

Validity of esthetic proportions in maxillary anterior teeth

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Abstract

Introduction: One of the primary considerations of patients seeking treatment for anterior teeth is to have esthetic proportions in maxillary anterior teeth. Various mathematical proportions that have been suggested to relate the width of maxillary anterior teeth include golden proportion, recurring esthetic dental (RED) proportion, golden percentage and Chu's proportion. The aim of this study was to evaluate the validity of these proportions in relating the width of maxillary anterior teeth.

Material and Methods: Standardized frontal images of 50 dental students were captured. All the images were downloaded to a personal computer and width of each tooth was measured by scale tool of Adobe Photoshop 7. Calculations were made for each theory of proportion. Descriptive statistics were used to calculate percentages.

Results: Golden proportion was found in 10% of the perceived lateral to central incisor ratio on both sides. RED proportion was not found to be constant. The values for golden percentage were found to be 22%, 15%, 12% for each of the centrals, laterals and canines respectively. Chu's proportion was not found to exist.

Conclusions: Golden proportion, RED proportion and Chu's proportion are unsuitable methods to relate the successive widths of maxillary anterior teeth. However, golden percentage theory can be applied to relate the widths of anterior teeth if percentages are adjusted taking into consideration the ethnicity of the population.

Keywords: Golden proportion; recurring esthetic dental proportion; golden percentage; Chu's proportion.

Introduction

One of the primary concerns of patients attending dental clinics for esthetic reasons is the creation of harmonious proportions between the widths of maxillary anterior teeth when restoring or replacing them. Therefore, the most difficult challenges in esthetic dentistry are achieving restorations that are in harmony with the patient's facial contour and appearance.¹ In the search to create esthetically pleasing restorations various proportions have been suggested to

describe the relationship between maxillary anterior teeth. These include; golden proportion, golden percentage, recurring esthetic dental proportion and Chu's proportion. By far the most cited is the golden proportion. This rule which is also called divine proportion was devised by Pythagoras in 530 BC. It was suggested that objects, animate or inanimate, whose features or details conform to this ratio are perceived as having innate beauty.² This ratio is approx 1.61803:1 which means that the smaller section is about 62% the size of the larger. The uniqueness of this ratio is that the ratio of the smaller part to the larger part is the same as the ratio of the larger part to the whole.¹ Lombardi and Levin were the first to introduce the concept of golden proportion to dentistry and to transpose this ratio to the maxillary anterior sextant.³ It has been suggested as one possible mathematical approach to development of ideal size and

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shape relationships for maxillary teeth. As applied to maxillary teeth, the golden proportion requires a 62% reduction in the viewing width of each tooth, beginning with the central incisor and proceeding posteriorly. For creation of harmony in the anterior segment the ratio should be repeated moving distally from the central to lateral incisor and from lateral incisors to canines.⁴

After the first documentation of this ratio in dental literature in 1978, there have been many studies regarding the use of golden proportion in various aspects of dental esthetics. Some suggest that golden proportion is valuable in achieving harmonious relationships between the teeth while others state that it is not the sole determinant in achieving dental esthetics. Levin pointed out that the width of the maxillary lateral incisor is in golden proportion to the width of the central incisor and also the width of the canine to the lateral incisor when viewing from the front.¹ Shoemaker has also endorsed the use of the golden proportion in anterior esthetics.⁵ Existence of golden proportion was analyzed by Hasanreisoglu et al by using the information obtained from both the computer images and the casts and it was found to be nonexistent in the maxillary anterior teeth.⁶ Ali Fayyad et al found golden proportion as an unsuitable method to relate the successive widths of the maxillary anterior teeth. According to them the golden percentage theory seems to be applicable to relate the successive widths of the maxillary anterior teeth if percentages are adjusted taking into consideration the ethnicity of the population.³ Chu identified that only 17% of the patients fit within the golden proportion and strict adherence to this rule would result in an excessively narrow maxillary arch and compression of the lateral segments. He described another way to relate the width of teeth within the esthetic zone and proposed that the width of maxillary lateral incisor should be approximately 2mm less than the

