Determining the Relationship Between Craniofacial and Dental Measurements in a Nigerian Population and its Usefulness in Maxillary Anterior Teeth Selection

***Omotayo A. OREMOSU, *Yetunde O. AJAYI, **Uchenna P. EGBUNAH**

[**Department of Restorative dentistry, College of Medicine, University of Lagos/Lagos University Teaching Hospital, Lagos, Nigeria.*
***Department of Oral and Maxillofacial Surgery, Lagos University Teaching Hospital, Lagos, Nigeria.]*

Correspondence
Omotayo A. Oremosu
Department of Restorative Dentistry,
Faculty of Dental Sciences, College of Medicine
University of Lagos,
Idi-Araba, Surulere, Lagos State
E mail: ooremosu@unilag.edu.ng

ABSTRACT

Objective: Maxillary anterior teeth selection for an edentulous patient is carried out majorly to achieve pleasant aesthetics. Facial measurements are one of the most frequently used measures for estimating maxillary teeth size however; these measures have not been proven to be useful in the Nigerian population. This study aimed to determine if craniometric and facial measurements can be used to predict intercanine width (ICW) in the Nigerian population.

Methods: The study was a descriptive cross-sectional study conducted at the Prosthodontics clinic, in the teaching hospital. An interviewer administered questionnaire was used to collect data on socio-demographic characteristics. Craniofacial and dental measurements including: circumference of the head (COH), innercanthal distance (ICD), interalar width (IAW), intercommisural width (ICoW) and ICW were also collected for all participants.

Results: A total of 120 subjects aged 18–48years participated in this study. Of the 120 participants, 58 were male and 62 were female. Craniometric and facial measurements were greater in men than women with significant differences for all variables tested ($p \leq 0.01$). No significant difference was seen between men and women for ICW ($p>0.05$). Among all the craniofacial measurements, only IAW showed significant correlation with ICW ($r=0.218$; $p<0.05$). Logistic regression was used to assess predictability and only IAW provided significant predictability for ICW. ICW can be calculated using the formula: ICW= 45.845+ (0.215 x IAW).

Conclusion: The study showed that craniofacial measurements are significantly higher in men than women and that IAW can be used to predict ICW in the Nigerian edentulous population.

Keywords: Intercanine width, measurements, Interalar width, Circumference of head

Omotayo A. Oremosu
https://orcid.org/0000-0003-0551-8020
Yetunde O. Ajayi
https://orcid.org/0000-0002-8708-0802
Uchenna P. Egbunah
https://orcid.org/0000-0002-3354-9732

Submitted: 28th August, 2020
Reviewed: 9th September, 2020
Accepted: 5th December, 2020

Citation: Oremosu OA, Ajayi YO, Egbunah UP. Determining the relationship between craniofacial and dental measurements in a Nigerian population and its usefulness in maxillary anterior teeth selection. Nig J Dent Res 2021; 6(1):98-108.

INTRODUCTION

A complete denture fabricated for an edentulous patient should perform the function of a normal dentition, allow for eating and speaking, and it must be aesthetically pleasing.[1] Anterior maxillary teeth selection is carried out majorly to achieve pleasant aesthetics,[2] and this requires adequate understanding of both physical and biological factors directly related to individual patient features.[3] However, aesthetic issues in anterior teeth selection arise due to individual anatomical variations especially in the absence of pre-extraction records.[3] In edentulous patients, the size, shape and position of the maxillary anterior teeth are not only important for dental aesthetics, but for facial aesthetics as well.[4] The lower teeth are usually set up to complement the arrangement of the maxillary teeth making the size, shape and position of maxillary anterior teeth of paramount importance.

