Evaluation of Maxillary Anterior Teeth Width and Their Relation to the Calculated Values for Smile Designing

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Abstract

Aim and objective: The present study was conducted to determine the golden proportion, golden mean, and the Preston proportion of the individuals between the widths of six maxillary anterior teeth and to determine which proportional formula exists in the population.

Materials and methods: This study was conducted among 60 participants between 18 years and 30 years of age with an esthetic smile. They were grouped into 30 females and 30 males. Maxillary arch impressions were made using irreversible hydrocolloid material from each individual. The width of the anterior teeth on the graph paper was analyzed by using digital vernier caliper. The data were statistically analyzed by one way ANOVA test.

Results: The study revealed that the formula of golden proportion and golden mean had no statistical differences between males and females but the Preston proportion has shown statistical differences in the total population.

Conclusion: From the current study, it was concluded that the formulas of golden mean and golden proportion proposed by Ward can be used for smile designing and full mouth rehabilitations.

Clinical significance: Demand for smiles has gained its importance with time. The golden proportion, golden mean, and the Preston proportion are the guidelines used by the professional for better esthetic proportion in the dentition.

Keywords: Golden mean, Golden proportion, Preston proportion, Smile designing, Ward formulas.

The Journal of Contemporary Dental Practice (2021): 10.5005/jp-journals-10024-3051

Introduction

Esthetic dentistry aims to reproduce harmonious form and function for therapy, and modification of appearance which is an integral part of dental treatment.[1] Smile is an evident sign of perceived self-esteem and satisfaction which has gained importance with time. To improve the appearance of a pleasing outcome new dental materials and techniques have been introduced. The size and form of the six maxillary anterior teeth are significant for both dental and facial esthetics.[2] Levin proposed a system for esthetic predictions. According to this system, a dental grid is used in the anterior esthetic segment, which is helpful for the diagnosis of dental and facial conflicts, and using these systems will aid to restore the facial esthetics.[3]

As we all desire to obtain a beautiful smile and face, Pythagoras defined the proportional body mathematically into 1.0–1.168, creating the definition of a divine or golden proportion of 1.0–1.168 which is believed to be a source given by the almighty because of its esthetic superiority.[4,5] This geometry of mathematics relationship is also known as sacred geometry, the magic numbers, the golden cut.[6] Golden proportion was proposed and applied in dentistry first by Lombardi who had proven its strong use in dentistry. Levin pointed that the width of the maxillary lateral incisor is in golden proportion with the width of the central incisor and the width of the maxillary canine is in golden proportion with the lateral incisor when inspected from the front.[3]

The ratio between the succeeding terms in a mathematical progression is called the famous Fibonacci series of numbers, in which each term is the sum of the previous two terms as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, etc. This is called the Fibonacci series after Leonardo of Pisa (or Filius Bonacci).[3,7]

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Golden proportion states that the width of the central incisor and the lateral incisor should be constant when progressed from the anterior to the posterior teeth in the oral cavity. The width of the maxillary canine should be 62% of the width of the lateral incisor, and the width of the lateral incisor should be 62% of the central incisor.[8,9]

Golden mean is defined as the width of maxillary central incisor should be 25% of the distance of maxillary canine on one side to the distal of the canine on the contralateral side the maxillary lateral incisor should be 15% and each maxillary canine should be 10% of the intercanine distance when viewed from the front.[10]

Preston proportion states that the average width of the maxillary lateral incisor was approximately 66% of the average width of the maxillary central incisor and the average width of the maxillary canine was approximately 84% of the average width of the maxillary lateral incisor.[11] Hence, the present study aimed to evaluate the existence of golden proportion, golden mean,

and the Preston proportion of the population among the widths of the six maxillary anterior teeth in individuals with permanent dentition with the aid of a desired formula to design the smile of the individual.

MATERIALS AND METHODS

This study was conducted in the Department of Prosthodontics and Crown and Bridge, MNR Dental College and Hospital, Sangareddy, Telangana, India. This study was approved by the Ethics committee of the MNR Medical and Dental College, Sangareddy. Formulas and the vernier calipers were used to analyze the existence of golden proportion, the golden mean, and Preston proportion between the widths of maxillary six anterior teeth in individuals with permanent dentition.

