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ORIGINAL RESEARCH

In vivo study to assess the being hood of the golden proportion, recurring esthetic dental proportion and golden percentage between the maxillary anterior successors in individuals with natural dentition in western Rajasthan population

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Abstract

Background: Patients seeking dental care place a high value on aesthetics. The size and shape of person's maxillary anterior teeth have a considerable impact on not just their dental but also their overall facial beauty. The Golden proportion (62%) and the recurring esthetic dental proportion (RED) are two theories in this field that have been suggested to create harmony among anterior teeth.

Aim: The aim of the study was to assess the beinghood of the Golden proportion, Recurring esthetic dental proportion and the Golden percentage between the maxillary anterior successors in individuals with natural dentition in Western Rajasthan population.

Materials and methods: A total of 250 dentulous subjects which comprised of 125 males and 125 females, with ages ranging between 18 and 30 years. Their dental casts were evaluated for apparent width by digital callipers.

Results: This study indicates that a Golden proportion in the range of 0.60 – 0.64 exists in 6.24% - 6.26% of lateral to central incisors and 4.76-4.78% of canine to lateral incisor in maxilla, with a 95% confidence level. In the present study the ratio between central and lateral incisors and between lateral incisors and canines are not constant as suggested by Ward[1].

Conclusion: In this study Golden proportion and RED were not found to exist between the perceived widths of maxillary anterior teeth. The Golden proportion and the RED proportion cannot be used as constant proportions to create a harmonious proportion throughout the width of maxillary anterior teeth. For lateral incisors, values observed were closer to the Golden Percentage.

Introduction

A smile is a facial expression that expresses pleasant feelings like happiness and pleasure. A charming grin enhances the beauty of a person's face. Beauty is a pleasurable experience that is perceived through our senses, interpreted through our associations, filtered through a philosophy of life, and felt through intuition. Since the dawn of time, people have been searching for the essence of beauty. Patients seeking dental therapy place a high value on

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aesthetics. It was once said that we welcome the world with our face, and that our social appearance is determined by them. It is more important when planning treatment to replace artificial anterior teeth in the region of maxilla and mandible since they are the most visible teeth when smiling, speaking, and biting, affecting an individual's aesthetic personality.
Dental and facial aesthetics are influenced by the size and shape of the maxillary anterior teeth. Several methods for assessing tooth size for restoring and replacing maxillary anterior teeth include previous photos, face measurements, facial kinds, and ideal teeth proportions such as the golden proportion (GP) and recurrent aesthetic dental proportion (RED) of the teeth. Methodical study reveals that principles can be used to predictably evaluate and change dental esthetics[1]. One of the most significant and critical objectives in aesthetic dentistry is to achieve a harmonious proportion while restoring and replacing teeth.

The Golden Proportion
The Greek letter Phidius inspired the number 1.618, which is known as "Phi." This ratio has also been referred to as the Fibonacci ratio or Divine ratio.[2]The Golden Proportion captivated Leonardo da Vinci (1452-1519)[2], who wrote on the ideas in 1509 and published the "Divine Proportion." The Golden proportion, according to Levin and other scholars more recently, was the most harmonic repeated dental ratio[3].

The Recurring Esthetic Dental Proportion
Ward[1] developed the RED Proportion concept, which states that physicians may employ any proportion they like as long as it is consistent and moves distally in the arch.
The RED proportion employed in most cases is between 60 and 80 percent. The width of the central incisor is multiplied by the desired RED proportion to get the frontal view width of the lateral incisor once the optimal size of the central incisor has been calculated. To get the appropriate frontal image of the canine, multiply the resultant lateral incisor width by the same RED proportion.

The Golden Percentage
Snow[4] has advocated the use of the “Golden Percentage” as a means of applying the Golden proportion across the midline to encompass the total canine-to-canine width. The Golden Percentage of 10%:15%:25%:25%:15%:10% is a more meaningful tool to analyse the esthetic properties of a smile.

Methodology
The study was conducted on 250 subjects which includes the students (post graduates, undergraduates, internees and technicians), patients, and their attendants who visited the Maharaja Ganga Singh Dental College and Research Centre, Sriganganagar. All subjects were from various places in the western Rajasthan.
Irreversible hydrocolloid impression of the maxillary arches were made in stock trays and poured with Dental stone. The dimensions of the anterior teeth and the perceived width of the anterior teeth were measured using digital calliper read to the nearest 0.1mm. The measurement of the width of the anterior teeth was done by drawing a line on the graph paper contacting the incisal surfaces of anterior teeth. From the contact points drawing lines parallel to grid lines represented the perceived mesio-distal widths of the teeth.

a) Golden proportion for central incisor was calculated by multiplying its width by 62% and compared with the width of adjacent lateral incisor. Golden proportion for lateral incisor was calculated by multiplying its width by 62% and compared with the width of adjacent canine.

