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Comparative Evaluation of Golden Proportion, Recurring Esthetic Dental Proportion and Golden Percentage in Himachal Demographic

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Authors' contributions

This work was carried out in collaboration among all authors. Authors VM, AN and RG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SV managed the analyses of the study. Authors FJ and KT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The purpose of this study was to comparatively evaluate the validity of Golden Proportion, Recurring Esthetic Dental (RED) proportion and Golden Percentage in maxillary anterior teeth in population of Himachal Pradesh.
Methods and Materials: Dentulous stone casts of maxillary arch were made of the subjects who met the inclusion criteria. Conditions for inclusion criteria included that the individuals:
1) should be of Himachali origin with agreeable smiles
2) have well aligned anterior dentition
3) should be between age group of 20-40 years
Total of 200 students representing Himachal Pradesh population were included. Measurements were done for the spaces in the grids using the digital caliper.

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Results:
1)The Golden Proportion ratio of 1.3 and 1.4 were more commonly observed in 27.5% and 40% respectively than 1.618 which was observed in 5.5% under study of the population.
2)A Paired sample t-test showed there was no significant gender based difference in Lateral/Central incisor Red Proportion. (P-value>0.05) except for the Canine/Lateral Red Proportion. (P-value<0.05).
3)The Golden Percentage for males in central and lateral incisors and canine was 22.48%, 15.96% and 11.08% respectively. The mean value for females in central and lateral incisors and canine was 22.72%, 16.25% and 10.97% respectively.
Conclusions: Golden percentage could be used for aesthetic correction and was found to be more applicable in the population included in this study. Golden percentage could be used for aesthetic correction and are more applicable to natural dentition in the population of Himachal Pradesh.

Keywords: Golden proportion; Recurring Esthetic Dental (RED) proportion; golden percentage.

1. INTRODUCTION

Dental esthetics is a primary consideration for patients. The labial aspects of maxillary anterior teeth are more prominently visible when a person smiles; therefore they have a significant consequence in cosmetic dentistry. It is important in aesthetic dentistry to create a harmonious proportion when restoring or fabricating these teeth. Lombardi stated that the golden proportion is a constant ratio between the larger and smaller length which is approximately 1.618:1 [1]. Levin suggested the theory of golden proportion. He said that the width of the central incisor should be in golden proportion to the width of the lateral incisor and that the lateral incisor should be in golden proportion to the width of the canine when viewed from front [2]. Ward suggested Recurring Esthetic Dental Proportion as the proportion of the successive widths of the teeth as viewed from the front should remain constant as one moves distally [3]. Snow stated the golden percentage as he proposed the proportional width of the central and lateral incisors and canine to be 25%, 15% and 10% respectively.[4]

2. MATERIALS AND METHODS

Parameters to be evaluated:

1. Golden Proportion
2. RED proportion
3. Golden percentage

A total number of 200 subjects i.e. 100 males and 100 females with agreeable smiles were considered in the age group of 20-40 years. The selection criteria required the subjects to have Himachal origin with all their natural anterior teeth. No history of orthodontics treatment, no tooth size alterations, rotation, spacing, crowding and restorations between anterior teeth.

3. METHODOLOGY

Impression of maxillary arch of each participant was made in stock tray with irreversible hydrocolloid impression material (Zhermack Tropicalgin, Badia Polesine (RO) Italy). These impressions were poured with type III dental stone (Kalabhai Kalstone, Mumbai, India) to make a study model. Care was taken to mix the material as recommended by the manufacturer. Any stone model with presence of air bubbles was discarded. The dimensions of the anterior teeth and the perceived width of the anterior teeth viewed from front was measured using digital calliper (PRECISE, Sudershan Measuring & Engg P. Ltd. Delhi, India) read to the nearest 0.01mm. Golden Proportion, RED Proportion and Golden Percentage were evaluated by drawing grids (Neelgagan, Delhi, India) that were obtained by placing the casts on a flat surface and drawing vertical lines representing the perceived mesiodistal width of the teeth (Fig. 1). The left maxillary central incisor, left maxillary lateral incisor and left maxillary canine were selected for evaluation. Measurements were done for the spaces in the grids using the digital calliper (Fig. 2). The entire procedure was performed by a single operator independently and the average of the measurements was taken. If the readings differed by more than 0.2mm, the procedure was repeated.