Criteria for Selection of Subjects

A total of 60 dental students participated in the study. They were grouped into 30 males and 30 females. Informed consent form from the subjects was obtained.

Following were the inclusion and exclusion criteria of the subject for study:

Inclusion Criteria

Study participants were aged between 18 years and 30 years. Participants with pleasant dental alignment and esthetic smile, complete intact of six mandibular and six maxillary anterior teeth were chosen for the study.

Exclusion Criteria

Study participants with periodontal disease, history of any orthodontic treatment, intrusion, extrusion or rotated teeth, spacing, and crowding of the anterior region were not included in this study.[12,13]

Procedure

Maxillary arch impressions were obtained from each student using the irreversible hydrocolloid (Zhermack-Tropicalign Alginate) by using stock trays. Casts were obtained by pouring the impressions with Type I dental stone (GC Fujirock EP) as shown in Figure 1.

Each cast was trimmed and identified with the participant's unique identity number. The widths of the six maxillary anterior teeth and their dimensions were viewed from the front. Evaluations regarding the widths were obtained by placing the cast and drawing the grids on graph paper. It was done by placing the assembly, that is, maxillary casts on graph paper which in turn was placed on the flat surface. Points were marked on the graph paper, vertical lines were drawn later, and the mesiodistal widths of the teeth were measured between the widths of the vertical lines as shown in Figure 2.[13]

The mesiodistal widths of the teeth are measured at the contact points of the teeth.[14] Mesiodistal measurements were calculated for the spaces in the grids using the digital vernier calipers read to the nearest of 0.1 mm as in Figure 3. The obtained values were substituted to the scholar's tooth width formula and the value of the population was obtained. The data were statistically analyzed by a one-way ANOVA test. The data were analyzed with Statistical Package for Social Sciences (SPSS) version 26.0 (IBM SPSS, Armonk, New York, USA). The descriptive data showing mean and, standard deviation (SD) were used for comparison between the groups. Confidence intervals were set at 95% and a p-value of <0.05 was interpreted as statistically significant.

Calculations

The Ward's formula given in Table 1 was used for calculating tooth width of golden proportion, the golden mean, and Preston proportion of six maxillary anterior teeth.
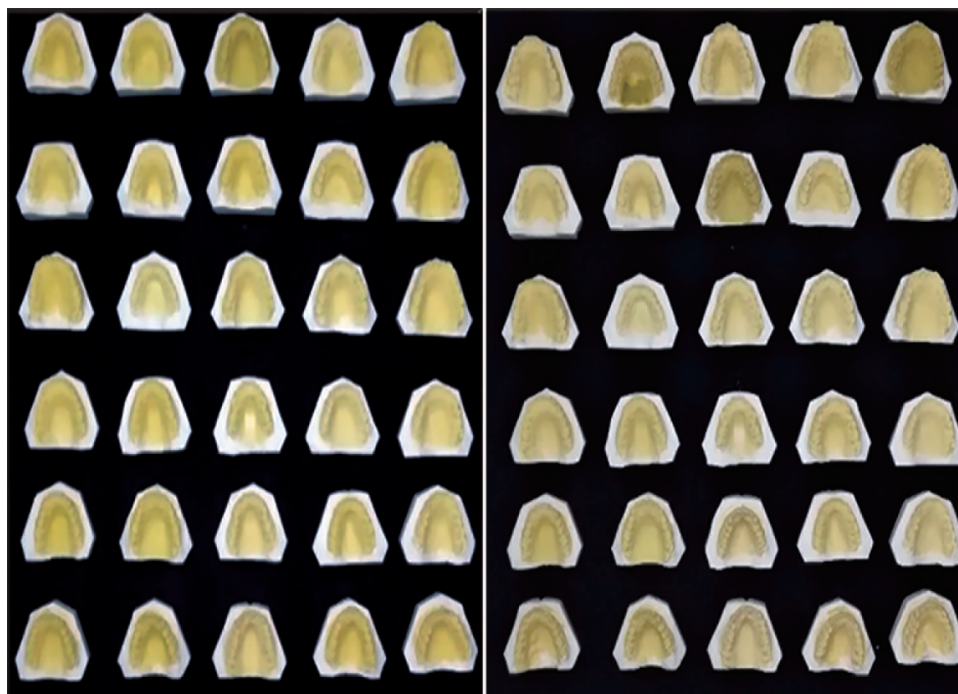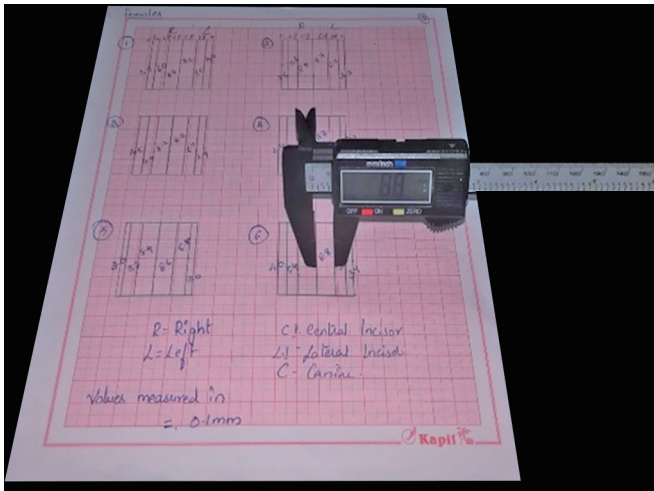