Choosing the size of the anterior teeth is one of the most important decisions to make when selecting maxillary anterior teeth. History has recorded several methods of determining tooth size from the use of dimensional measurements of the maxilla to the use or incorporation of facial or anthropological measurements.[4] Facial measurements are one of the most frequently used measures for estimating maxillary teeth size in edentulous patients especially when pre-extraction records are not available. Some of these measurements include the bizygomatic width (BZW), the interpupillary distance (IPD), the interalar width (IAW), the inner canthal distance (ICD), the intercommissural width (ICoW), and other anatomical structures.[5-7] Studies have also purported the use of the circumference of the skull to estimate the intercanine width (ICW).[8]

These craniofacial measurements have been proven to be useful in the Caucasian population in selection of denture maxillary anterior teeth, therefore, there is a need to investigate the Nigerian population.[9] Only two studies have reported the relationship between these measurements and the size of the maxillary anterior teeth in Nigerians. A study conducted in Nigeria[9] to determine the size of anterior maxillary teeth using facial anatomic landmarks reported a significant correlation between the horizontal width of the philtrum of the lip and the width of the central incisors. However, no anatomic facial landmark provided significant predictive value for intercanine width. Another study conducted in Nigeria,[10] to evaluate the relationship between the maxillary intercanine width and measures of facial proportion reported a similar result but suggested that 1.75-2.45cm be subtracted from the ICoW to determine the ICW. These two studies did not provide conclusive evidence of a relationship between facial measurements and the size of maxillary anterior teeth. They also did not assess the relationship between craniometric measurements and maxillary intercanine width.

There is a need for establishing a scientific basis for anterior teeth selection as there is no universally accepted method to determine the width of the incisors, hence the need for more research to investigate if craniofacial measurements can be used to estimate the size of missing anterior teeth in edentulous patients. This study aimed to determine if a relationship exists between craniometric measurements, facial measurements and dental measurements in the Nigerian population as this could assist dental practitioners in the selection of maxillary anterior teeth in edentulous patients without pre-extraction records. The objectives addressed were: to determine the correlation between craniofacial measurements and the maxillary intercanine width and to determine if these craniofacial measurements can serve as predictors for maxillary intercanine width in the Nigerian edentulous population.

MATERIALS AND METHODS

Study Design: The study was a descriptive cross-sectional study to determine the correlation between craniofacial and dental measurements and determine if such measurements can be used in the selection of maxillary anterior teeth in edentulous patients without pre-extraction records. The study was carried out in the Prosthodontics clinic, in a teaching hospital in Lagos, Nigeria. The study population included newly graduated dentists, dental students, dental surgery assistants, dental technologists, dental hygienists and dental patients attending the Restorative dentistry clinic of the teaching Hospital.

Sample size determination: Since there were no studies available on the prevalence of artificial prosthesis use in replacing maxillary anterior teeth, a convenient sample size was adopted. A similar study[9] conducted in Nigeria used a convenient sample size of 115 participants. This was rounded up to 120 and was adopted for this study.

Population selection: All newly graduated dentists, dental students, dental nurses, dental technologists and dental hygienists attending the Restorative

dentistry clinic of the teaching hospital that met the inclusion criteria were included in the study. Patients selection was done daily. Every second patient who presented at the restorative dental clinic and met all inclusion criteria were selected for the study.

Inclusion criteria included sample population aged 18 years and above with full complement of upper and lower teeth, class I canine relationship, fully erupted teeth, healthy state of gingiva and periodontium; participants with absence of maxillary anterior caries, tooth fracture, attrition, malocclusion, congenital anomalies (like microdontia, macrodontia, hypodontia, hyperdontia, etc.), or past facial surgery, and those willing to participate in the study. Participants with developmental abnormalities involving the face and head, intracoronal or extracoronal restorations, and midline diastema were excluded from the study.

Data collection: A well structured close ended interviewer administered questionnaire was used to collect data from the participants. It included information on socio-demographic characteristics (such as age, sex and designation), craniometric, facial and dental measurements. All measurements were taken with the patient seated at an upright relaxed position. Measurements were conducted using non stretchable measuring tape for skull circumference, dental floss, plastic rule for ICW and digital stainless steel veneer caliper for facial measurements, as described in previous studies.[8] Training session for all measurements was done and an ideal protocol established. All measurements were carried out by the third author (UPE) following strict calibration and standardization protocols developed during training session with (OAO)and (YOA). All measurements were taken three times and the average recorded. Intra-examiner reliability was calculated at 99% for all measurements. Adequate standard precautions and infection control protocols were observed during measurements. The techniques for recording craniometric, facial and dental measurements are described below; with picture representation of each technique (the recordings on the images do not represent the actual values for participants).