4. MEASUREMENTS

The golden proportion is a mathematically constant ratio that defines the dimensions between larger and a smaller length. The ratio is

approximately (1.618:1) and the proportion of the smaller tooth is about 62% the size of the larger one. To calculate the RED proportion the width of each lateral incisor was divided by the width of the adjacent central incisor and the value obtained was multiplied by 100. Similarly, the width of canine was divided by the width of the adjacent lateral incisor and multiplied by 100. If the values obtained are constant, it will show that the central and lateral incisors and the canine are in RED proportion. The golden percentage stated that the width of central incisor, lateral incisor and canine is 25%, 15% and 10 % respectively which was calculated by dividing the width of all maxillary six anterior teeth and multiplying the value obtained by 100%.

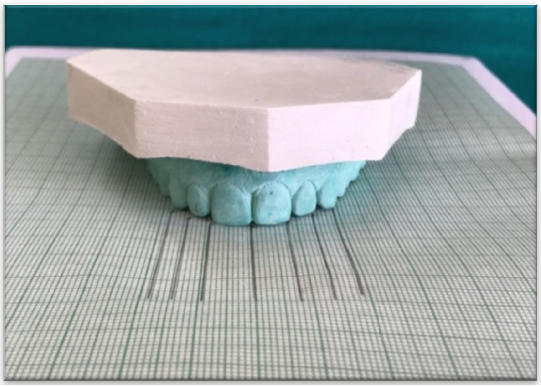


Fig. 1. Use of grid for measuring the width of the teeth

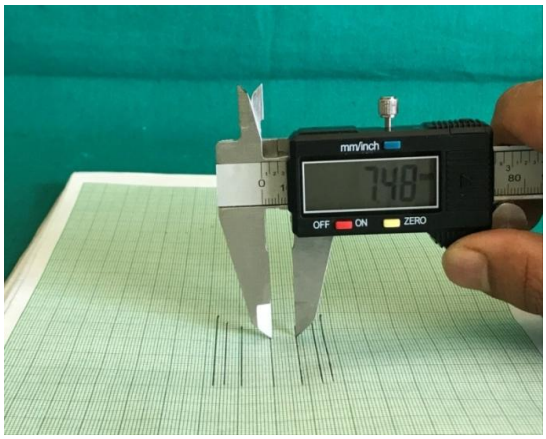


Fig. 2. Measuring the width using digital caliper

The data thus obtained was subjected to statistical analysis which was entered into Microsoft excel sheet.

Descriptive statistics were calculated for the frequency of participants having various ratio of Golden Proportion based on gender. Chi square analysis was used to find if there existed any association between different genders and various ratios of proportion. Rest of the data was analyzed using the paired t-test with value of significance set at $p<0.05\%$.

5. RESULTS

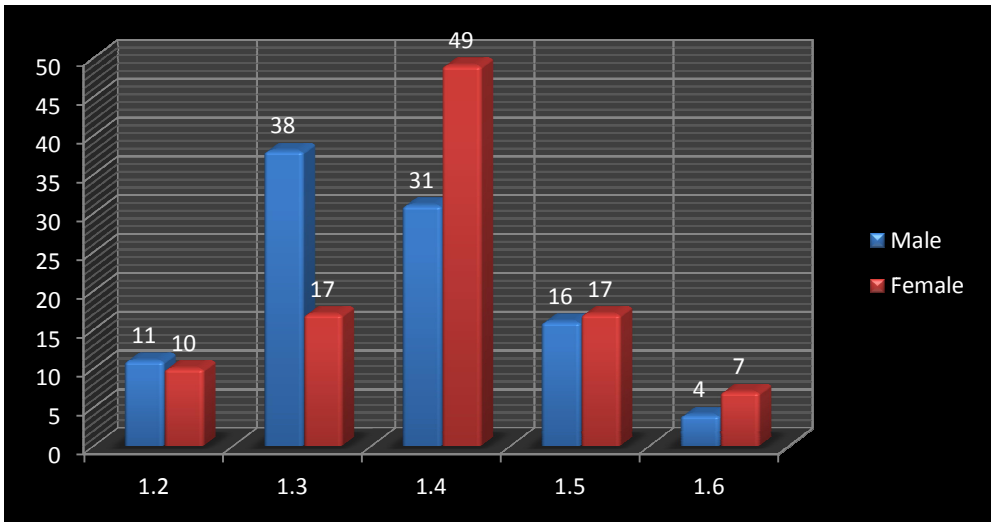
The results of this study indicated that the golden proportion did not exist in majority of the Himachal Pradesh population. The ratio of 1.3 was commonly observed in 38% of males and 17% of females whereas ratio of 1.4 was seen in 31% in males and 49% in females as compared to the ideal ratio suggested by golden proportion of 1.618 which was only seen in 5.5% of the population corresponding to 4% of males and 7% of females (Table1). In RED proportion the width of the maxillary lateral incisors to the width of the central incisors for male is 71.11% and for females is 71.88% as there was no significant gender based difference with the *P*-value=0.499. A Paired sample t-test showed there was a statistically significant gender based difference in the relation between the widths of the maxillary canine to the width of the lateral incisors for males 69.45% and for females 67.15% with the *P*-value=0.034 (Table 2). The mean value of golden percentage for males in central and lateral incisors and canine was 22.48%, 15.96% and 11.08 % respectively. The mean value for females in central and lateral incisors and canine was 22.72%, 16.25% and 10.97% respectively (Table 3).