Fig. 1: Maxillary arch casts

Fig. 2: Measuring the mesiodistal width on the graph paper using vernier caliper
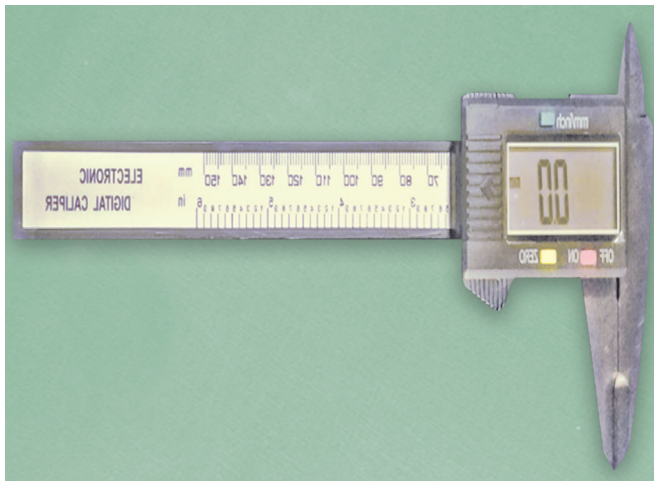

Fig. 3: Digital vernier caliper

Table 1: Ward's formulas used for the tooth width calculations

Tooth to tooth width proportion	Central incisor (CI) width	Lateral incisor (LI) width	Canine (C) width
Golden proportion	IC width × 0.25	CI width × 0.62	LI width x 0.62
Golden mean	IC width × 0.25	IC width × 0.15	IC width × 0.10
Preston proportion*	Preston CIW*	CI width × 0.66	LI width × 0.84

$$*\text{Preston CIW} = \frac{\text{Total intercanine frontal view width}}{2(1 + 0.66 + (0.66 \times 0.84))}$$

RESULTS

The present study investigated the extent of golden proportion, golden mean, and Preston proportion of the population between the widths of six maxillary anterior teeth and esthetic smile.

Cast Analysis

In females mean values and their standard deviation of the overall population, golden proportion, golden mean, and Preston proportion were 3.73 ± 0.73, 3.46 ± 0.15, 3.61 ± 0.16, and 4.51 ± 0.20, respectively, for right central incisors; 5.84 ± 0.54, 5.59 ± 0.24, 5.41 ± 0.24, and 5.37 ± 0.23, respectively, for right lateral incisors; 8.38 ± 0.47, 9.02 ± 0.39, 9.02 ± 0.39, and 8.14 ± 0.36, respectively, for right canine; 8.65 ± 0.45, 9.02 ± 0.39, 9.02 ± 0.39, and 8.14 ± 0.36, respectively, for left central incisors; 5.97 ± 0.50, 5.59 ± 0.24, 5.41 ± 0.24, and 5.37 ± 0.23, respectively, for left lateral incisor and 3.54 ± 0.54, 3.46 ± 0.15, 3.61 ± 0.16, and 4.51 ± 0.20, respectively, for left canine (p-value = 0.000 for all the six teeth) (Table 2). There was no statistically significant difference between the observed values, golden proportion, golden mean, and Preston proportion of females; hence, pairwise comparison was carried out for all six anterior teeth in which the golden proportion and the golden mean showed no statistically significant difference in all the teeth. There was a statistically significant difference for the Preston proportion of the female population in all the six maxillary anterior teeth.

