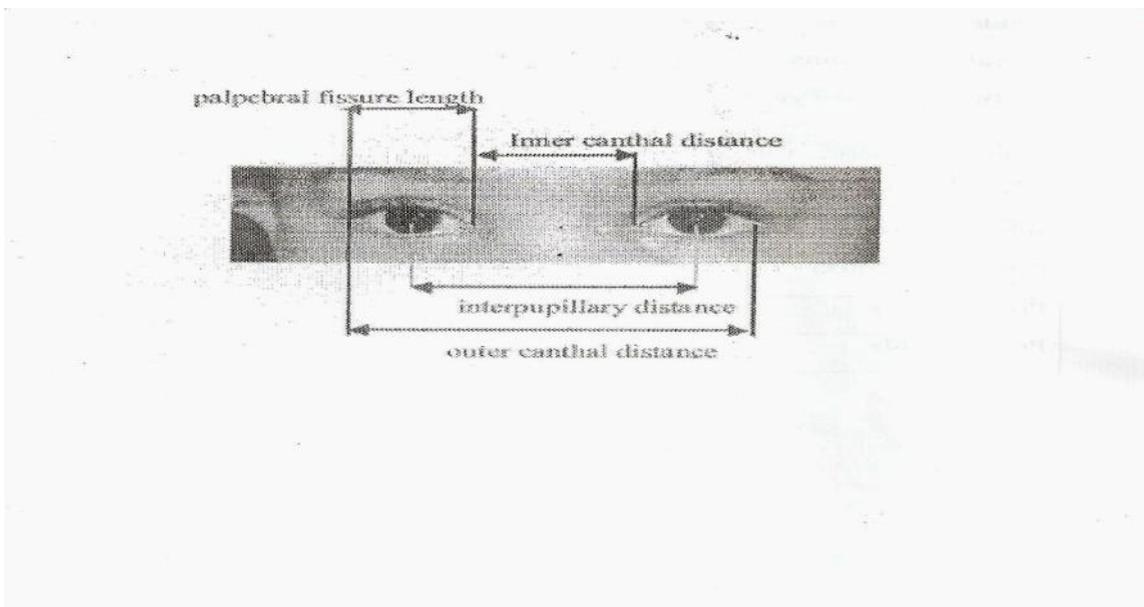

Fig 1: A picture showing canthal measurements. (www.google.com)

RESULTS

The result of this study is presented in the tables below. Table 1. Table showing the mean and standard deviation of the outer intercanthal distance, inner intercanthal distance, canthal index, head circumference, near and far interpupillary distance of Igbo males and females. The results showed that there was no significant difference between the Igbo males and females.

Table 2. Table showing mean and standard deviation of outer intercanthal distance, inner intercanthal distance, canthal index, head circumference, near and far interpupillary distance of Igbo males and females by age. The results revealed that among the Igbos, in ages 23-27, 28-39, there was a significant difference in the canthal index between the males and the females, while the other ages studied had no significant difference. Table 2.

Table 1: Table showing measurements of outer canthal distance, inner canthal distance, near interpupillary distance, far interpupillary distance, canthal index and head circumference in 500 males and 500 females.

Sex	N	HC (cm) Mean±SD	ICD (mm) Mean±SD	OCD(mm) Mean±SD	CI Mean±SD	NIPD(mm) Mean±SD	FIPD(mm) Mean±SD
MALES	500	59.25± 6.46	37.61±4.49	102.07±4.43	36.72±3.65	68.28±5.08	74.9±4.11
FEMALES	500	59.44±4.98	37.70±4.93	102.09±4.54	36.75±4.90	68.45±5.12	74.5±4.03

Total number of subjects= 1000 subjects. N= number of subjects, OCD= Outer canthal distance, ICD= Inner canthal distance, NIPD = Near Interpupillary distance, FIPD= Far Interpupillary distance, CI= Canthal Index, HC= Head Circumference.

Table 2: Table showing mean and standard deviation of measurements of outer canthal distance, inner canthal distance, near interpupillary distance, far interpupillary distance, canthal index and head circumference in Igbo males and Females by age.

