ORIGINAL ARTICLE

A Study to Assess the Correlation between Golden Proportion and Inner Canthal Distance to Predict the Central Incisor Width and between Interalar Width and Maxillary Anterior Width in Western Population

Renuka Makani[1], R. Sushma[2], Shweta D. Mishra[3]

ABSTRACT

Introduction: Golden proportion is an age-old concept for interpreting the beauty of nature. The corresponding application of this concept was done in dental esthetics through this study. The concept was used along with inner canthal distance (ICD) for selection of an appropriate width of maxillary central incisor width (CIW), which forms a dominant aspect in a person's smile. Furthermore, interalar width (IAR) was used to estimate maxillary anterior width. **Materials and Methods**: A total of 130 subjects with age 19–25 years were selected. A digital Vernier caliper was used to measure the ICD, interalar distance, and CIW. CIW was measured mesiodistally at its contact points. Since ICD was greater than the combined width of incisors, it was multiplied by 0.618 to obtain combined CIW. The product was divided by two to obtain calculated single CIW. CIW was measured with the help of a dental floss. **Statistical Analysis:** Paired sample tests were performed for CIW and ICD. Correlation between IAR and CIW was checked using Kendall's tau and Spearman's rho tests. **Results:** According to Paired sample tests, the statistical significant difference between measured and calculated CIW was $P < 0.001$ which inferred that it was not reliable to depend on just one parameter for CIW. Kendall's tau and Spearmans' rho tests for IAR and combined maxillary anterior width showed $P = 0.400$ and $P = 0.429$ indicating no statistically significance. **Conclusions:** In the target population, one has to consider more than one biometric parameter for the selection of an appropriate width of maxillary central incisor. Furthermore, IAR cannot be used to estimate combined maxillary anterior width.

Keywords: Esthetics, Innercanthal distance, Interalar width, Maxillary anteriors, Maxillary central incisor, Tooth selection

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Intern[1,3], Associate Professor[2]

[1-3]Department of Prosthodontics, School of Dental Sciences, Krishna institute of Medical Sciences Deemed University, Karad, Maharashtra, India

Corresponding Author: Dr. R. Sushma, Associate Professor, Department of Prosthodontics, School of Dental Sciences, Krishna institute of Medical Sciences Deemed University, Karad, Maharashtra, India. Phone: +91-8105328348. e-mail: doc.sushma.r@gmail.com

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INTRODUCTION

Maxillary anterior teeth play a major role in a person's facial esthetics. The central incisors because of their position form a dominant pair in the smile.[1,2]

Due to variability in features among individuals, clinicians have tried to simplify it by applying concepts such as golden proportion and biometric guidelines to select an appropriate width of teeth in the prosthesis.

Many such studies done have shown a specific pattern that can aid in restoring the patient's smile.

This study was conducted to check the reliability of golden proportion and inner canthal distance (ICD) in estimating central incisor width (CIW) along with determining the presence of any significant correlation between interalar width (IAR) and maxillary anterior width. The data were recorded so that it can be of significance to the target population.

MATERIALS AND METHODS

As per convenient sampling technique, a total of 130 western Indian subjects, 103 female and 27 male subjects, were selected from the student population of School of Dental Sciences, Karad, with the age group of 19–25 years. The subjects selected had their maxillary anterior teeth free from any caries, diastema, restorations, crowding, or other dental anomalies. Informed consent was obtained. The investigation was carried out from January 2017 to May 2017 after the due approval from the Ethical Committee of the University.

The subjects were made to sit in a relaxed and upright position before the measurements were taken.

Biometric Measurements

ICD measurement

The distance between median angles of palpebral fissure is the ICD. This distance was measured with a dig tal Vernier caliper by bringing its recording parts

just touching the medial angle of palpebral fissure as shown in Figure 1.

IAR measurement

The IAW is the distance between the ala of the nose at the widest points, and this parameter was measured by bringing the recording points of Vernier caliper such that it just touched the outer surface of the nose as shown in Figure 2.

Tooth Measurements

Central incisor measurement

Mesiodistal width of maxillary central incisors was mesasured by inserting the recording points of Vernier caliper interdentally between maxillary central and lateral incisor.

Maxillary anterior width measurement

A dental floss was taken, and one end of it was inserted between the contact points of the canine and first premolar. The floss was confirmed along the curvature of anteriors, and the other end was again inserted between the contact points of the canine and first premolar. With the help of a marking pen, the distal end of the canine was marked on both the sides. This distance was me sured with the help of Vernier caliper and recorded.

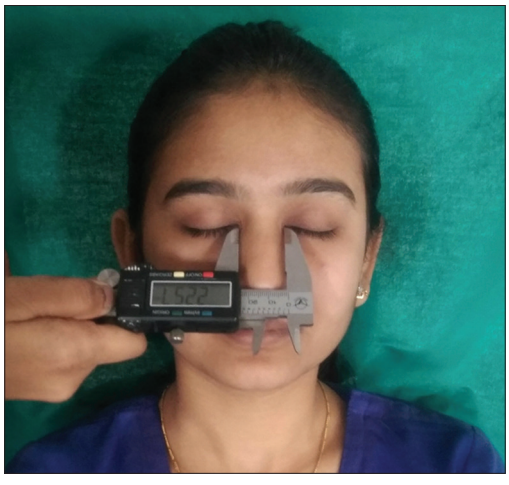

Figure 1: The measurement of inner canthal distance

Figure 2: The measurement of interalar distance

1.618:1 is widely known as the golden proportion ratio and 0.618 forms it reciprocal. It is of common knowledge that to obtain the result where golden proportion is concerned, any increasing function is to be multiplied by 1.618 and the decreasing function by 0.618. ICD was multiplied by 0.618 (decreasing function value of geometric progression) since its values exceeded to that of the combined mesiodistal width of maxillary central incisors. The width of single central incisor was obtained by dividing the product by two.