In males, mean values and their standard deviation of the overall population, golden proportion, golden mean, and Preston proportion were 3.83 ± 0.69, 3.54 ± 0.19, 3.86 ± 0.94, and 4.60 ± 0.25, respectively, for right central incisors; 5.75 ± 0.56, 5.71 ± 0.30, 5.53 ± 0.29, and 5.51 ± 0.30, respectively, for right lateral incisors; 8.58 ± 0.47, 9.22 ± 0.49, 9.22 ± 0.49, and 8.34 ± 0.44, respectively, for right canine; 8.74 ± 0.41, 9.22 ± 0.49, 9.22 ± 0.49, and 8.34 ± 0.44, respectively, for left central incisors; 6.02 ± 0.75, 5.71 ± 0.30, 5.53 ± 0.29, and 5.51 ± 0.30, respectively, for left lateral incisor; 3.97 ± 0.72, 3.54 ± 0.19, 3.86 ± 0.94, and 4.60 ± 0.25, respectively, for left canine (p-value = 0.000 for all the five teeth except right lateral incisor with p-value = 0.025) (Table 3). As there is no statistically significant difference with the one-way ANOVA test, a pair-wise comparison was carried out for all the six maxillary anterior teeth. The right lateral incisor of males had no statistically significant difference when compared to females. As in females, the golden proportion and the golden mean showed no statistically significant difference when compared to males and there was a statistically significant difference for the Preston proportion of the male population.

Overall, males and females mean values and their standard deviations of overall population, golden proportion, golden mean, and Preston proportion were 3.78 ± 0.71, 3.50 ± 0.17, 3.73 ± 0.68, and 4.56 ± 0.23, respectively, for right central incisors; 5.80 ± 0.55, 5.65 ± 0.28, 5.47 ± 0.27, and 5.44 ± 0.28, respectively, for right lateral incisors; 8.48 ± 0.48, 9.12 ± 0.45, 9.12 ± 0.45, and 8.24 ± 0.41, respectively, for right canine; 8.70 ± 0.43, 9.12 ± 0.45, 9.12 ± 0.45, and 8.24 ± 0.41, respectively, for left central incisors; 5.99 ± 0.63, 5.65 ± 0.28, 5.47 ± 0.27, and 5.44 ± 0.28, respectively, for left lateral incisor and 3.76 ± 0.66, 3.76 ± 0.66, 3.73 ± 0.68, and 4.56 ± 0.23, respectively, for left canine (p-value = 0.000 for all the teeth) (Table 4). Comparison of the observed values and the golden proportion and golden mean of males and females did not show any statistically significant difference, but the Preston proportion showed statistically significant difference in all the criteria.

DISCUSSION

Dental esthetics depends on different geometrical and mathematical relationships among several teeth. The golden proportion is thought to be more consistently seen in attractive smiles which are also considered esthetic.[8] Golden proportion

Table 2: The mean value with standard deviations of observed values, golden proportion, the golden mean, and Preston proportion of females

	Observed values	Golden proportion	Golden mean	Preston proportion	ANOVA F value	p-value
Right canine	3.73 ± 0.73	3.46 ± 0.15	3.61 ± 0.16	4.51 ± 0.20	42.433	0.000
Right lateral incisor	5.84 ± 0.54	5.59 ± 0.24	5.41 ± 0.24	5.37 ± 0.23	11.999	0.000
Right central incisor	8.38 ± 0.47	9.02 ± 0.39	9.02 ± 0.39	8.14 ± 0.36	37.567	0.000
Left central incisor	8.65 ± 0.45	9.02 ± 0.39	9.02 ± 0.39	8.14 ± 0.36	33.114	0.000
Left lateral incisor	5.97 ± 0.50	5.59 ± 0.24	5.41 ± 0.24	5.37 ± 0.23	21.196	0.000
Left Canine	3.54 ± 0.54	3.46 ± 0.15	3.61 ± 0.16	4.51 ± 0.20	76.807	0.000

Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean difference (I − J)	p-value
Right canine	Observed values	Golden proportion	0.26200	0.053
		Golden mean	0.11633	0.662
		Preston proportion	−0.78433*	0.000
	Golden proportion	Observed values	−0.26200	0.053
		Golden mean	−0.14567	0.480
		Preston proportion	−1.04633*	0.000
	Golden mean	Observed values	−0.11633	0.662
		Golden proportion	0.14567	0.480
		Preston proportion	−0.90067*	0.000
	Preston proportion	Observed values	0.78433*	0.000
		Golden proportion	1.04633*	0.000
		Golden mean	0.90067*	0.000
Right lateral incisor	Observed values	Golden proportion	0.24933*	0.026
		Golden mean	0.42833*	0.000
		Preston proportion	0.46867*	0.000
	Golden proportion	Observed values	−.24933*	0.026
		Golden mean	0.17900	0.175
		Preston proportion	0.21933	0.063
	Golden mean	Observed values	−0.42833*	0.000
		Golden proportion	−0.17900	0.175
		Preston proportion	0.04033	0.967
	Preston proportion	Observed values	−0.46867*	0.000
		Golden proportion	−0.21933	0.063
		Golden mean	−0.04033	0.967
Right central incisor	Observed values	Golden proportion	−0.64667*	0.000
		Golden mean	−0.64667*	0.000
		Preston proportion	0.23567	0.113
	Golden proportion	Observed values	0.64667*	0.000
		Golden mean	0.00000	1.000
		Preston proportion	0.88233*	0.000
	Golden mean	Observed values	0.64667*	0.000
		Golden proportion	0.00000	1.000
		Preston proportion	0.88233*	0.000
	Preston proportion	Observed values	−0.23567	0.113
		Golden proportion	−0.88233*	0.000
		Golden mean	−0.88233*	0.000
Left central incisor	Observed values	Golden proportion	−0.37333*	0.002
		Golden mean	−0.37333*	0.002
		Preston proportion	0.50900*	0.000

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Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean difference (I − J)	p-value
	Golden proportion	Observed values	0.37333*	0.002
		Golden mean	0.00000	1.000
		Preston proportion	0.88233*	0.000
	Golden mean	Observed values	0.37333*	0.002
		Golden proportion	0.00000	1.000
		Preston proportion	0.88233*	0.000
	Preston proportion	Observed values	−0.50900*	0.000
		Golden proportion	−0.88233*	0.000
		Golden mean	−0.88233*	0.000
Left lateral incisor	Observed values	Golden proportion	0.37600*	0.000
		Golden mean	0.55500*	0.000
		Preston proportion	0.59533*	0.000
	Golden proportion	Observed values	−0.37600*	0.000
		Golden mean	0.17900	0.145
		Preston proportion	0.21933*	0.047
	Golden mean	Observed values	−0.55500*	0.000
		Golden proportion	−0.17900	0.145
		Preston proportion	0.04033	0.963
	Preston proportion	Observed values	−0.59533*	0.000
		Golden proportion	−0.21933*	0.047
		Golden mean	−0.04033	0.963
Left Canine	Observed values	Golden proportion	0.07867	0.752
		Golden mean	−0.06700	0.831
		Preston proportion	−0.96767*	0.000
	Golden proportion	Observed values	−0.07867	0.752
		Golden mean	−0.14567	0.258
		Preston proportion	−1.04633*	0.000
	Golden mean	Observed values	0.06700	0.831
		Golden proportion	0.14567	0.258
		Preston proportion	−0.90067*	0.000
	Preston proportion	Observed values	0.96767*	0.000
		Golden proportion	1.04633*	0.000
		Golden mean	0.90067*	0.000

* significant value

Table 3: The mean values with standard deviations of the observed values, golden proportion, golden mean, and Preston proportion of males