central incisor and the width of canine should be 1mm less than the central incisor.⁷ On the contrary, Ward stated that rather than being locked into using the 62% proportion, the dentists can use a proportion of their choice. He described recurring esthetic dental proportion (RED) which states that the proportion of the successive width of the teeth as viewed from the front should remain constant as one moves distally.⁸ The RED proportion has been found to be pleasing to the patients as well as clinicians and can be used to arrange the teeth for a pleasing smile.⁹ The aim of the study was to evaluate the validity of various esthetic proportions that have been suggested in the literature to relate the width of maxillary anterior teeth.

Material and Methods

This descriptive study was conducted on fifty dental students. Only those students who had a well aligned anterior dentition were included in the study. Those who had missing teeth, maxillary anterior restorations or trauma, history of orthodontic treatment, crowding, spacing or rotations in the anterior teeth were excluded from the study. A frontal photograph of each subject was taken from a distance of one meter using digital SLR camera Nikon D5000. The camera was stabilized with the help of the tripod at this fixed distance. Lips were retracted to clearly display the maxillary teeth. All the images were downloaded to a personal computer. The photograph of each subject was opened in the software Adobe Photoshop 7 and apparent mesiodistal width of each tooth from canine to canine was measured using the scale tool provided in the software. All the measurements were made by a single investigator to ensure reliability of results. For this study the golden proportion was taken as 62%. Therefore, for estimation of the existence of golden proportion the measured width of the central incisor was multiplied by 62% and compared with that of the adjacent lateral incisor. Similar values indicated that

the width of the central incisor is in golden proportion to the width of the lateral incisor. Similarly by comparing the width of the lateral incisor after multiplying by 62% with that of the canine, it was determined whether the width of the lateral incisor is in golden proportion to the width of the canine.

The golden percentage was calculated by dividing the width of each central incisor, lateral incisor and canine by the total width of all six maxillary anterior teeth and multiplying the resulting value by 100. If the resulting width of the canines, lateral incisors and central incisors showed 10%, 15%, 25% respectively of the intercanine distance they were taken as following golden percentage.

For RED proportion, ratio of the width of lateral incisor and central incisor was compared to that of canine and lateral incisor. Constant values indicated existence of RED proportion.

For chu's proportion, if the width of the lateral incisor was calculated to be 2mm less than the width of central incisor, it was taken as following Chu's proportion. Similarly if the width of canine was less than 1mm of the width of central incisor Chu's proportion existed.

Results

The study group consisted of 50 subjects of which 14(28%) were males and 36 (72%) were females. The mean age was calculated to be 20.4 (Table I).

The occurrence of golden proportion was found to be 10% of the perceived lateral to central incisor ratio on both sides and 2% of the perceived canine to lateral incisor ratio on the right side and 6% on the left side (Table II). The occurrence of golden proportion on the right and left side was found in different subjects therefore it did not exist in the maxillary anterior teeth. The values obtained for golden percentage, beginning with the right side canine and moving to the left side canine in this study were 12, 15, 22, 22, 15 and 12% respectively (Table III).

RED proportion existed in 4% of the subjects on the right side and 2% on the left side showing inconsistent results (Table IV). In this study, the ratio of the width of maxillary lateral incisors to the width of central incisors was found between 69.3 and 70.1% and the ratio of the width of canines to lateral incisors was between 79.6 and 82.3%. Regarding chu's proportion, results of the present study did not find its validity in maxillary anterior teeth (Table V).