Circumference of the head (COH): We measured maximal fronto-occipital length by placing a non-stretchable measuring tape (calibrated in millimeters) just on the occipital prominence and the supraorbital ridges while seating the patient in an upright relaxed position. Female participants were asked to remove their wigs and lift their hair away from the measured area to avoid errors in measurements.

Facial measurements: Facial parameters measured included: the inner canthal distance (ICD – between the two medial canthi), interalar width (IAW – between the most outward curve/the most lateral part of the alar of the nose, from left to right), and the intercommisural width (ICoW – between the left and right lip commissures). All facial measurements were done using a digital veneer caliper (which was calibrated/ reset to zero before next measurement). The recording parts of the caliper were made to just contact the reference points on the face without applying pressure, and then measurements were recorded.

Dental measurements: Dental parameter to be measured is the intercanine width (ICW). The ICW was measured indirectly using a dental floss. The dental floss was marked on one end prior to placement in the mouth. Using that point as reference, the dental floss is then extended from the distal surface of one canine along the greatest curvature of the maxillary arch to the distal surface of the contralateral canine which is then marked with dental floss in-situ by the first author (OAO). Length of floss was then measured on a plastic meter rule.

Ethical Considerations: The data collection procedure was fully explained to all participants in the study and written informed consent was obtained before commencement of data collection and use of clinical photographs. Participants were made to understand the scope of the study including the procedure for conducting measurements and they were allowed to ask questions.

Ethical clearance: The approval for the study was obtained from the Teaching hHspital; Health Research and Ethics Committee (HREC).

Statistical analysis: Data entry, analysis and validation were performed using the SPSS software (version. 22, IBM SPSS Statistics, Chicago, IL, USA). Analysis of variance (ANOVA) test was used to test for comparability between socio-demographic characteristics and craniofacial and dental measurements. Pearson's correlation coefficient was employed to determine the level of correlation between facial and dental parameters. Significance was set at P=0.05. Correlation coefficient r $\leq$0.2 was considered as weak, >0.2-0.5 as moderate, >0.5-0.7 as strong correlation, >0.7 as very strong correlation. Linear regression was done for individual craniofacial measurements to test their predictability for ICW

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Figure 1: Circumference of the head in male and female subjects

