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Evaluating the presence of golden percentage, golden proportion and red proportion in maxillary anterior teeth in the endemic region of Jaipur, Rajasthan

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Abstract

The aim of the study is to evaluate the existence of golden percentage, golden proportion and red proportion in maxillary anterior teeth of students in Jaipur, Rajasthan. The objectives of this article include to evaluate the existence of golden percentage, golden proportion and red proportion in the given population, esthetic and unesthetic smiles in individuals and their co-relation with golden percentage, golden proportion and red proportion, the presence of golden percentage, golden proportion and red proportion between male and female subjects having esthetic and unesthetic smiles and the percentage of esthetic and unesthetic smiles between male and female subjects.

Keywords: RED, Unesthetic, Algin-gum

Introduction

Esthetics pertains to the sense of beauty. It is the science derived from nature. Esthetics is closely associated with the philosophy of High Art. Esthetics includes art as well as the very purpose behind it.

The concept of Golden proportion has fascinated scientists, architects and artists for more than 2,400 years. Although it has existed in mathematics and in the physical universe, it is still not known exactly when it was first discovered and applied by mankind.[1]

Ward proposed the concept of proportional smile design using the recurring esthetic dental (RED) proportion which states that the proportion of the successive widths of the maxillary teeth as viewed from front should remain constant, while progressing distally.[2] The 70% RED proportion has been recommended for normal length of maxillary central incisor tooth (78% width/ height-ratio). When using the 70% RED proportion, the width of the maxillary lateral incisor is reduced by 70% of the frontal view width of the maxillary central incisor, and the maxillary canine is reduced by 70% of the width of the preceding lateral incisor.[2]

The use of RED proportion (recurring esthetic dental proportions) presented lack of constant relation with successive teeth widths i.e the ratio between central incisor and lateral incisor was not always similar to the one between the latter and canine.[3,4]

However Golden percentage theory was found more applicable for esthetic smile analysis if percentage were adjusted considering ethnicity of population.[12] But snow stated that further studies are required to validate if golden percentage are essential for creating subjectively beautiful smiles.[4]

Inspite of widespread acceptability, it is surprising to note the existing vagueness about the precise proportion to be used for obtaining esthetically pleasing smile and also none of the authors have further discovered if the golden percentage, golden proportion and recurring esthetic dental (RED) proportion existed in esthetically unpleasing smile. Thus we have carried out a study to evaluate the existence of the golden percentage, golden proportion and recurring esthetic dental (RED) proportion between the widths of maxillary anterior natural teeth in individuals with esthetically pleasing and unpleasing smiles.

Methodology

This study was carried out in the Department of Prosthodontics, Jaipur Dental College, Jaipur among 100 dental students to determine the correlation of esthetic and unesthetic smile with various standard proportions in dental literature.

This study protocol was reviewed by the Ethical committee of Jaipur Dental College, Jaipur and granted ethical clearance. A written informed consent was obtained from all the individuals who participated in the study before the start of examination.

100 students (50 males and 50 females) between age group 19-27 years were selected. They were briefed about the procedures and written consents were obtained for the study. The subjects were questioned about their origin as to determine if he/she belonged to the Asian population. For determining the various standard proportions in selected subjects, procedure followed for the study was- A standardized frontal image of each subject's face was taken using a digital camera (NIKON DSLR 5200, FS 90mm 1:2.8, Macro 1:1 ,24.1 Mega Pixel). The distance between camera and subject was fixed at working distance of 60 cm. The camera was stabilized with help of tripod, at this fixed distance. The subject's head was positioned such that Frankfort horizontal plane was parallel to the floor and the mid-sagittal plane of the head was aligned with the center of the camera lens. The camera was positioned and adjusted so as to obtain a sharp image of the face from the upper eyebrows to the tip of the chin (frontal view). The subject was asked to smile, and the profile image was captured during the smile. After capturing the image, the images were then downloaded to a personal Laptop. All the marking were made with help of software Adobe Photoshop 7 (CS2 , Version 9.0),according to the mentioned criteria and the photographs were given to 5 different individuals to evaluate the smile of subjects by smile analysis score rating from score 1 to score 4, where score 1 is least esthetic smile and score 4 is most esthetic smiles, Where the smile getting the **score greater than or equal to 15 will be considered as aesthetic smile** .This is owing to the fact that aesthetics is subjective.