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b) RED proportion was calculated by dividing the width of each lateral incisor by the width of the adjacent central incisor and the resulting number was multiplied by 100. Similarly, the width of each canine was divided by the width of adjacent lateral incisor and the resulting number was multiplied by 100.
c) The golden percentage was calculated by dividing the width of each central incisor, lateral incisor and canine by the total width of all maxillary anterior teeth and multiplying the resulting value by 100, in order to obtain the golden percentage for each tooth.

Results

a) Evaluating the Existence of the Golden Proportion: This study indicates that a Golden proportion in the range of 0.60 – 0.64 exists in 6.24% - 6.26% of lateral to central incisors and 4.76-4.78% of canine to lateral incisor in maxilla, with a 95% confidence level (Table 1,2).
b) Evaluating the Existence of the RED Proportion: The results of this investigation showed in Males the ratio of the width of the maxillary lateral incisors to the width of the central incisors fall between 67.37% for right side and 67.98% for the left side and for Female subjects width of the lateral incisors to central incisors fall between 73.21% and 73.50% for the right and left quadrants respectively (Table 3).
c) Evaluating the Existence of the Golden Percentage: This investigation suggests the mean values for golden percentage for women's central incisors has a range of 21.95%-21.98%, while that for men is 22.71%-22.82. The mean values of golden percentage for lateral incisors ranged from 16.01%-16.05% for women and 15.29%-15.34% for men. With respect to the golden percentage of canines, the results of this study showed mean values of 11.86-11.94% for male canines and 11.96-12.02% for females.

Table 1. The actual measurements for the existence of Golden Proportion in subjects

Golden Proportion (Measured)	N	Minimum	Maximum	Mean	Std. Deviation
CA-R	250	2.90	7.10	4.7888	.72380
LI-R	250	4.70	8.30	6.2432	.69413
LI-L	250	4.70	8.40	6.2624	.70798
CA-L	250	3.10	7.00	4.7622	.71887

Table 2. The supposed measurements for the existence of Golden Proportion in subjects

Golden Proportion (Calculated)	N	Minimum	Maximum	Mean	Std. Deviation
CA-R (62% of LI-R)	250	2.91	5.15	3.8708	.43036
LI-R (62% of CI-R)	250	4.40	6.94	5.5336	.38003
LI-L (62% of CI-L)	250	4.34	6.94	5.5153	.37655
CA-L (62% of CI-L)	250	2.91	5.21	3.8827	.43895

Table 3. Existence of Recurring Esthetic dental (RED) proportion:

Red Proportion	N	Minimum	Maximum	Mean	Std. Deviation
CA/LI(R)	250	43.28	128.57	77.7371	14.98403
LI/CI(R)	250	50.54	96.51	70.2921	9.30271
LI/CI(L)	250	49.54	98.82	70.7471	9.48592
CA/LI(L)	250	43.84	136.17	77.0862	14.79762