Figure 2: Inner canthal distance (ICD) in male and female subjects

Figure 3: Interalar width (IAW) in male and female subjects

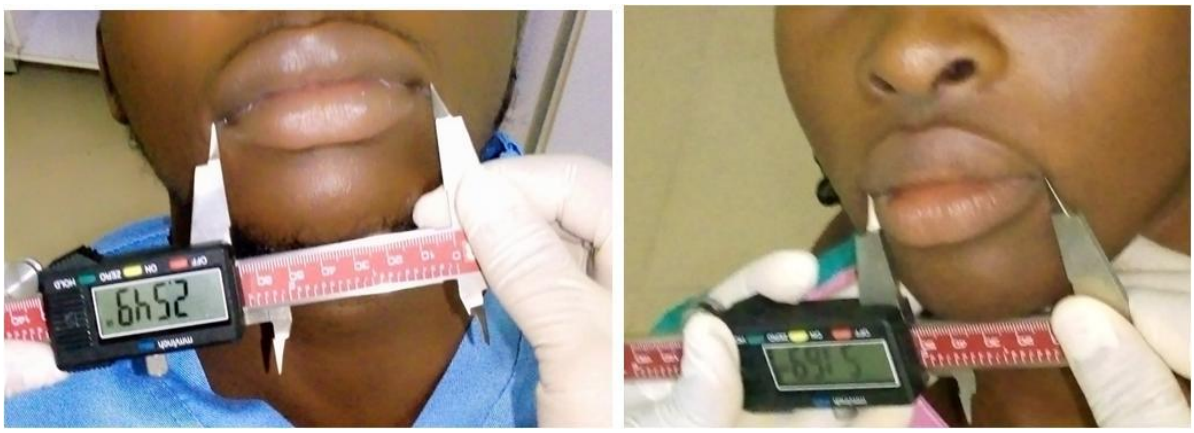

Figure 4: Intercommisural width (ICoW) in male and female subjects

Figure 5: Inter-canine width (ICW) using dental floss and meter rule

RESULTS

A total of 120 subjects aged 18 – 48 years participated in this study. Of the 120 participants, 58 were male and 62 were female; 56 were dentists, 10 were dental students, 11 were dental nurses, 4 were dental technologists, 9 were dental hygienists, and 30 were dental patients.

The descriptive statistics including mean, standard deviation, and minimum and maximum values of all recorded measurements grouped by sex are listed in Table 1. Craniometric and facial measurements were greater in men than women with significant differences for all variables tested ($p \leq 0.01$). However, no significant difference was seen between men and women for ICW ($p>0.05$). In addition, no significant difference was seen when age was matched with craniometric, facial and dental measurements ($p>0.05$).

The correlation matrix including Pearson's correlation coefficient and P-values for all participants is demonstrated in Table 2. Moderate and highly significant correlation was seen between COH and IAW ($r=0.484$; $p<0.01$), COH and ICoW ($r=0.412$; $p<0.01$). Moderate and significant correlation was seen between ICD and IAW ($r=0.208$; $p<0.05$). Strong and highly significant correlation was seen between IAW and ICoW ($r=0.572$; $p<0.01$). Among all the craniofacial measurements, only IAW showed significant correlation with ICW ($r=0.218$; $p<0.05$). Tables 3 and 4 demonstrate the correlation matrix for male and female participants respectively. For male participants, both COH and IAW showed significant correlation with ICW ($r=0.340$; $p<0.01$ and $r=0.299$; $p<0.05$ respectively). For female participants, none of the craniofacial measurements showed significant correlation with ICW ($p>0.05$).

Table 1: Descriptive statistics of craniofacial and dental measurements stratified by sex

Table 2: Correlation matrix for all participants' craniofacial and dental measurements

Correlations		COH	ICD	IAW	ICoW	ICW
COH	r	1	0.089	0.484**	0.412**	0.111
	P		0.334	0.000	0.000	0.228
ICD	r	0.089	1	0.208*	0.168	0.075
	P	0.334		0.023	0.067	0.415
IAW	r	0.484**	0.208*	1	0.572**	0.218*
	P	0.000	0.023		0.000	0.017
ICoW	r	0.412**	0.168	0.572**	1	0.068
	P	0.000	0.067	0.000		0.461
ICW	r	0.111	0.075	0.218*	0.068	1
	P	0.228	0.415	0.017	0.461	

*Correlation is significant; **Correlation is highly significant; r=Pearson correlation coefficient; P=2-tailed significance; COH=circumference of the head; ICD=inner canthal distance; IAW=interalar width; ICoW=intercommisural width; ICW=intercanine width

Table 3: Correlation matrix for male participants' craniofacial and dental measurements

Correlations		COH	ICD	IAW	ICoW	ICW
COH	r	1	-0.089	0.329*	0.286*	0.340**
	P		0.505	0.012	0.029	0.009
ICD	r	-0.089	1	-0.071	0.048	-0.109
	P	0.505		0.597	0.721	0.416
IAW	r	0.329*	0.071	1	0.402**	0.299*
	P	0.012	0.597		0.002	0.022
ICoW	r	0.286*	0.048	0.402**	1	0.004
	P	0.029	0.721	0.002		0.977
ICW	r	0.340**	-0.109	0.299*	0.004	1
	P	0.009	0.416	0.022	0.977	

*Correlation is significant; **Correlation is highly significant; r=Pearson correlation coefficient; P=2-tailed significance; COH=circumference of the head; ICD=inner canthal distance; IAW=interalar width; ICoW=intercommisural width; ICW=intercanine width

