ORIGINAL ARTICLE

EVALUATION OF MAXILLARY CENTRAL INCISOR WIDTH BY REGRESSION ANALYSIS IN DIFFERENT FACE FORMS

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ABSTRACT

Restoration of esthetics and function are the primary objectives of prosthodontic rehabilitation. Estimating the width of central maxillary incisor mesiodistally is a tedious task in edentulous subject having no pre-extraction records. Several anthropometric measurements of face have been advocated as a guide to calculate the width of central maxillary incisors in edentulous subjects. The study was conducted in Faryal Dental College to assess relationship between the inner canthal distance with maxillary central incisor width in squarish, ovoid and tapering face forms by regression analysis and whether it is applicable in selection of maxillary anterior teeth in edentulous patients. The face forms of different patients were evaluated by subjecting the photographs to computer analysis. Regression analysis was performed to find the relationship of maxillary central incisor width to inner canthal distance both of which were measured by vernier calipers in patients having no facial or dental deformaties. The statistically significant result of this study proved that there is weak association between inner canthal distance and mesiodistal width of central incisors. The inner canthal distance cannot be taken as dependable anthropometric measurement to select central maxillary incisor width.

Key Words: *Esthetics, incisors, edentulous, inner canthal distance, face forms.*

INTRODUCTION

Reproduction of harmony and balance by selection of teeth and its placement affects the patient's confidence and produces esthetic results. Size, color, form, arrangement and framing of the teeth are the qualities which must work together in order to restore facial appearance and function for edentulous patients.

The advancement in computational techniques has led to additional treatment options with more predictable esthetic.[1] In order to have esthetic and beautiful smile the maxillary central incisors, due to the strategic location in the anterior teeth, must not only have appropriate size but should also harmonize with facial morphology.[2]

Out of several theories and classifications Williams "Law of harmony" is currently accepted to be more practical and reproducible.[3] Inverted geometric face forms classified as square, tapered or oval forms aids in the selection of shape and form of central maxillary incisors.[4] This has resulted in selection of the shape of central maxillary incisors which harmonizes with the facial appearance and esthetics.[5]

In previous studies various facial anthropometric measurements such as width of the mouth, intercomissural width, bizygomatic width, interalar width and interpupillary distance have been explored for determining the width of anterior maxillary teeth.[6] This study was conducted to predict the width of maxillary central incisor by equation derived by regression analysis of inner canthal distance and age as predictable values against central incisor width values with respect to different face forms in dentate patients.

Objective was to determine the frequency of face forms among dentate patients and to see relationship between width of central maxillary incisor width, inner canthal distance and age with respect to different face form by regression analysis.

METHODOLOGY

A cross-sectional study was conducted at Faryal Dental College in which a total of five hundred and fifty subjects of age 18-30 years of either gender were enrolled in the study using non-probability purposive

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sampling. OPEN EPI online sample size calculator was used to calculate the sample size, with margin of error 2.9% and confidence level at 95. Subjects who had facial or dental deformities and/or restorations were excluded from the study. Informed consent was taken from the patients for using their data in research. Digital vernier calipers was used to measure the inner canthal distance (ICD) and mesiodistal width of the maxillary central incisor (MCIW) to an accuracy of tenth of a millimeter. The distance between the medial canthus of the eyes was measured for inner canthal distance and interproximal contacts were used as reference points for measuring the width of central maxillary incisors. All measurements and data were recorded by the same examiner to ensure consistency.

A full frontal view of the patient's face was photographically captured with a digital camera (Samsung i8, Korea) at a focal distance of 56.0 cm between the camera lens and tip of the patient's nose to maintain standardization.[7] The photographs of the face were subjected to computational analysis using Adobe Photoshop CS 2 version to determine the face forms. An outline was drawn from the superior edges of the eyebrows crossing the bitemporal region which was joined by the lines joining the bizygomatic region through the angle of the jaw to the chin margin.