Each subject was seated comfortably on dental chair in a relaxed state and upright position. With a mouth mirror and probe, using artificial light, the mouth was examined and subject was selected according to the criteria laid earlier.

Impressions of the Maxillary teeth were made by perforated dentulous metallic tray with Alginate-Irreversible Hydrocolloid material (Algin-gum) and casts

were poured from Type 3 gypsum product (Neelkanth). Measurement of maxillary anterior teeth was done by vernier caliper (Insize 1112) followed by drawing of grids for the perceived widths of maxillary anterior teeth. And then the data of each tooth was recorded. Using the formula of different anterior teeth proportion, the golden percentage, golden proportion and red proportion was calculated.

Then the collected data was correlated with esthetic and unesthetic smile with various standard proportions in dental literature.

Golden Proportion

The golden proportion for each subject was measured as: The width of the central incisor was multiplied by 62% and compared with the width of the adjacent lateral incisor. The width of the lateral incisor was multiplied by 62% and compared with width of the adjacent canine.

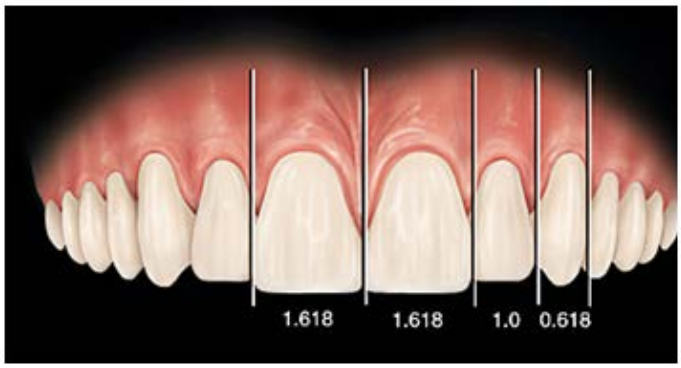


Figure 1: Golden Proportion

Red Proportion

The RED proportion was calculated by dividing the width of each lateral incisor by the width of the adjacent central incisor and multiplying by 100. Similarly, the width of each canine was divided by the width of the adjacent lateral incisor and multiplied by 100. If the resultant values are constant, it means the central incisor, lateral incisor, and canine are in RED proportion.

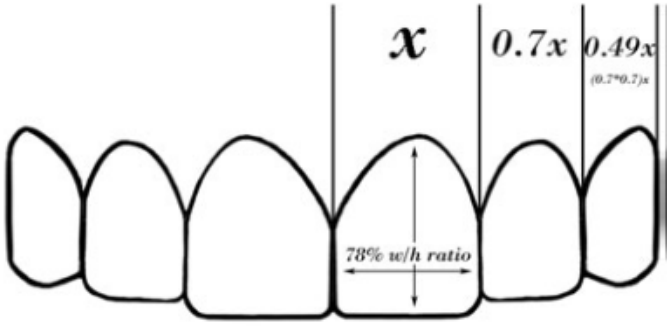


Figure 2: Red Proportion

Classification criteria for esthetic and unesthetic smile

Midline or Median Facial Line

For analysis, this method used 3 anatomic points: midpoint between the eyebrows (nasion), the nose base, and the philtrum, or the midpoint of the arch in the upper lip. (Figure 3)

A line was traced to join these 3 points, thus locating the median facial line.

All the smiles in which the median facial line did not coincide with the median dental line between the central maxillary incisors were considered to be esthetically unpleasing and the smiles in which the median facial line coincide with the median dental line between the central maxillary incisors were considered to be esthetically pleasing (Figure 4 & 5)

Figure 3: Midpoint between the eyebrows (nasion), the nose base, and the philtrum, or the midpoint of the arch in the upper lip