Table 1. Ratios obtained in study samples

Ratio	Male		Female		Total	
	N	%	N	%	N	%
1.2	11	11	10	10	21	10.5
1.3	38	38	17	17	55	27.5
1.4	31	31	49	49	80	40
1.5	16	16	17	17	33	16.5
1.6	4	4	7	7	11	5.5

6. DISCUSSION

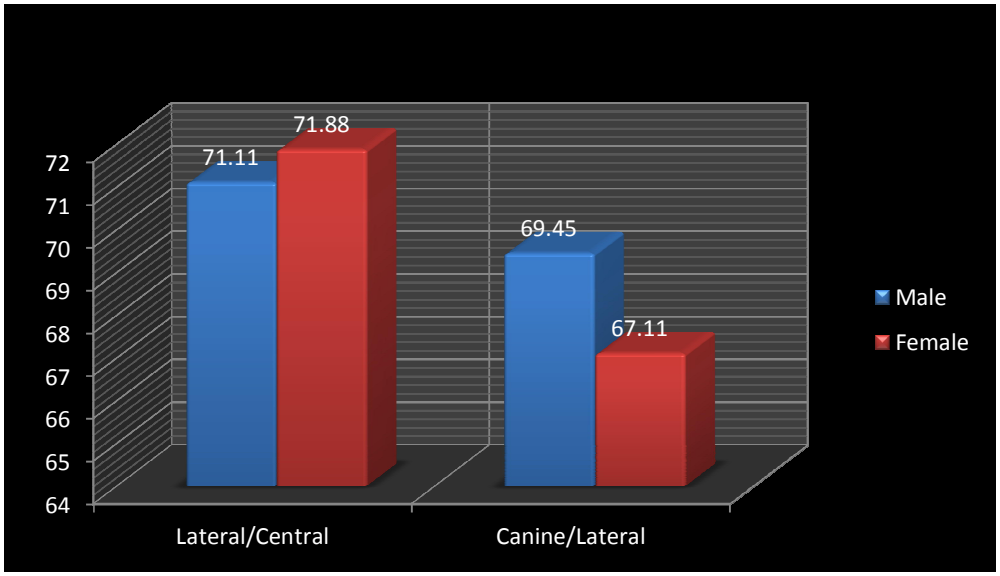
Esthetic dentistry believes in creating geometric or mathematical proportion to relate the successive width of anterior teeth thereby creating a harmonious proportion. Preston [5] found 17% of his study samples had golden proportion between the width of the maxillary



Graph 1. Bar diagram showing ratios obtained in golden proportion

Table 2. Red proportion values as obtained for the study samples

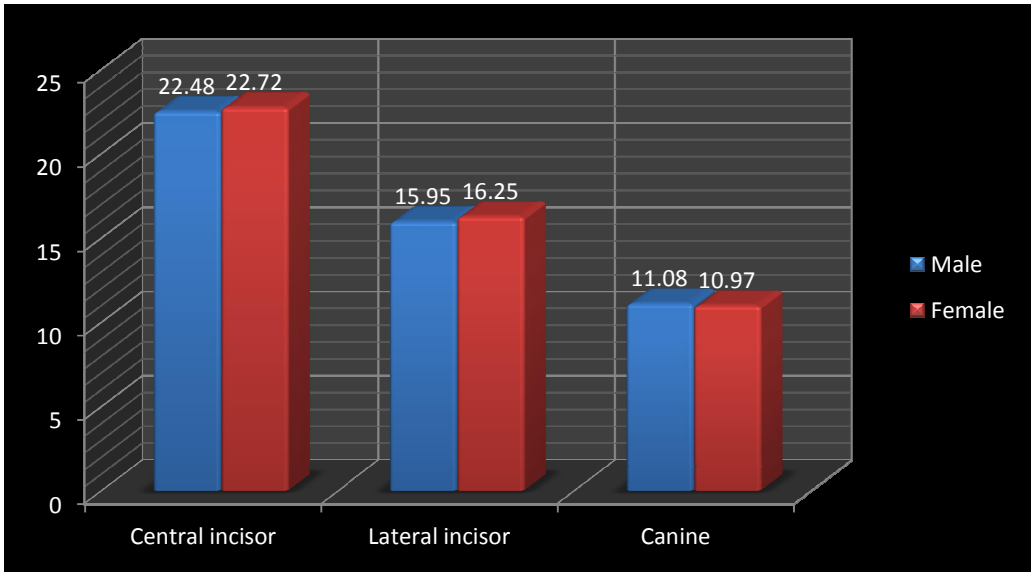
Gender	N	Mean %	Std. deviation	Std. error	Min	Max	t	P-value
Lateral/central								
Male	100	71.11	7.84	0.78	47.38	83.57	-0.677	0.499
Female	100	71.88	8.12	0.81	56.75	88.90		
Total	200	71.50	7.97	0.56	47.38	88.90		
Canine/lateral								
Male	100	69.45	8.18	0.82	57.75	88.97	2.132	0.034
Female	100	67.15	6.97	0.70	48.82	82.56		
Total	200	68.30	7.67	0.54	48.82	88.97		