The inverted tooth form was classified as square, tapering or ovoid according to the outline form.[8] If the bitemporal, bizygomatic and bimandibular distances were found equal the face form was labeled squarish. If the bitemporal and bimandibular distances were smaller than the bizygomatic the face form was labeled as ovoid. If the bitemporal distance was more than the bizygomatic and the bizygomatic was more than the bimandibular the face form was labeled as tapering. The shape of the maxillary central incisor was verified on every patient. Readings were recorded on the proforma.

Data were analyzed using IBM SPSS statistics version 20. Face form wise segregation of data was done. Mean and standard deviation was calculated for age, inner canthal distance (ICD), mesiodistal central incisor width (MCIW). Frequency and percentages were calculated for gender. ICD value was used as predicting variable against central incisor width values measured by linear regression method. Age was also regressed in order to see whether the age also has some role to play in this relationship. On the basis of linear regression constant value and coefficient for central incisor width was obtained by the following regression equation;

$$y=a+\beta_1 x_1+\beta_2 x_2$$

Where y=dependent variable (Predicted central incisor width), a= constant for linear regression, β_1 and β_2 are the coefficients for inner canthal distance and age, x_1 and x_2 is the value of ICD and age of the subject. The confidence level was kept as 95% and p-value<0.05 was taken as statistically significant.

RESULTS

Total 550 subjects were enrolled in the present study. Mean and SD for age, MCIW and ICD values recorded for face forms are presented in Table 1. Regarding face form with respect to gender, 314(57%) were square out of which 224(71.3%) were males and 90(28.7%) were females, 168(31%) were ovoid out of which 91(54.2%) were males and 77(45.8%) were females and 68(12%) were tapering out of which 58(85.3%) were males and 10(14.7%) were females as presented in Fig 1.

Table 2 depicts the results of linear regression and derived equations in order to predict maxillary central incisor width taking ICD and age as predictors. The coefficient of determination (R^2) indicators of predictive accuracy of the regression equation for Y based on values of X. As a rule of thumb R^2 values greater than 0.5 are considered as acceptable. R^2 value of 0.046 shows very weak association between the ICD, age and MCIW.

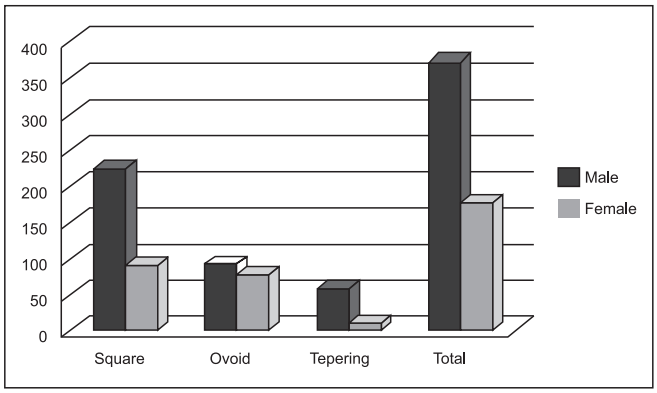

Fig 1: Gender wise distribution of face forms

TABLE 1: DESCRIPTIVE STATISTICS OF QUANTITATIVE VARIABLES

Face Forms	Variables	Mean	Standard Deviation
Square (n = 314,57%)	Age	24.6	3.63
	MCIW	8.56	0.47
	ICD	31.55	1.88
Ovoid (n = 168,31%)	Age	24.29	3.38
	MCIW	8.57	0.48
	ICD	30.9	1.85
Tapered (n = 68,12%)	Age	26.03	3.51
	MCIW	8.64	0.42
	ICD	31.54	1.81
Total	Age	24.68	3.57
	MCIW	8.58	0.47
	ICD	31.35	1.88

TABLE 2: LINEAR REGRESSION OF MCIW AGAINST ICD & AGE

Adjusted R^2		Unstandardized Coefficients		Standardized Coefficients	t	P-value	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
	(Constant)	6.731	0.356		18.924	0.000	6.033	7.430
0.046	ICD	0.054	0.010	0.217	5.216	0.000	0.034	0.075
	Age	0.006	0.006	0.042	1.018	0.309	-0.005	0.016
Derived equation form: Predicted MCIW=6.731+0.054*ICD+0.006*Age								

