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Evaluation of validity of geometric theory in Malwa population

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Abstract
Selection of maxillary anterior teeth for complete dentures is crucial in clinical practice and controversy about the validity of even best method to employ still exists. Leon Williams formulated and publicized a method called the "Geometric theory" which is still widely used. Williams believed that there exists a relationship between the face-form and the form of the maxillary central incisor in most people and that this relationship should be taken into account in the tooth selection procedure. In spite of the SPA theory introduced later, the geometric theory remains till date a popular method of selection of anterior artificial teeth. For this reason, it was decided to assess the validity and specificity of William's geometric theory by comparing tooth shape and form with apparent facial form as well as actual facial form in Malwa population for the age group 18-30 years and integrate it with teeth selection procedure.

Keywords: Geometric theory, Leon Williams and face-tooth form

Introduction
Aesthetic replacement of missing teeth is one of the major concerns of the dentist and patients. The maxillary central incisor is the most relevant teeth of the human dentition and is often used as a guide for the selection of the artificial anterior teeth [1]. The art of selecting artificial teeth is very crucial as it not only restores the facial harmony, but also enhances the beauty and brings psychological comfort to the patients. Selection of maxillary anterior teeth for complete dentures is still a problem in clinical practice and controversy about the validity of even best method to employ still exists [2].

Leon Williams formulated and publicized a method called the "Geometric theory" which is still widely used. Williams believed that "the contour lines of your upper incisors must be, in a general way, the reverse of what they are in the face. This was the accepted theory for about 50 years [3].

Then Frush and Fisher introduced the SPA theory, in which selection of teeth was determined on the basis of sex, personality, and age of the individual. However, despite the widespread acceptance of the SPA concept, the Geometric theory is still used by many dentists for selection of the shape and size of the artificial anterior teeth in complete denture patients [4]. Thus, a study was planned to assess the validity of the Geometric theory in a sample Indore-Malwa (Madhya Pradesh, India) dentate population [5].

Method and Material:
This cross sectional observational study was carried out on the 200 subjects (100 males and 100 females) which included the dental students as well as the patients of College of Dental Science & Hospital, Rau, and Indore within the age group of 18-30 years. On the basis of following formula:

$$\text{Sample size} = \frac{Z_{1-a/2}{}^2 \, SD^2}{d^2}$$

$Z_{1-a/2}$ -Standard normal variate (at 5% type one error (P<0.05) it is 1.96), SD- standard deviation of variation based on previous studies and, d- absolute error or precision (0.05), each group should contain atleast 70 subjects, so the following samples size was selected containing Male -100, Female -100 subjects.

Front profile photographs were recorded for analysis of facial form and intraoral photographs were recorded by placing cheek retractor for analysis of maxillary central incisor form. Both form was compared digitally using Adobe photoshop software (CS3) and Image analyzer software (version 1.38)

Sample Size Estimation

Sample size $= (Z^2 X [p] X [I-p])/C^2$

Where Z = Z value for the confidence level chosen

p = Percentage having a particular disease / problem etc. and it is expressed as a percentage

C = Confidence interval (CI) expressed, expressed as a decimal

Inclusion criteria

- Patient belonging to Indore-Malwa region with at least domiciled for four previous generations.
- Patient in the age group of 18-30 years.
- Patient having a full complement of permanent natural teeth (excluding third molars).

Exclusion criteria

- Presence of obvious facial asymmetry or craniofacial anomaly either congenital or acquired.
- Previous history of maxillofacial trauma, Maxillofacial or orthognathic surgery.
- Excessive body weight
- Presence of congenitally missing or extracted maxillary central incisor teeth.
- Presence of gingival recession, gingival enlargement or advanced periodontal diseases
- Any restoration or prosthesis involving maxillary central incisor
- History of aesthetic treatment in anterior teeth.
- Anterior teeth showing regressive alterations.

The objective of the study was explained to each subject and written informed consent were obtained from them. The study protocols were approved by the Institutional Ethical Committee, College of Dental Science & Hospital, Rau, Indore, which was in accordance with Helsinki declaration.