		Observed values	Golden proportion	Golden mean	Preston proportion	ANOVA F value	p-value
Right canine	Observed values	3.83 ± 0.69	3.54 ± 0.19	3.86 ± 0.94	4.60 ± 0.25	16.840	0.000
Right lateral incisor	Observed values	5.75 ± 0.56	5.71 ± 0.30	5.53 ± 0.29	5.51 ± 0.30	3.230	0.025
Right central incisor	Observed values	8.58 ± 0.47	9.22 ± 0.49	9.22 ± 0.49	8.34 ± 0.44	27.001	0.000
Left central incisor	Observed values	8.74 ± 0.41	9.22 ± 0.49	9.22 ± 0.49	8.34 ± 0.44	25.651	0.000
Left lateral incisor	Observed values	6.02 ± 0.75	5.71 ± 0.30	5.53 ± 0.29	5.51 ± 0.30	8.066	0.000
Left Canine	Observed values	3.97 ± 0.72	3.54 ± 0.19	3.86 ± 0.94	4.60 ± 0.25	15.934	0.000

Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean difference (I − J)	Sig.
Right canine	Observed values	Golden proportion	0.29400	0.241
		Golden mean	−0.02200	0.999
		Preston proportion	−0.76800*	0.000

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Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean difference (I − J)	Sig.
	Golden proportion	Observed values	−0.29400	0.241
		Golden mean	−0.31600	0.185
		Preston proportion	−1.06200*	0.000
	Golden mean	Observed values	0.02200	0.999
		Golden proportion	0.31600	0.185
		Preston proportion	−0.74600*	0.000
	Preston proportion	Observed values	0.76800*	0.000
		Golden proportion	1.06200*	0.000
		Golden mean	0.74600*	0.000
Right lateral incisor	Observed values	Golden proportion	0.04100	0.976
		Golden mean	0.22367	0.114
		Preston proportion	0.24833	0.064
	Golden proportion	Observed values	−0.04100	0.976
		Golden mean	0.18267	0.259
		Preston proportion	0.20733	0.162
	Golden mean	Observed values	−0.22367	0.114
		Golden proportion	−0.18267	0.259
		Preston proportion	0.02467	0.995
	Preston proportion	Observed values	−0.24833	0.064
		Golden proportion	−0.20733	0.162
		Golden mean	−0.02467	0.995
Right central incisor	Observed values	Golden proportion	−0.63500*	0.000
		Golden mean	−0.63500*	0.000
		Preston proportion	0.24567	0.190
	Golden proportion	Observed values	0.63500*	0.000
		Golden mean	0.00000	1.000
		Preston proportion	0.88067*	0.000
	Golden mean	Observed values	0.63500*	0.000
		Golden proportion	0.00000	1.000
		Preston proportion	0.88067*	0.000
	Preston proportion	Observed values	−0.24567	0.190
		Golden proportion	−0.88067*	0.000
		Golden mean	−0.88067*	0.000
Left central incisor	Observed values	Golden proportion	−0.47833*	0.001
		Golden mean	−0.47833*	0.001
		Preston proportion	0.40233*	0.005
	Golden proportion	Observed values	0.47833*	0.001
		Golden mean	0.00000	1.000
		Preston proportion	0.88067*	0.000
	Golden mean	Observed values	0.47833*	0.001
		Golden proportion	0.00000	1.000
		Preston proportion	0.88067*	0.000
	Preston proportion	Observed values	−0.40233*	0.005
		Golden proportion	−0.88067*	0.000
		Golden mean	−0.88067*	0.000
Left lateral incisor	Observed values	Golden proportion	0.30433	0.052
		Golden mean	0.48700*	0.000
		Preston proportion	0.51167*	0.000

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Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean difference (I − J)	Sig.
	Golden proportion	Observed values	−0.30433	0.052
		Golden mean	0.18267	0.409
		Preston proportion	0.20733	0.296
	Golden mean	Observed values	−0.48700*	0.000
		Golden proportion	−0.18267	0.409
		Preston proportion	0.02467	0.997
	Preston proportion	Observed values	−0.51167*	0.000
		Golden proportion	−0.20733	0.296
		Golden mean	−0.02467	0.997
Left Canine	Observed values	Golden proportion	0.43400*	0.034
		Golden mean	0.11800	0.877
		Preston proportion	−0.62800*	0.001
	Golden proportion	Observed values	−0.43400*	0.034
		Golden mean	−0.31600	0.193
		Preston proportion	−1.06200*	0.000
	Golden mean	Observed values	−0.11800	0.877
		Golden proportion	0.31600	0.193
		Preston proportion	−0.74600*	0.000
	Preston proportion	Observed values	0.62800*	0.001
		Golden proportion	1.06200*	0.000
		Golden mean	0.74600*	0.000