Table 4: Correlation matrix for female participants' craniofacial and dental measurements

Correlations		COH	ICD	IAW	ICoW	ICW
COH	r	1	0.019	0.279*	0.171	0.128
	P		0.881	0.028	0.184	0.322
ICD	r	0.019	1	0.197	-0.018	0.154
	P	0.881		0.126	0.891	0.233
IAW	r	0.279*	0.197	1	0.359**	-0.016
	P	0.028	0.126		0.004	0.900
ICoW	r	0.171	-0.018	0.359**	1	0.124
	P	0.184	0.891	0.004		0.336
ICW	r	0.128	0.154	0.016	0.124	1
	P	0.322	0.233	0.900	0.336	

*Correlation is significant; **Correlation is highly significant; r=Pearson correlation coefficient; P=2-tailed significance; COH=circumference of the head; ICD=inner canthal distance; IAW=interalar width; ICoW=intercommisural width; ICW=intercanine width

Linear regression coefficient of ICW using COH, ICD, IAW and ICoW to test for predictability is demonstrated in tables 5, 6 and 7 for all participants, male participants and female participants respectively. Regression equation for predicting dependent variable equals beta unstandardized coefficient for constant plus beta unstandardized coefficient for independent variable multiplied by independent variable[11] i.e. ICW= constant(B) + (COH(B) or ICD(B) or IAW(B) or ICoW(B)) x (COH or ICD or IAW or ICoW).

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For all participants, only IAW provided significant predictability for ICW. The ICW can be calculated using the formula: ICW= 45.845 + (0.215 x IAW). For male participants, both COH and IAW provided significant predictability for ICW. The ICW for males can be calculated using either of the formulas: 1) ICW= 26.882 + (0.507 x COH) or 2) ICW= 43.063 + (0.285 x IAW). No craniofacial measurements provided significant predictability for ICW

Table 5: Linear regression: Predicting ICW using COH, ICD, IAW or ICoW for all participants

Predictor	B	SE (B)	T	P	95% CI for B		R^2 Adjusted
					Lower bound	Upper bound	
Constant	43.886	9.294	4.722	0.000	25.481	62.291	0.004
COH	0.199	0.164	1.213	0.228	-0.126	0.523	
Constant	52.354	3.435	15.243	0.000	45.553	59.155	-0.003
ICD	0.076	0.093	0.819	0.415	-0.108	0.261	
Constant	45.845	3.849	11.910	0.000	38.223	53.468	0.039
IAW	0.215	0.088	2.427	0.017*	0.039	0.390	
Constant	52.043	4.219	12.334	0.000	43.687	60.398	-0.004
ICoW	0.054	0.073	0.739	0.461	-0.090	0.0198	

COH=Circumference of head; ICD=Inner canthal distance; IAW=Interalar width; ICoW=Inter commisural width; ICW=Inter canine width of maxillary anterior teeth; B=beta unstandardized coefficient; SE=Standard error; t=T-statistic; P=significance; CI=Confidence interval; R^2=Coefficient of determination; *significant.

Table 6: Linear Regression: Predicting ICW using COH, ICD, IAW or ICoW for all male participants

Predictor	B	SE (B)	T	P	95% CI for B		R^2 Adjusted
					Lower bound	Upper bound	
Constant	26.882	10.808	2.487	0.016	5.231	48.534	0.100
COH	0.507	0.188	2.704	0.009**	0.131	0.883	
Constant	59.374	4.026	14.747	0.000	51.309	67.440	-0.006
ICD	-0.087	0.106	-0.819	0.416	-0.299	0.125	
Constant	43.063	5.563	7.740	0.000	31.918	54.208	0.073
IAW	0.285	0.122	2.347	0.022*	0.042	0.529	
Constant	55.937	5.386	10.387	0.000	45.149	66.726	-0.018
ICoW	0.003	0.089	0.029	0.977	-0.176	0.181	

COH=Circumference of head; ICD=Inner canthal distance; IAW=Inter alar width; ICoW=Inter commisural width; ICW=Inter canine width of maxillary anterior teeth; B=beta unstandardized coefficient; SE=Standard error; t=T-statistic; P=significance; CI=Confidence interval; R^2=Coefficient of determination; *significant; **highly significant.