TABLE 3: LINEAR REGRESSION OF MCIW AGAINST ICD AND AGE WITH RESPECT TO FACE FORMS

Face forms	Adjusted R^2		Unstandardized Coefficients		Standardized Coefficients	t	P-value	95% Confidence Interval for B	
			B	Std. Error	Beta			Lower Bound	Upper Bound
Square	0.108	Constant	5.599	0.471		11.875	0.000	4.671	6.527
		ICD	0.082	0.014	0.322	6.030	0.000	0.055	0.109
		Age	0.016	0.007	0.119	2.226	0.027	0.002	0.029
Derived equation form: Predicted MCIW=5.599+0.082*ICD+0.016*Age									
Ovoid	0.046	Constant	8.797	0.661		13.310	0.000	7.492	10.102
		ICD	0.019	0.020	0.071	0.944	0.347	-0.020	0.057
		Age	-0.033	0.011	-0.229	-3.023	0.003	-0.054	-0.011
Derived equation form: Predicted MCIW=8.797+0.019*ICD-0.033*Age									
Tapering	0.142	Constant	6.793	0.869		7.821	0.000	5.058	8.528
		ICD	0.020	0.027	0.086	0.749	0.456	-0.033	0.073
		Age	0.047	0.014	0.389	3.404	0.001	0.019	0.074
Derived equation form: Predicted MCIW=6.793+0.020*ICD+0.047*Age									

TABLE 4: MEAN DIFFERENCES BETWEEN OBSERVED & PREDICTED VALUES OF MAXILLARY CENTRAL INCISOR WIDTH

Parameter	Mean Differences				
	Mean	Std. Deviation	95% Confidence Interval of the Difference		P-value
			Lower	Upper	
Mean Mesiodistal Width of Central Incisor – Prediced MCIW	-0.008	0.447	-0.046	0.028	0.643

Table 3 depicts the results of linear regression by taking ICD value and age as predicting variable against central incisor width values with respect to different face forms and regression equations were derived. R^2 values ranges from 0.046 to 0.142 which shows weak to moderate association between variables. A paired t

test revealed that there is significant difference between observed and predicted values of MCIW (p-value>0.05) in Table 4.

DISCUSSION

The anterior teeth of the maxilla play a vital role defining smile line and facial esthetics. The most influential factors responsible for dental esthetics include width, shape and arrangement of the maxillary anterior teeth.[1,2] The purpose of this study was to find a mathematical relationship between mesiodistal width of the central maxillary incisor and inner canthal distance in different face forms.

The mean width of the central incisors measured mesiodistally in our study is in harmony with the measurements of Scandrett et al[9], conversely, the measurements were less compared to the investigations reported by Woodhead[10] and Cesario et al.[11] The measurement of the width between the medial canthus were comparable to the findings of Freihofer[12] but was less to the values reported by Abdullah et at[13] and Murphy and Laskin[14] and greater than that reported by Laestadius et al.[15] In the present study the mesiodistal central incisor widths observed in tapered face form were high as compared to square and ovoid. The measurements of inner canthal distance were high in square face form as compared to ovoid and tapered.

The frequency of males and females having square face form were found in majority as compared to ovoid and tapered, this could be due to unequal percentage of different face forms taken in the study.

Regression analysis was applied to determine the relationship of inner canthal distance, age and central incisor width. The squarish face form showed significant relationship between the variables compared to other face forms when subjected to regression. However the value of co-efficient of determination (R^2) shows that there was a weak association between variables.

In the present study accuracy of predicted values with observed values of maxillary central incisor had been checked using paired t-test which showed significant difference (p-value>0.05) as compared to the study conducted by Agarwal B et al[16] which showed statistical significance between observed and calculated values of maxillary central incisor for both the genders.

CONCLUSION

The results of our study suggest that inner canthal distance might not be a dependable predictor to decide on maxillary central incisor width for edentulous patients.

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1	**Muhammad Saad Mateen Munshi:**	Principle researcher and wrote the manuscript.
2	**Muhammad Ashfaq:**	Associate researcher and collected data.
3	**Afsheen Zakir:**	Statistically analyzed the data