The recordings were then subjected to statistical analysis.

RESULTS

The subjects ranged from 19 to 25 years with a mean age of 21.57 years. Using a paired sample test (Table 1), the calculated CIW showed the mean value of 9.328 with a standard deviation of 1.008 and measured CIW showed the mean value of 8.282 with a standard deviation of 0.398. However, the statistical significant difference came out to be $P < 0.001$ which inferred that it was not reliable to depend on just one parameter for CIW.

Kendall's tau and Spearman's rho tests (Tables 2 and 3) were performed to find the correlation between IAR and combined maxillary anterior width. However, the tests gave $P = 0.400$ and $P = 0.429$ indicating no statistically significant correlation between them.

DISCUSSION

Numerous studies have shown high variability in biometric parameters among the individuals of different populations, races, and countries. Thus, before making any concept universal, extensive studies are required among different populations to find the existence of any specific correlation.

Cases of lost or unavailability of pre-extraction records are not uncommon. Hence, selection of width of the maxillary anterior becomes a daunting task. In a research conducted by Baer and Reynolds,[6] people prefer a lesser width of their artificial teeth than that of their natural ones. Several anatomic parameters such as interpupillary distance[4,5,7-9] bizygomatic width[4,7,8] IAR[4,5,8-13] have also been used to determine the width of maxillary anteriors.

In a study conducted by Shetty *et al.*,[14] it was concluded that the length of maxillary central incisor may be estimated using the distance from the bridge of the

Table 1: Comparison between measured and calculated values

Paired samples statistics				
Central incisors' width	**Mean**	***n***	**SD**	**Standard error mean**
Pair 1				
Calculated CIW	9.328638	130	1.0083886	0.0884415
Measured CIW	8.282538	130	0.3983577	0.0349383

CWI: Central incisor width, SD: Standard deviation

Paired samples test								
Central incisors' width	**Paired differences**					***t***	**df**	**Significant (2-tailed) *P* value**
	Mean	**SD**	**Standard error mean**	**95% confidence interval of the difference**				
				Lower	**Upper**			
Pair 1								
Calculated CIW - measured CIW	1.0461000	1.0546174	0.0924961	0.8630943	1.2291057	11.310	129	0.000

CWI: Central incisor width, SD: Standard deviation

Table 2: Calculated mean, median, and mode with interalar distance and combined maxillary anteriors width

Parameters	Interalar distance	Combined maxillary anterior width
n		
Valid	130	130
Missing	0	0
Mean	35.250154	49.016769
Standard error mean	0.2604042	0.3214118
Median	35.090000	48.740000
Mode	35.0900	45.2700[a]
SD	2.9690643	3.6646586
Variance	8.815	13.430
Range	14.0900	19.9100
Minimum	29.6200	38.3700
Maximum	43.7100	58.2800

SD: Standard deviation

Table 3: Correlation between IAR and combined maxillary anteriors width

Correlations		
Parameters	**Interalar distance**	**Combined maxillary anterior width**
Kendall's tau-b		
Interalar distance		
Correlation Coefficient	1.000	0.050
Significant (two-tailed)		0.400
n	130	130
Combined maxillary anteriors width		
Correlation coefficient	0.050	1.000
Significant (two-tailed)	0.400	.
n	130	130
Spearman's rho		
Interalar distance		
Correlation coefficient	1.000	0.070
Significant (two-tailed)	.	0.429
n	130	130
Combined maxillary anteriors width		
Correlation coefficient	0.070	1.000
Significant (two-tailed)	0.429	.
n	130	130

IAR: Interalar width

nose to the base of the nose as reference. Another study done in the Brazilian population by Gomes *et al*.[15] concluded that when interalar distance is increased by 31% of its value can give the circumferential distance of the maxillary anterior teeth.

It was found that, in Caucasian population, changes in measurements of palpebral fissures were minimal once maturation was attained.[16] Hence, we can rely on the stability of dimensions of palpebral fissures. A study conducted by Le *et al*.[17] in Asian and North American Caucasian population showed a wider ICD with respect to a shorter palpebral fissure, a smaller mouth width, wider soft nose within wide facial contours, and forehead height larger than the lower face in the Asian population. According to a study by Varjão and Nogueira,[13] a weak correlation existed between the intercanine width and the nasal width in 48.2% of the Asian population. Various parameters such as intercommissural width[18] were also used to relate with the maxillary anterior teeth. However, the results concluded non-existence of any strong correlation.

This study was carried out to present the possibility of using biometric parameters in teeth selection of target population. George and Bhat[19] conducted a study that concluded that CIW can be estimated by multiplying decreasing function value with ICD.

The purpose of this study was to find any correlation between width of maxillary anterior teeth and IAR as well as estimating the mesiodistal width of a maxillary central incisor using ICD and golden proportion as

predictors. A significant statistical difference between measured and calculated CIW indicated that it is not reliable to depend only on ICD for teeth selection.

The tests done to evaluate the correlation between interalar distance and combined maxillary anterior width showed no significant correlation.

CONCLUSION

The correlation between the biometric parameters varies between populations and communities pertaining to the demographics. The present study conducted on the western Indian population shows that one cannot rely on a single biometric parameter for selection of an appropriate width of maxillary central incisor. Furthermore, IAR cannot be solely used to estimate combined maxi lary anterior width. Therefore, the clinician may have to take other parameters into consideration such as interpupillary width and bizygomatic width specific to the population to select the most appropriate width of the anteriors to create the most natural, confident, and a pleasing smile.

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