DISCUSSION

The number of participants included in this study was similar to the range of sample size employed by past studies.[5,9,12] Participants were of different age groups (18 – 48 years) similar to previous studies[9-11] to assess age comparability with craniofacial and dental measurements. The result showed that no significant relationship exists between age and COH, ICD, IAW, ICoW and ICW for participants above the age of 18 years indicating that results gotten from this study can be applied to any adult age group.

The mean COH of participants (56.67mm± 2.03) was higher than values reported by Banerjee et al.[8] (54.13mm). The mean ICD of participants (36.73mm ± 3.58) was higher than the values reported by Al Wazzan et al.[13] (31.92mm), Arigbede et al (31.7mm),[9] and Deogade et al (26.22mm).[6] The mean IAW of participants (43.38mm ± 3.69) was higher than the values reported by Deogade et al.[6] (38.28mm), Arigbede et al.[9] (38.1mm), Qamar et al.[14] (35.46 mm), and Ibrahimagic et al.[15] (32.2 mm). The mean ICoW of participants (57.85mm ± 4.59) was lower than values reported by Esan et al (74.6mm)[10] but higher than values reported by Arigbede et al.[9] (53.3mm). The mean ICW of participants (55.15mm ± 3.63) was higher than the values reported by Arigbede et al.[9] (47.4mm), Qamar et al.[14] (46.01 mm), Al Wazzan et al.[13] (45.23 mm), Deogade et al.[6] (43.86mm), Ibrahimagic et al.[15] (37.08 mm) and Esan et al.[10] (36.1mm). These variations may be due to differences in techniques of measurements and/or the fact that these measurements were taken in different populations.

The study also showed a statistically significant difference between sex and all craniofacial measurements taken with higher measurements recorded in males (p<0.05). This is similar to results gotten from previous studies performed here in Nigeria[9,10] as well as other international studies.[6,16] The higher values seen in men can be explained by the influence of the male dominance factor, which also accounts for larger size of long bones and height differences seen between men and women.[6] However, although the mean ICW was slightly higher in males (55.75) than females (54.60), this difference was not significant. Similar results were gotten in previous studies.[6, 8-10]

Statistics	Age (years)			COH (mm)			ICD (mm)			IAW (mm)			ICoW (mm)			ICW (mm)		
	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All
Mean	27.10	26.55	26.82	57.59	55.81	56.67	37.80	35.73	36.73	45.66	41.24	43.38	60.28	55.58	57.85	55.75	54.60	55.15
SD	4.75	5.75	5.27	2.03	1.62	2.03	3.80	3.07	3.58	3.18	2.75	3.69	4.55	3.31	4.59	4.51	2.47	3.63
Min	18	18	18	53.70	52.87	52.87	31.69	29.38	29.38	36.50	34.50	34.50	45.67	49.39	45.67	49.00	48.00	48.00
Max	46	48	48	64.00	59.27	64.00	59.00	42.08	59.00	52.18	47.98	52.18	70.35	61.75	70.35	65.00	63.00	65.00
MD		0.550			1.774			2.078			4.421			4.701			1.150	
F		0.330			28.137			10.906			66.643			42.326			3.050	
P		0.567			0.000**			0.001**			0.000**			0.000**			0.083	

**Highly significant, SD=standard deviation; Min=minimum value; Max=maximum value; MD=mean difference; F=ratio of mean squares; P=significance; COH=circumference of the head; ICD=inner canthal distance; IAW=interalar width; ICoW=intercommisural width; ICW=intercanine width

Table 7: Linear regression: Predicting ICW using COH, ICD, IAW or ICoW for all female participants