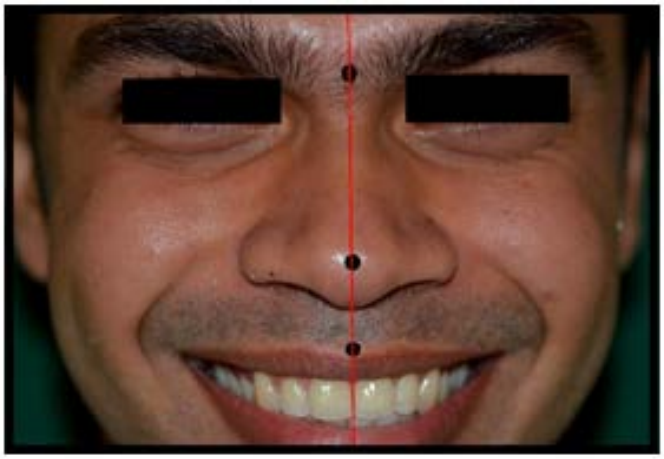


Figure 4: Esthetically pleasing smile

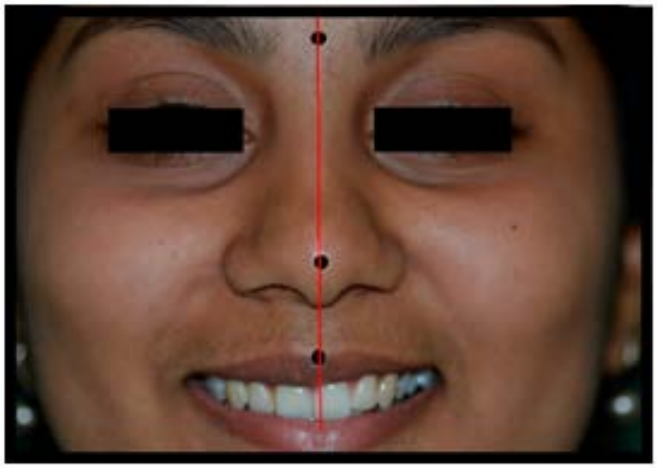


Figure 5: Esthetically unpleasing smile

Labial line or Lip line

I. Classification used for the analysis relates the upper lip, gingival tissue and antero-maxillary teeth in the following manner:

Low Lip Line or Low Smile—shows less than 3/4 of the maxillary teeth (Figure 6)

Figure 6. Low lip line (Esthetically Unpleasing)

II. Median Lip Line or Medium Smile—shows a large portion of or complete maxillary teeth and tip of the interdental papilla (Figure 7)

Figure 7. Median Lip Line (Esthetically Pleasing)

III. High Lip Line or High Smile—shows the total height of the maxillary teeth and a strip of gingival tissue (Figure 8)

Figure 8. High Lip Line (Esthetically Unpleasing)

Smile line or Incisal Curvature

I. **Positive smile line**: when the incisal edges of the central maxillary incisors are below the canine cusps, one would have a convex curve, which may approximate and harmonize with the bottom lip line.

II. **Neutra**l: when the incisal edges of the central maxillary incisors coincide with the tips of the canine cusps.

III. **Negative or reverse incisal line** (inverted smile): when the incisal edges of the central maxillary incisors are above the canine cusps, creating a convex and esthetically unpleasing line.

Line between the Commissures

The smile that presented with exposure of more than 75% of the maxillary teeth below the line between the commissures was considered to be an esthetically pleasing smile (Figure 12).

Figure 12: (Esthetically Pleasing smile)

Figure 13: Esthetically Unpleasing Smile

Methodology to calculate golden percentage, golden proportion and red proportion

Figure 14: Drawing of the grids for the perceived widths of maxillary anterior teeth.