* significant value

Table 4: Overall population values of males and females

	Observed values	Golden proportion	Golden mean	Preston proportion	ANOVA F value	p-value
Right canine	3.78 ± 0.71	3.50 ± 0.17	3.73 ± 0.68	4.56 ± 0.23	48.361	0.000
Right lateral incisor	5.80 ± 0.55	5.65 ± 0.28	5.47 ± 0.27	5.44 ± 0.28	12.706	0.000
Right central incisor	8.48 ± 0.48	9.12 ± 0.45	9.12 ± 0.45	8.24 ± 0.41	60.787	0.000
Left central incisor	8.70 ± 0.43	9.12 ± 0.45	9.12 ± 0.45	8.24 ± 0.41	56.044	0.000
Left lateral incisor	5.99 ± 0.63	5.65 ± 0.28	5.47 ± 0.27	5.44 ± 0.28	24.719	0.000
Left Canine	3.76 ± 0.66	3.76 ± 0.66	3.73 ± 0.68	4.56 ± 0.23	51.727	0.000

Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean Difference (I − J)	p-value
Right canine	Observed values	Golden proportion	0.27800*	0.017
		Golden mean	0.04717	0.958
		Preston proportion	−0.77617*	0.000
	Golden proportion	Observed values	−0.27800*	0.017
		Golden mean	−0.23083	0.067
		Preston proportion	−1.05417*	0.000
	Golden mean	Observed values	−0.04717	0.958
		Golden proportion	0.23083	0.067
		Preston proportion	−0.82333*	0.000
	Preston proportion	Observed values	0.77617*	0.000
		Golden proportion	1.05417*	0.000
		Golden mean	0.82333*	0.000
Right lateral incisor	Observed values	Golden proportion	0.14517	0.129
		Golden mean	0.32600*	0.000
		Preston proportion	0.35850*	0.000

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Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean Difference (I − J)	p-value
	Golden proportion	Observed values	−0.14517	0.129
		Golden mean	0.18083*	0.034
		Preston proportion	0.21333*	0.008
	Golden mean	Observed values	−0.32600*	0.000
		Golden proportion	−0.18083*	0.034
		Preston proportion	0.03250	0.961
	Preston proportion	Observed values	−0.35850*	0.000
		Golden proportion	−0.21333*	0.008
		Golden mean	−0.03250	0.961
Right central incisor	Observed values	Golden proportion	−0.64083*	0.000
		Golden mean	−0.64083*	0.000
		Preston proportion	0.24067*	0.018
	Golden proportion	Observed values	0.64083*	0.000
		Golden mean	0.00000	1.000
		Preston proportion	0.88150*	0.000
	Golden mean	Observed values	0.64083*	0.000
		Golden proportion	0.00000	1.000
		Preston proportion	0.88150*	0.000
	Preston proportion	Observed values	−0.24067*	0.018
		Golden proportion	−0.88150*	0.000
		Golden mean	−0.88150*	0.000
Left central incisor	Observed values	Golden proportion	−0.42583*	0.000
		Golden mean	−0.42583*	0.000
		Preston proportion	0.45567*	0.000
	Golden proportion	Observed values	0.42583*	0.000
		Golden mean	0.00000	1.000
		Preston proportion	0.88150*	0.000
	Golden mean	Observed values	0.42583*	0.000
		Golden proportion	0.00000	1.000
		Preston proportion	0.88150*	0.000
	Preston proportion	Observed values	−0.45567*	0.000
		Golden proportion	−0.88150*	0.000
		Golden mean	−0.88150*	0.000
Left lateral incisor	Observed values	Golden proportion	0.34017*	0.000
		Golden mean	0.52100*	0.000
		Preston proportion	0.55350*	0.000
	Golden proportion	Observed values	−0.34017*	0.000
		Golden mean	0.18083	0.062
		Preston proportion	0.21333*	0.018
	Golden mean	Observed values	−0.52100*	0.000
		Golden proportion	−0.18083	0.062
		Preston proportion	0.03250	0.970
	Preston proportion	Observed values	−0.55350*	0.000
		Golden proportion	−0.21333*	0.018
		Golden mean	−0.03250	0.970