Predictor	B	SE (B)	T	P	95% CI for B		R^2 Adjusted
					Lower bound	Upper bound	
Constant	43.736	10.886	4.018	0.000	21.961	65.512	0.000
COH	0.195	0.195	0.998	0.322	-0.195	0.585	
Constant	50.194	3.672	13.670	0.000	42.849	57.538	0.007
ICD	0.123	0.102	1.204	0.233	-0.082	0.328	
Constant	55.202	4.792	11.521	0.000	45.618	64.787	-0.016
IAW	-0.015	0.116	-0.127	0.900	-0.247	0.217	
Constant	49.447	5.322	9.291	0.000	38.801	60.093	-0.001
ICoW	0.093	0.096	0.969	0.336	-0.099	0.284	

COH=Circumference of head; ICD=Inner canthal distance; IAW=Inter alar width; ICoW=Inter commisural width; ICW=Inter canine width of maxillary anterior teeth; B=beta unstandardized coefficient; SE=Standard error; t=T-statistic; P=significance; CI=Confidence interval; R^2=Coefficient of determination.

Among all the craniofacial measurements taken for all participants, IAW was the only significant predictor of ICW showing moderate and significant positive correlation (r = 0.218; p<0.05). This result was similar to values of previous studies[6, 9,17-19] which reported significant correlation between IAW and ICW, although some studies reported a negative correlation.[6, 9] The amount of variation of ICW that could be explained by IAW was only 3.9% (R^2 adjusted= 0.039). The Pearson's correlation coefficient (r) between IAW and other craniofacial measurements were also significant showing moderate and highly significant correlation with COH (r = 0.484; p<0.01), moderate and significant correlation with ICD (r = 0.208; p<0.05), and strong and highly significant correlation with ICoW (r = 0.572; p<0.01). When results were stratified by sex, both COH and IAW were significant predictors of ICW in male participants. COH showed a moderate and highly significant positive correlation with ICW (r = 0.340; p<0.01) and IAW showed a moderate and significant positive correlation with ICW (r = 0.299; p<0.05). The amount of variation of ICW that could be explained by COH and IAW were 10% (R^2 adjusted= 0.100) and 7.3% (R^2 adjusted= 0.073) respectively.

Hoffman et al.[17] conducted a similar study in an American population and reported that ICW could be estimated by multiplying IAW by 1.31. Abdullah et al.[18] and al-el-Sheikh et al[19] reported that ICW could be estimated by IAW multiplied by 1.26 or IAW multiplied by 1.56 respectively in Arab population. Deogade et al.[6] in a similar study in Indian population reported an estimated ICW as IAW multiplied by 1.14. Deogade et al.[6] also reported a multiplying factor of IAW as 1.07 for estimated ICW in males. Two previous studies[9, 10] conducted in Nigerian population did not report any significant predictor of ICW. This present study reported that ICW could be estimated by IAW multiplied by 0.215 and result added to constant 45.845 (ICW= 45.845 + 0.215 IAW). Although this result was gotten from a moderate correlation between IAW and ICW, the existence of this formula suggests that IAW could be used as a predictor for the estimation of ICW in the adult Nigerian population. Limitations of this study included the small sample size, as a larger sample size would have given a more representative result. Also, methods of measurements differed from past studies, with limited studies reporting on craniofacial measurements in the Nigerian population limiting comparability of results.

CONCLUSION

The analysis of craniofacial measurements and dental measurements showed moderate or strong correlations between COH and IAW, COH and ICoW, ICD and IAW, IAW and ICoW, and IAW and ICW. Only IAW was a significant predictor of ICW. Within the limitations of the present study, the following conclusions were drawn:

- The mean values for COH, ICD, IAW, and ICoW were significantly higher in men than women
- The Pearson's correlation coefficient for ICD and ICoW were not statistically significant even when values for men and women were analyzed separately. Hence, based on the results of this study, the ICD and ICoW cannot

be used as facial measures in the selection of size of maxillary anterior teeth in an edentulous patient without pre-extraction records.

- The Pearson's correlation coefficient for IAW and ICW was positive and moderate (r= 0.218).
- For male participants, the Pearson's correlation coefficients for COH and ICW and IAW and ICW were positive and moderate (r= 0.340 and r= 0.299 respectively).
- The formula for calculating ICW for either male or female participant is ICW= 45.845 + (0.215 x IAW). And the specific formulas for calculating ICW in males are 1) ICW= 26.882 + (0.507 x COH) or 2) ICW= 43.063 + (0.285 x IAW).