Sex	Age	N	OCD (cm) Mean±SD	ICD (mm) Mean±SD	NIPD (mm) Mean±SD	FIPD (mm) Mean±SD	CI Mean±SD	HC (mm) Mean±SD
Males								
	23-27	134	102.89±0.86	41.53±0.81	65.07±1.38	74.21±1.47	40.62±1.09	61.25±0.94
	28-32	105	103.13±1.42	39.22±2.15	66.62±1.92	76.60±1.98	40.10±2.09	61.38±0.48
	33-37	80	102.47±0.59	40.08±1.76	65.07±1.82	75.30±2.01	38.88±1.60	61.29±3.83
	38-42	181	100.91±0.86	39.97±0.68	65.33±1.01	75.16±1.28	39.89±0.58	61.77±0.43
Females								
	23-27	114	102.59±0.74	37.05±1.17	66.64±0.42	75.78±0.82	36.39±1.15	60.13±0.96
	28-32	80	100.70±1.30	38.62±2.76	67.22±0.48	76.04±1.53	36.72±1.39	60.64±2.26
	33-37	74	101.75±1.63	38.82±0.96	66.37±0.46	75.16±1.22	38.13±1.13	63.31±2.94
	38-42	232	101.28±1.95	39.02±1.60	66.37±0.91	75.89±0.74	38.60±1.45	62.18±1.04

Total number of subjects= 1000 subjects. N= number of subjects, OCD= Outer canthal distance, ICD= Inner canthal distance, NIPD = Near Interpupillary distance, FIPD= Far Interpupillary distance, CI= Canthal Index, HC= Head Circumference.

DISCUSSION

The results of this study have shown that there was no significant difference between the Igbo males and females. In this study the mean of the overall head circumference was 59.25± 6.46 and 59.44±4.98 cm for males and females respectively. This agrees with the work carried out by Faruk, (2006) in which he found the head circumference of a Turkish population to be 58.0cm and 55.9cm for men and women respectively. The values obtained for head circumference in this study is also in line with that obtained by Osuobeni and Al-Musa, (1993), 57.43±1.46 cm and 56.57±1.24cm for male and female children respectively. For the near and far interpupillary distances, there was no significant difference (p>0.05) between the males and the females. The values obtained from this study were higher than that obtained by Hofstetter (1972), for adult white males in United States. The mean interpupillary distance (IPD) was between 65mm and 66mm, 90% of subjects were between 60 and 70mm, and in 99.8% between 55 and 75mm, He also revealed that the mean IPD of adult white American females will be 2-3mm less than the value for males and that it is probable that about 2% of adult white American females have an eye separation less than 55mm.

The values from this study were also higher than that obtained by Dodgson, (2004) on American adult males and females. The mean

adult interpupillary distance was 63mm, the vast majority of adults have IPDs in the range 50–75 mm, the wider range of 45–80 mm was likely to include all adults, and the minimum IPD for children (down to five years old) was 40 mm, Ngeow et al., (2005), IPD ranged from 53.0mm to 73.0mm with a mean of 63.2 ± 3.3mm. IPD was higher in males (mean 64.6± 3.2mm) than females (mean 61.2± 3.0mm), Waardenburg (1951), overall far inter-pupillary distance for men and women were 65.3mm and 62.7mm respectively.

The overall inner intercanthal and outer intercanthal distances obtained from this study are 37.61±4.49mm and 102.07±4.43mm for males, and 37.70±4.93mm and 102.09±4.54mm for females respectively. These values were higher than that obtained by Osuobeni and Al-Musa (1993) for inner intercanthal and outer intercanthal distances 31.90±2.41mm, 89.29 ± 4.34mm, for males and 31.45 ± 2.65mm, 87.71 ± 4.11mm, for female children respectively, Freihofer (1980); Murphy and Laskin (1990) the mean intercanthal distance in the black population was 31.2 ± 2.5 mm and 33.9 ± 3.0mm respectively. The values obtained by Oladipo et al.,(2009) were lower than that obtained from this study for inner intercanthal distance 3.40 and 3.00cm for males and females respectively, while that obtained for outer intercanthal distance 13.10cm and 12.10cm for males and female Urhobo's respectively were than that obtained from this study. The overall mean value of the canthal index gotten from this study were higher than that obtained by Oladipo et al., (2009), 24.38 and 29.38 respectively for Urhobo males and females, while that obtained for Itsekiri males and females were 26.03 and 27.07 respectively.