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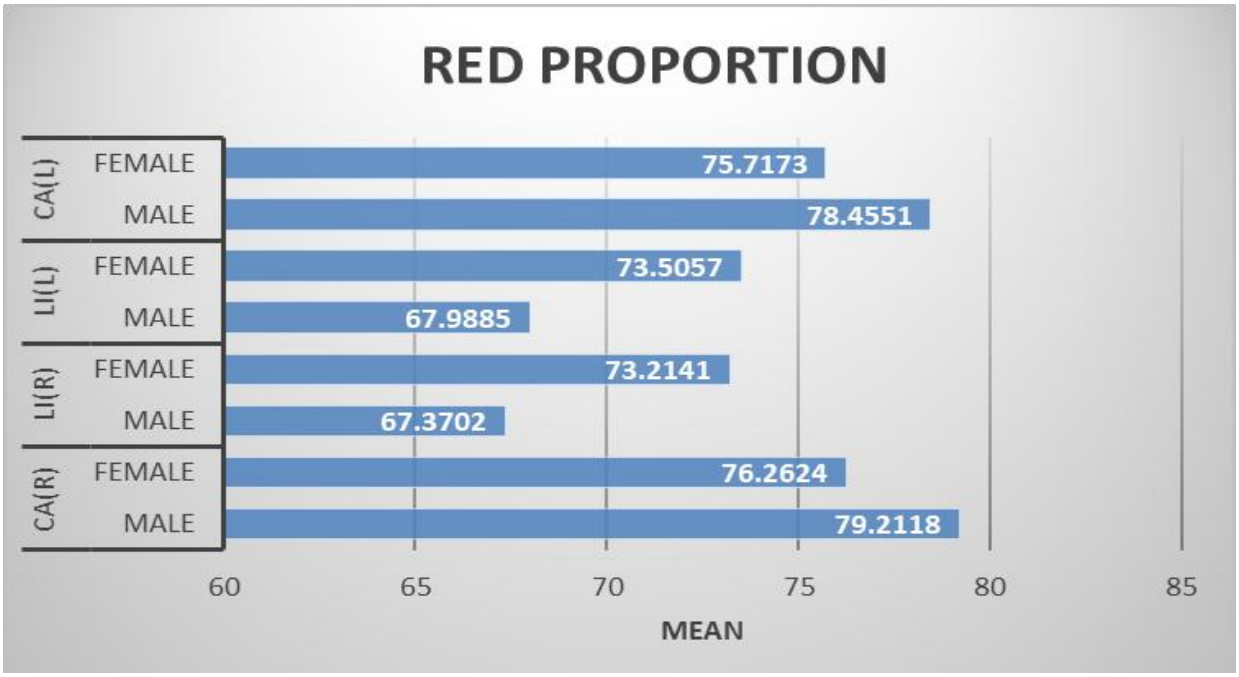
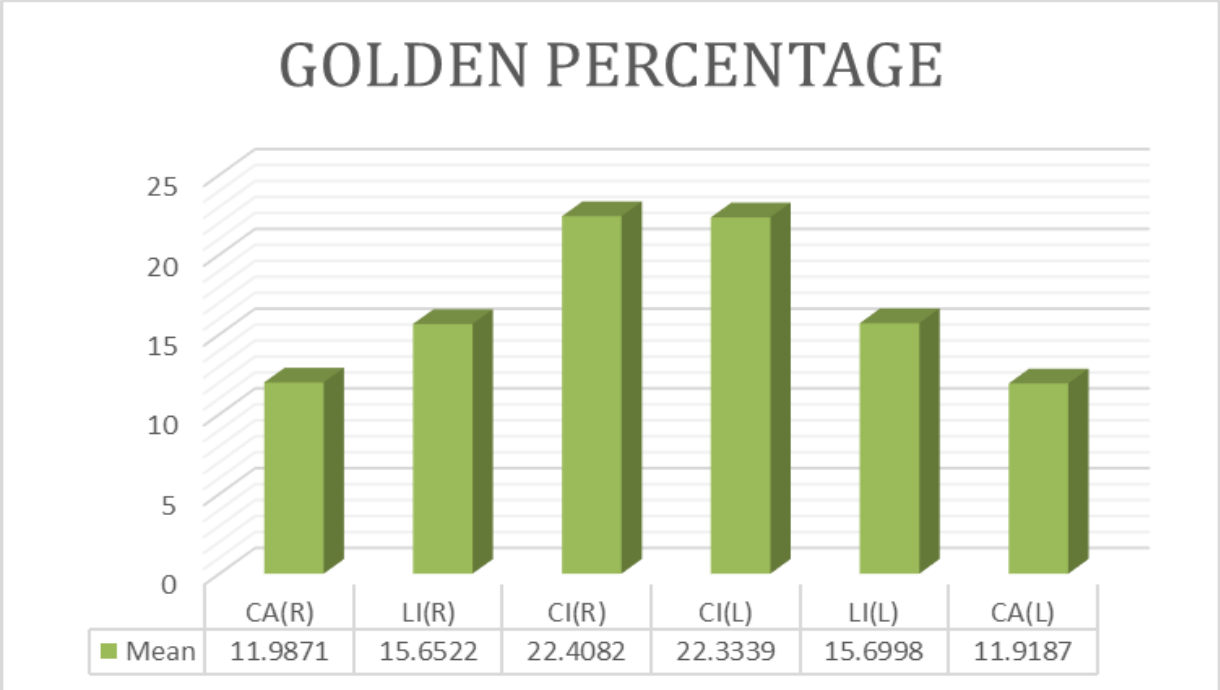
Graph 1: Comparing the existence of RED proportion in male and female subjects



Graph 2: Comparing the existence of Golden Percentage among both Males and Females subjects



Discussion

Krajicek[5] in 1969 stated that out of the two proportions width and length, the most important factor to be considered is width. Efforts to identify anatomical landmarks that correlate highly with the width of maxillary anterior teeth are least successful, so it is important to determine adequate teeth size.

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In 1973, Lombardi[2] was the first one to introduce the application of golden proportion in dentistry. The theory of golden proportion states that the proportional width of the maxillary lateral incisor is 62% width of the maxillary central incisor when viewed from the frontal plane. Similarly, the width of the maxillary canine is 62% the width of maxillary lateral incisor which is 38% width of maxillary central incisor.