Contd…

Contd…

Pairwise comparison

Dependent variable	(I) Group	(J) Group	Mean Difference (I – J)	p-value
Left Canine	Observed values	Golden proportion	0.25633*	0.026
		Golden mean	0.02550	0.992
		Preston proportion	−0.79783*	0.000
	Golden proportion	Observed values	−0.25633*	0.026
		Golden mean	−0.23083	0.055
		Preston proportion	−1.05417*	0.000
	Golden mean	Observed values	−0.02550	0.992
		Golden proportion	0.23083	0.055
		Preston proportion	−0.82333*	0.000
	Preston proportion	Observed values	0.79783*	0.000
		Golden proportion	1.05417*	0.000
		Golden mean	0.82333*	0.000

* significant value

which is a blueprint for all the structures in nature, monuments, artist works, and even the humans that conforms to harmony and beauty. The golden proportion is observed in natural and architectural marvels and also in organic and inorganic entities. It is seen from most valuable monuments like Egyptian pyramids, the Taj Mahal from India, Mona Lisa, and Last supper—classical works by Leonardo Da Vinci, the famous Greek temple of Parthenon, Le Corbusier's modular human body sketch of proportion, musical compositions of Mozart and Beethoven and in the human form itself. Nature is a beautiful creature which is abundant with examples of golden proportion like the double-helical structure of human DNA, flowers, insects, butterflies, dolphins, moths to peacocks feather; there is the existence of the golden proportion in and around us.[12] Levin was the first to observe the existence of golden proportion and described its association of proportion with an aesthetically pleasing dentition that results in a beautiful smile.[3]

A mathematical or geometrical relationship between the six anterior teeth is important to calculate and determine a beautiful smile, in order to result in a restorative esthetic smile. In this present study, a total of 60 participants (30 males and 30 females) were recruited.

Ward derived a new formula considering the golden proportion, golden mean, and Preston proportion theories. In this study, the best results were obtained with the golden mean than the golden proportion and the Preston proportion.

Literature reveals a small difference in means between the larger populations and the current study. It can be concluded from the present study that the golden proportion did not exist between the six anterior teeth, which was similar to the results obtained in the studies by Al-Marzouk et al.[16], Fereydoun et al.[17], Swileh et al.[18], Mashid et al.[19], Hegde et al.[20], Sandeep et al.[21], Bukhary et al.[22], Murthy et al.[9], Rosenstiel et al.[23], and Francis Beyuo[13].

If the anterior teeth are in golden proportion, it results in an esthetic smile, but a beautiful smile or esthetics is not limited to the presence of a golden proportion. For designing and reconstructing an anterior tooth it is not necessary to achieve the exact width of the golden proportion. These exact proportions rarely occur in natural teeth. Golden proportion (1.618:1) is one of the factors in designing the smile but not the only factor in smile designing.[12]

Results of the golden mean of the present study are supported with results by Chander et al.[24], Fayyad et al.[25], and Vishwas et al.[26], which reported that the widths of the six anterior teeth were not in golden proportion but the widths of the six anterior teeth were in constant terms in golden percentage. Krishna et al.[27]concluded that the Preston proportion was most prevalent among the lateral incisors and central incisors of all the participants, this finding supported the present study and was contrary to findings in studies by Condon et al.[28] and Agarwal et al.[29]

This study was conducted to create an esthetic smile for the individual by using the formula so that it makes it feasible for a dentist to create the proportions of the anterior teeth accordingly obtained from it.

The limitations of the present study include the parallax errors in the delayed pouring of the casts obtained from the subjects that affect the results of the study. For arriving at a definite conclusion and generalization of the findings of the current study, the sample size was not sufficient. An accurate paper grid and calculations at the chair side and research with a large sample size will do great justice to the study.

CONCLUSION

The following conclusions were drawn within the limits of the study. The golden mean was more applicable to the subjects of the current study. Golden proportion did not exist in the population but the values were in relation to the golden mean and the observed values. Preston proportion did not exist between the six maxillary six anterior teeth. The right lateral incisor values of golden proportion, the golden mean, and Preston proportion were in close relation to the formula in males than compared to females.

The current study enlightens that when individual reports for the smile designing, the formula of the golden mean instead of the golden proportion or Preston proportion can be used as the average values of the golden mean approximate the values of the esthetic smile.

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