CONCLUSION

Craniofacial measurements should be performed with the same standards world wide. The data obtained will provide a guide when making a clinical assessment of telecanthus, ocular hyper and hypotelorism and in early treatment of craniofacial abnormalities and various syndromes. This information is of importance in forensic investigations, clinicians and craniofacial surgeons during facial reconstruction.

REFERENCES

Abdullah, M. A., Huda, D. S., Yousef, F. T and Nazeer, K., 2002. The Significance of Inner Canthal distance in Prosthodontics. Saudi Dental Journal; 1013 - 9052.

Bray, P. E., Shield, W. N., Wilcott, G. J and Madsen, J. A., 1969. Occipital-frontal Head circumference, an accurate measure of intracranial. Journal of peadiatrics. (75): 303.

Cem, Evereklioglu., Cengiz, Yakinci., Hamdi, Er., Selim, Doganay and Yasar, Durmaz., 2001. Normative values of craniofacial measurements in idiopathic benign macrocephalic children. The cleft Palate Craniofacial Journal 38, (3): 260 -263.

Cem, Evereklioglu., Doganay, S., Er, H., Gunduz, A., Tercan, M., Balat, A and Cumurcu, T., 2002. Craniofacial anthropometry in a Turkish population.Cleft palate Craniofacial Journal, 39, (2): 208 -18.

Daniel, W. W., 1987. Biostatistics. A Foundation for Analysis in the Health Science. New York: John Wiley and sons. 207- 218.

Dodgson, N. A., 2004. Variation and extrema of human inter-pupillary distance. Proc. SPIE (5291): 36-46.

Faruk, O., 2006. Normal periocular anthropometric, measurements in the Turkish population. Ophthalmol Epidemiology, (13): 145 -149.

Fledelius, H. C and Stubgaard, M., 1986. Changes in eye position during growth and adult life as based on exophthalmometry, interpupillary distance and orbital distance measurements. Acta Ophthalmol. (64): 481-486.

Freihofer, H. P. M., 1980. inter canthal and interorbital distances. Journal of maxillofacial surgery, volume (8): 324-326.

Hofstetter, H. W., 1972. Measurement of inter-pupillary distance of adult white males from U.S.A. Journal of American Optometric Association (54): 108 -110.

Juberg, R. C., Sholte, F. G and Touchstone, W. J., 1975. Normal values for intercanthal distance

of 5-11 years old American Blacks. Paediatrics, (55): 431-436.

Kitaoka, T., Tsuda, Y., Deguchi, H., So, K., Tsuiki, E., Kinoshita, A., kishikawa, Y and Amemiya, T., 2001. Standard values of inter-inner canthal, inter-outer canthal, and interpupillary distances in normal Japanese infants and children. Nippon Ganka Zasshi, 105, (6): 411-4.

Murphy, W. K., Laskin, D. M and Richmond, M. S., 1990. Inter canthal and inter pupillary distance in the black population. Oral Surgery, Oral Medical Pathology. (69): 676 - 680.

Ngeow, W. C., Akan, A and George, J. M., 2005. The intercanthal and interpupillary distance in An   Asian population. Pub Med, 41, (1): 22-7.

Oladipo Gabriel, S., Fawehinmi Hakeem, B and Okoh Peter, D., 2009. Canthal indices of Urhobo and Itsekiri ethnic groups. Australian Journal of Basic and Applied Sciences, 3, (4): 3093-3096.

Omotade, O. O., 1990. Facial measurements in newborn (toward syndrome delineation). Journal of. Medical. Geneticcs (27): 358-362.

Osuobeni, E. P and Al-Musa, K. A., 1993. Gender difference in interpupillary distance among Arabs. Optm Vis Sci. (70): 1027-1030.

Poswillo, D., 1963. Causal mechanisms of craniofacial deformity. Journal of Tropical Pediatrics. 78:29.

Waardenburg, P. J., 1951. A new syndrome combining development anomalies of the eyelids, eyebrow and nose root with pigmentary defects of the iris and head hair with congenital deafness. American Journal of Human Genetics. (31): 195-253.