Table I: Mean age

STUDY GROUP (50 Subjects)		
Gender	Males	Females
		14 (28%)
Age	20.4	

Table II: Golden proportion

Right side		Left side	
Lateral to Central Incisor Ratio	Canine to Lateral Incisor Ratio	Lateral to Central Incisor Ratio	Canine to Lateral Incisor Ratio
05 (10%)	01 (2%)	05 (10%)	03 (6%)

Table III: Golden percentage

RIGHT SIDE			LEFT SIDE		
Canine	Lateral Incisor	Central Incisor	Central Incisor	Lateral Incisor	Canine
12%	15%	22%	22%	15%	12%

Table IV: RED proportion

Right Side	Left Side
02 (4%)	01 (2%)

Table V: Chu's proportion

RIGHT SIDE		LEFT SIDE	
Lateral Incisor	Canine	Lateral Incisor	Canine
02 (1%)	10 (5%)	03 (1.5%)	05 (2.5%)

Discussion

Information regarding the existence of a mathematical or geometrical relationship is important in order to achieve an esthetic restorative result. In the current study we

found poor correlations between the dimensions of the teeth and the various esthetic proportions suggested in the literature.

Golden proportion has been suggested as a useful ratio for relating the widths of maxillary anterior teeth. Many studies have been conducted to evaluate its validity and have reported nonexistence of this ratio in natural teeth.^{1, 3, 6,9,10} The results of our study support the findings of the previous studies. However of all the anterior teeth, the highest percentage of the golden proportion was found between the lateral to central incisor ratio on both sides. Similar results have been reported by a study on American subjects.¹¹ In a study conducted on Arabs by Fayyad et al the highest percentage of golden proportion was found between left central incisor and left lateral incisor in males and between left lateral incisor and left canine in females.³ In another study on Indians the highest value for golden proportion was reported between the perceived left lateral incisor width and the perceived left canine width.⁹

Regarding the RED proportion, the present study showed that the ratio of the width of maxillary lateral incisors to the width of central incisors falls in the range of 69.3% to 70.1% and the ratio of the width of the canines to lateral incisors in the range of 79.6% to 82.3%. Our findings are in accordance with the results of Murthy and Ramani who reported a range of 69.5% to 70.3% for lateral to central incisor ratio and a range of 80% to 83% for canine to lateral incisor ratio.⁹ Although the values for the ratio of lateral to central incisor is in agreement with the 70% RED proportion suggested by Ward, the ratio between central and lateral incisors and between lateral incisors and canines was not found to be constant as proposed by Ward.⁸ Therefore we conclude that there is no evidence to support the application of RED proportion to natural teeth.

Our study contradicts the golden percentage theory as we found the values of 12%, 15%, 22%, 22%, 15% and 12% while moving from the right side to left side canine. The value for lateral incisors corresponds to that as proposed by Snow but the percentage obtained for central incisors is slightly lower and for the canines is slightly higher than the one suggested by Snow.³ However, the results for golden percentage in this study correspond to the values reported by other studies.^{3,9}

In the present study we have not observed the validity of Chu's proportion in maxillary anterior teeth. We must point out here that existence of Chu's proportion has not been studied so far.

Of all the esthetic proportions that have been suggested to relate the width of maxillary anterior teeth, golden percentage theory has been recommended by many studies if the percentages are adjusted taking into consideration the ethnicity of the population.^{3,9} Therefore, the values that we have calculated for the golden percentage might serve as a guideline to create harmonious proportions in maxillary anterior teeth for our population.

Conclusions

Application of golden proportion universally in anterior teeth should be reconsidered as it is found to be the least pleasing and accepted in studies worldwide. RED proportion and Chu's proportion are also not validated as a useful mathematical proportion to relate the width of maxillary anterior teeth. However, the golden percentage theory has been supported by various studies as a useful way to create harmonious proportions in maxillary anterior teeth if the percentages are adjusted according to the ethnicity of the population. Since esthetics is subjective and depends on the patient's and clinician's perceptions, it is therefore difficult to obtain specific guidelines that will lead to consistent results. Therefore, it is suggested that neither of the proportions

can be taken as a sole criterion to determine the width of maxillary anterior teeth and modifications should be done according to age, sex, ethnicity, personality and profession of the individual.

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