This study indicates that a Golden proportion in the range of 0.60 – 0.64 exists in 6.24% - 6.26% of lateral to central incisors and 4.76-4.78% of canine to lateral incisor in maxilla, with a 95% confidence level.

George and Bhat[7] found that the golden proportion is reliable predictors for determining the width of the maxillary central incisors in the south Indian population. In 1993, Preston[8] conducted a study among dental students at the University of Southern California, measured 58 computer-generated images of dental casts with an image-measurement program and evaluated the frequency of the golden proportion (considered to be in the range of 0.61 - 0.63) in the ratios of the perceived maxillary lateral to central incisors and canine to lateral incisors. He found 17% of his study samples had golden proportion between the width of the maxillary central and lateral incisors.

The results of the present study were similar to the study conducted by Mahshid et al. (Among dental students at Shahid Beheshti Medical Science University, Tehran).[9] Variations in the values obtained in this study, as compared to the Preston study, maybe attributed to the difference between the range in the present study (0.60 – 0.64) and the range in the Preston study (0.61 – 0.63).

Hasanreisoglu et al.[10] conducted a study in Turkish dental students stated that the Golden proportion did not exist in natural dentition. Their studies revealed that significant differences emerged when the mean ratios between various perceived widths (lateral to central incisors and canines to lateral incisors) were compared with the Golden Ratio.

The Recurring Esthetic Dental proportion (RED) was proposed by Ward[1] in the year 2001 (Ward, 2001). This theory is based on the concept of linear coefficient progression. This theory states that the ratio between the two teeth placed next to each other should be constant as the measurements progress distally. However, these should be expressed as ratios that do not have a fixed value. For example, the Golden proportion gives a fixed value of 62% for the width of the lateral incisor as compared to the central incisor. However, in case of the RED, this value can show a variable value from 60%-80%.

With respect to the RED proportion, the results of this investigation showed in Males the ratio of the width of the maxillary lateral incisors to the width of the central incisors fall between 67.37% for right side and 67.98% for the left side and for Female subjects width of the lateral incisors to central incisors fall between 73.21% and 73.50% for the right and left quadrants respectively (Graph 1). These findings are in close agreement with previous studies conducted by Mahshid M[9], Preston JD[8], and Gillen RJ (Study at Wilford Hall Medical Center Dental Directorate)[11] that evaluated the ratio of the width of the maxillary lateral to the central incisors in samples and reported a mean proportion of 66% to 78%.

Hasanreisoglu et al.[10] stated that no continuous proportion was found in their study population, but they did not explain the details of this evaluation. Shetty[12] et al. divided central incisors into three categories: “small,” “medium," and "tall.” They calculated the average width of maxillary lateral incisor to central incisor and maxillary canine to lateral incisor in each category and compared them to evaluate the existence of the RED proportion. They concluded that the RED proportion was not seen in natural dentition.

Murthy[13] in 2008, and Fayyad[14] in 2006, compared the average width ratio of maxillary lateral incisor to central incisor with average width ratio of maxillary canine to lateral incisor. They concluded that the RED proportion is an unsuitable method for creating harmony in the width of the maxillary anterior teeth.

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In the present study the ratio between central and lateral incisors and between lateral incisors and canines are not constant as suggested by Ward[1].

As for using the golden percentage theory to correlate the six anterior teeth, the result of the present investigation suggests the mean values for golden percentage for women's central incisors has a range of 21.95%-21.98%, while that for men is 22.71%-22.82 (Graph 2). These figures are slightly lower than those suggested by Snow[9] who estimated a value of 25% for central incisors. However, the mean values of golden percentage for lateral incisors ranged from 16.01%-16.05% for women and 15.29%-15.34% for men.

For lateral incisors, these figures can be considered to be in agreement with those suggested by Snow[4] who recommended a value of 15% as the golden percentage. With respect to the golden percentage of canines, the results of this study showed mean values of 11.86-11.94% for male canines and 11.96-12.02% for females.

For canines, these figures are slightly higher than those suggested by Snow[4] who recommended a golden percentage value of 10%. In general, it appears that the width of central incisors is slightly smaller and the width of canines is slightly larger than those suggested by the golden percentage theory. A value of 22% for centrals, 16% for laterals, and 12% for canines can be adopted as these percentages are more applicable to natural dentition.

Conclusion

In this study conducted in Western Rajasthan population Golden proportion and RED were not found to exist between the perceived widths of maxillary anterior teeth. The Golden proportion and the RED proportion cannot be used as constant proportions to create a harmonious proportion throughout the width of maxillary anterior teeth. For lateral incisors, values observed were closer to the Golden Percentage.

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