Graph 2. Bar diagram showing values obtained in RED proportion

Table 3. Golden percentage values as obtained for the study samples

Gender	N	Mean %	Std. deviation	Std. error	Min	Max	t	P-value
Central incisor								
Male	100	22.48	1.37	0.13	19.34	26.80	-1.265	0.207
Female	100	22.72	1.40	0.14	20.08	25.80		
Total	200	22.60	1.39	0.10	19.34	26.80		
Lateral incisor								
Male	100	15.95	1.19	0.11	12.74	17.93	-1.784	0.076
Female	100	16.25	1.20	0.11	13.37	18.26		
Total	200	16.10	1.20	0.08	12.74	18.26		
Canine								
Male	100	11.08	1.03	0.10	8.19	13.49	0.774	0.440
Female	100	10.97	0.98	0.09	8.29	13.85		
Total	200	11.02	1.00	0.07	8.19	13.85		



Graph 3. Bar diagram shows the values obtained in golden percentage

central and lateral incisors. The study was conducted on 200 subjects from Himachal Pradesh including 100 males and 100 females.

The result of the study indicated that Golden Proportion does not exist in Himachal Pradesh population. The ratio of 1.3 and 1.4 were more commonly observed (Table 1). Hasanreisoglu et al. [6] and Mazaheri et al. [7] 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. Azimi et al. [8], , Marzok et al. [9], Muhammad et al. [10], Rosenstiel et al. [11], Preston [5] , Mahshid et al. [12], Wolfart et al. [13] consider that the golden proportion is more artistic, theoretical and impractical in nature. It is also inappropriate to anticipate that every patient to possess this precise relationship because human are individuals with unique facial and dental features. Ward3 suggested that the ratio of lateral to central incisor to be 70% Red Proportion. In relation of the RED proportion, the mean value of the width of the maxillary lateral incisors to the width of the central incisors for male is 71.11% and for females is 71.88% and the widths of the maxillary canine to the width of the lateral incisors for males is 69.45% and for females is 67.15% (Table 2). So, the ratio between central and lateral incisors and between lateral incisors and canine is not constant, so there

was no evidence to support Red Proportion theory as applicable to Himachal Pradesh population.

The golden percentage theory states that the width of the central and lateral and canine to be 25%, 15% and 10% respectively. The results of the present study that the mean value of golden percentage for central and lateral incisors and canine in males are 22.48%, 15.95% and 11.08% respectively and for females are 22.72%, 16.25% and 10.97%. The average value for Golden Percentage between central and lateral incisor and canine was found to be 22.6%, 16.1% and 11.2% respectively (Table 3). According to Murthy et al [14] it appears that the value of 22% for centrals, 15.5% for laterals, and 12.5% for canines can be adopted, as these percentages are more applicable to the natural dentition also stated that the minor variation in the values obtained in the study as compared to the previous studies. Thus the values obtained in the golden percentage could be used for aesthetic correction and are more applicable to natural dentition in the present population.

5. CONCLUSION

Within the limitations of the study it can be concluded that

- The theory of Golden Proportion and the RED Proportion was not found to be an appropriate method to relate the successive width of the maxillary anterior teeth in the Himachal Pradesh population and are not applicable to the natural dentition.
- After analysing the obtained data, we could easily determine the true Golden percentage for the population and use it to establish objectively quantifiable width ratio between maxillary anterior teeth. The theory of golden percentage was more applicable to the subjects of this study.

CONSENT

Informed consent to participate was obtained from each patient prior to their enrolment in the study.

ETHICAL APPROVAL

Ethical approval was obtained from institutional and university ethical research cell committee.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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