Source of Support
Nil.

Conflict of Interest
None declared

REFERENCES

1. Roumanas ED. The social-solution denture aesthetics, phonetics and function. J Prosthodont 2009: 18(2):112-115.
2. Gomes VL, Gonçalves LC, do Prado CJ, Junior IL, de Lima Lucas B. Correlation between facial measurements and the mesiodistal width of the maxillary anterior teeth. J Esthet Restor Dent 2006; 18:196-205.
3. Alsaadi M. Use of Facial Indicator for Choosing Anterior Teeth (Female Arabs and Persians Students). Adv Dent Oral Health 2016. doi: 10.19080/adoh.2016.01.555566.
4. Kumar MV, Ahila SC, Devi SS. The science of anterior teeth selection for a completely edentulous patient: A literature review. J Indian Prosthodont Soc 2011; 11:7-13
5. Ellakwa A, McNamara K, Sandhu J, James K, Arora A et al. Quantifying the selection of maxillary anterior teeth using intraoral and extraoral anatomical landmarks. J Contemp Dent Pract 2011; 12:414-421.
6. Deogade SC, Mantri SS, Sumathi K, Rajoriya S. The relationship between innercanthal dimension and interalar width to the intercanine width of maxillary anterior teeth in central Indian population. J Indian Prosthodont Soc 2015; 15:91-97.
7. Özdemir H, Köseoglu M. Relationship between different points on the face and the width of the maxillary central teeth in a Turkish population. J Prosthet Dent 2019; 122(1):63-68.
8. Banerjee R, Chahande J, Radke U, Jaiswal P. Evaluation of the role of skull anthropometry for complete denture teeth selection: A cross-sectional study. J Indian Prosthodont Soc 2018; 18:42-46.
9. Arigbede A, Igwedibia P. Size of Maxillary Anterior Teeth in Relation to Selected Facial Anatomic Landmarks among a Group of Subjects in Port Harcourt. Br J Med Med Res 2016; 14:1-6.
10. Esan TA, Oziegbe OE, Onapokya HO. Facial approximation: Evaluation of dental and facial proportions with height. Afr Heal Sci 2012; 12:63-68.
11. Laerd statistics. Linear Regression Analysis using SPSS Statistics; SPSS training, https://statistics.laerd.com/spss-tutorials/linear-regression-using-spss-statistics.php (2020).
12. EL-Sheikh NMA, Mendilawi LRB, Khalifa N. Intercanthal distance of a Sudanese population sample as a reference for selection of maxillary anterior teeth size. Sudan J Med Sci 2010; 5(2):117-121.
13. Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. J Prosthet Dent 2001; 86:608-612.
14. Qamar K, Hussain MW, Naeem S. The role of the interalar width in the anterior teeth selection. Pak Oral Dental J 2012; 32:569-573.
15. Ibrahimagic L, Celebic A, Jerolimov V. correlation between the size of maxillary frontal teeth, the width between Alae Nasi and the width between corners of the lips. Acta Stomatol Croat 2001; 35:175-179.
16. Patel JR, Sethuraman R, Naveen YG, Shah MH. A comparative evaluation of the relationship of inner-canthal distance and inter-alar width to the inter-canine width amongst the Gujrati population. J Adv Oral Res 2011; 2:31-37.
17. Hoffman W Jr, Bomberg TJ, Hatch RA. Interalar width as a guide in denture tooth selection. J Prosthet Dent 1986; 55:219-221.
18. Abdullah MA, Stipho HD, Talic YF, Khan N. The significance of inner canthal distance in prosthodontics. Saudi Dent J 1997; 9:36-39.
19. al-el-Sheikh HM, al-Athel MS. The relationship of interalar width, interpupillary width and maxillary anterior teeth width in Saudi population. Odontostomatol Trop 1998; 21:7-10