A front facial profilometric photographs were recorded using a Canon DSLR camera model No. 1200d with 25-55 & 55-250X optical zoom. The photographs obtained were then transferred to the computer. The camera had a resolution of 20 Mega pixels which may be considered to be more than adequate for computer analysis. The in-built zoom lens with a focus range to infinity helped ensuring high quality images. The camera was fixed on a standard adjustable tripod stand, so that it can become parallel to the horizontal plane. Each subject was made to sit upright, the position and the distance of subject's sagittal plane and photographic film was predetermined at 50 cm for face and 20 cm for intraoral photograph. The in-built zoom lens with a focus range to infinity helped ensuring high quality images. A grid was used to stabilize the head and to minimize the chances of errors due to lateral head rotation during photography. The camera was fixed on a standard adjustable tripod stand, so that it could be made parallel to the long axis passing from tip of subject's nose and the lens of camera was pre-focused**.**

For intraoral photograph a cheek retractor was used.

The images obtained were then transferred to a computer (hp Elitebook 2560p).The facial form and any one of the maxillary central incisor form were traced using image analyzer (version 1.38) software using standard points 1 cm apart. Outlines of facial form and maxillary central incisor form was digitally marked using Adobe™ Photoshop software (CS3). Outlines were analysed digitally and classified according predetermined standard as follows:

- Triangular face with edges converging from the condylar point to the chin.
- Square face with sides almost parallel to each other.
- Ovoid face in which surface are rounded with greatest mesio-distal diameter being in centre of face

Similarly the maxillary central incisor forms were also classified according to predetermined standards. Then the acquired outline of facial form was superimposed on the maxillary central incisor outlines and tracings were analyzed in Digital image analyzer (1.38) and Adobe Photoshop (CS3) ™ and classified as:

A. Identical: When there was perfect superimposition or a negligible difference is there in tracings.
B. Similar: When there was close approximation without accurate superimposition.
C. Dissimilar: When the shapes presented different tracing.

The data thus obtained was then statistically analyzed. Mean, standard deviation, Chi-sq values and P values were statistically evaluated by using commercially available program statC. The facial outline form and maxillary central incisor form were classified according to gender in sample population, the significant level was standardized at p = 0.05 for this analysis. Later analysis of comparison of facial form and tooth form was done by calculating percentage of identical, similar and dissimilar form using Chi-sq. test, the significant level was standardized at p = 0.05 for this analysis.

Results and Discussion

Table 1: Frequency of types of apparent facial form, actual facial form and tooth form.

FACE FORM	GENDER	SQUARE (N)	SQUARE (%)	TRIANGULAR (N)	TRIANGULAR (%)	OVOID (N)	OVOID (%)	Chi-sq Value	P Value
APPARENT FACE FORM	M	34	60.7	6	10.7	16	28.6	9.14	<0.01
	F	14	31.8	12	27.3	18	40.9		
ACTUAL FACE FORM	M	40	71.4	8	14.3	8	14.3	9.94	<0.01
	F	18	40.9	16	36.4	10	22.7		
TOOTH FORM	M	28	50.0	20	35.7	8	14.3	5.94	<0.05
	F	32	72.7	10	22.7	2	4.5		

The results obtained in present study revealed:

- A highly significant statistical relationship between apparent face form and gender with P-value <0.01
- A highly significant statistical relationship between actual face form and gender with P-value <0.01
- A significant statistical relationship between tooth form and gender with P-value <0.05

- However, it was found that there was no statistically significant relationship between Apparent face form and tooth form with Chi-sq value 2.82 and P-value > 0.05
- There was no statistically significant relationship between Actual face form and tooth form with Chi-sq value 5.03 and P-value > 0.05

Table 2: Comparison of Apparent face form, Actual face form with Tooth form.

FACE FORM	GENDER	TOOTH FORM						Chi-sq value	P-value
		IDENTICAL		SIMILAR		DISSIMILAR			
		N	(%)	N	(%)	N	(%)		
APPARENT FACE FORM	M	0	0.0	24	42.9	32	57.1	2.82	>0.05
	F	2	4.5	16	36.4	26	59.1		
ACTUAL FACE FORM	M	1	1.8	19	33.9	36	64.3	5.03	>0.05
	F	4	9.1	20	45.5	20	45.5		

The analysis of face form and tooth form has been done previously in various geographical populations (Sellen *et al*., 1998; Brodbelt *et al*., 1988; Lindemann *et al*., 2004; Wolfart *et al*., 2004). However, the method used varied and the analysis was done by visual assessment by three or more layman or dentist in most of the studies. This method is dependent on many variables related to experience, background, social agreement and personnel preference and is thereby biased.

In this study, standardized digital images were used. An image analysing software (Image Analyzer 1.38) and Adobe Photoshop CS3 were used to capture the face, analyse the maxillary central incisor form, and face form in order to limit the variability in recording and evaluation. This method seems to be more practical, easy to perform and offered acceptable precision and reliability.

The study conducted by Mavroskoufis F *et al* and Sellen PN et a revealed no correlation between the shape of the face and the inverted shape of the maxillary central incisor [2].

However, the results obtained in the present study are in disagreement with Wright WH *et al* and DeSouza *et al* who found similar shapes in 64% and 70.2% of the individuals respectively [5].

Considering face form, the result of this study is not consistent with those reported by Wright WH (1936), in which the square shape was observed in 7% of the sample, ovoid in 11%, and triangular in 82% [5].

DeSouza *et al* also found different results the triangular shape was the most frequent one (56.7%), followed by the square (35.1%), and the ovoid shape (8.1%).

Miraglia S *et al* concluded that none of the tooth selection system can perfectly guide selection of teeth without artistic and scientific inputs of operator [6]. Thus, the theory advised by Williams, in spite of the wide use, seems not to be completely reliable

Images

Armamentarium

Fig 1: Canon DSLR camera model No. 1200d

Fig 2: Tripod

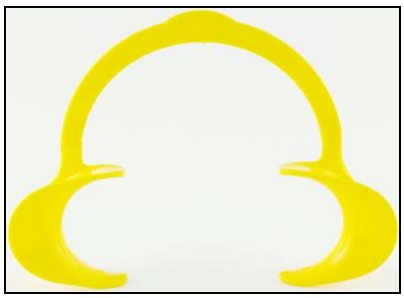

Fig 3: Cheek retraction

Fig 4: Setup for extra oral photograph

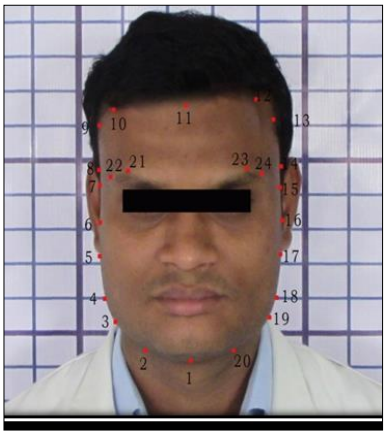

Fig 5: Guide points for Face outline

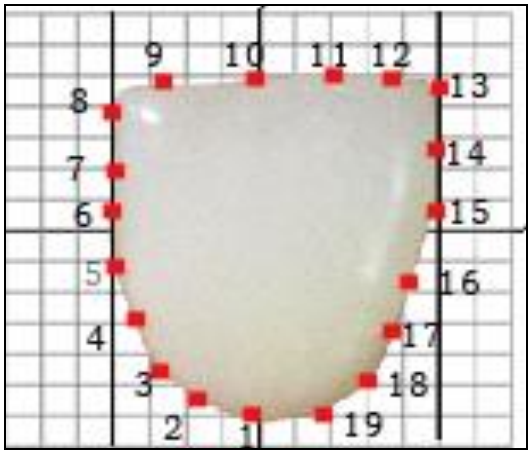

Fig 6: Guide points for tooth outline

Fig 7: Maxillary central incisor outline over Facial outline

Conclusion

This study concludes that there is a much greater percentage of dissimilarity between incisor and face-form, in sample Malwa population. The "Williams' law of harmony" to select artificial teeth stands inconclusive in sample Malwa population both in males and females.

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