Figure 15: Evaluation of proportions

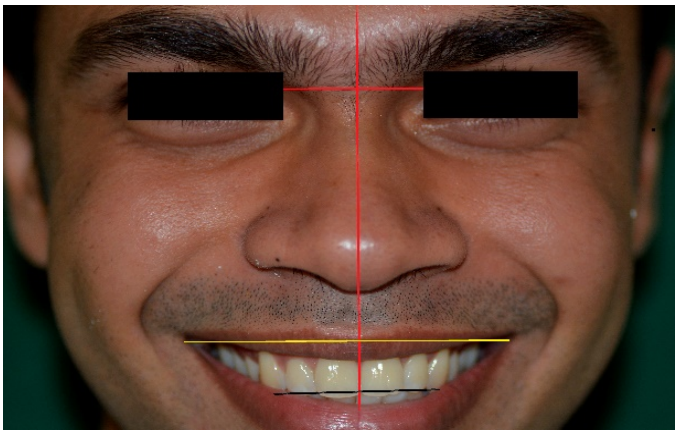


Figure 16: Esthetic smile

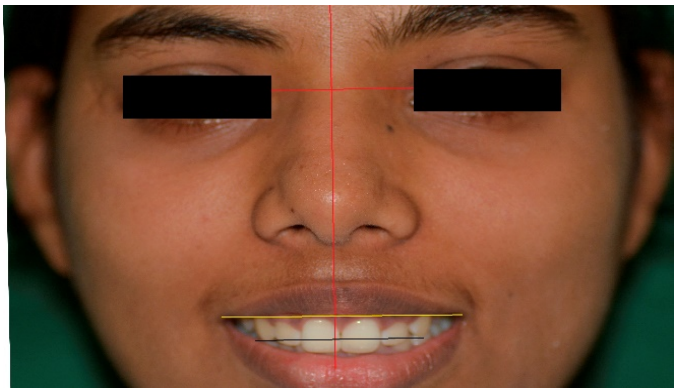


Figure 17: Unesthetic smile

Golden Percentage

- $\frac{\text{Width of central incisor (9mm)}}{\text{Total width of 6 anterior teeth (39mm)}} \times 100 = 23.07\ \%$
- $\frac{\text{Width of lateral incisor (6 mm)}}{\text{Total width of 6 anterior teeth (39mm)}} \times 100 = 15.38\ \%$
- $\frac{\text{Width of canine (4.5mm)}}{\text{Total width of 6 anterior teeth (39mm)}} \times 100 = 11.8\ \%$

Here so teeth are in golden percentage.

Golden Proportion

- Width of C.I x 62% = 9 x 62%
  = 5.6 mm
- Value for width of CI x 62 = compared with width of lateral incisor
  5.6 mm = 6 mm
- Width of lateral incisor x 62% = 6 x 62%
  = 3.8 mm
- Value for width of LI = Compared with width of canine
  3.8 mm = 4.5 mm

So here central incisor, lateral incisor is not in golden proportion lateral incisor and canine are also not in golden proportion.

Red Proportion

$$\frac{\text{Lateral incisor}}{\text{Central incisor}} \times 100 = \frac{6}{9} \times 100 = 66.7$$

$$\frac{\text{Canine}}{\text{Lateral incisor}} \times 100 = \frac{4.5}{6} \times 100 = 75$$

66.7 = 75

So, here as value is not comparable, so teeth are not in red proportion.

Results

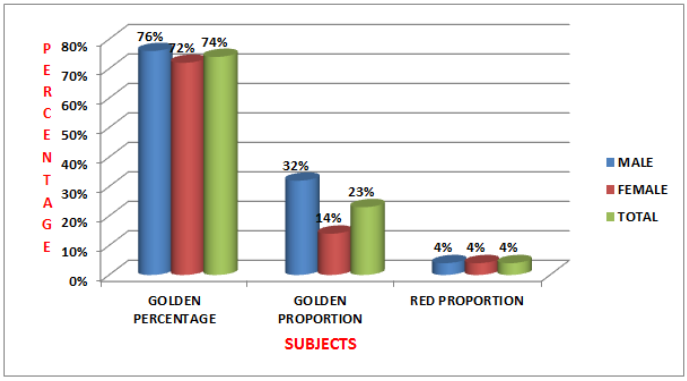
The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2010) and then exported to data editor page of SPSS (Statistical Package for Social Sciences) version 15.0 (SPSS Inc., Chicago, Illinois, USA). The values obtained were statistically analyzed.

Descriptive statistics included computation of percentages, means and standard deviations. Chi-square (x^2) test was used to compare percentages of categorical data (different types of proportions) in males and females. Paired t- test and Unpaired t- test was applied for quantitative data to compare the width between left and right side of maxillary anterior teeth and for the comparing the same in males and females respectively.

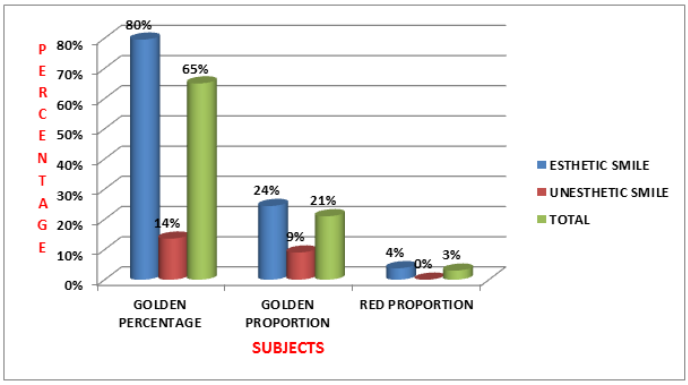
The results obtained were analyzed by applying Paired t-test, unpaired t-test and chi-square test using SPSS (Statistical Package for Social Sciences) version 15.0 (SPSS Inc., Chicago, Illinois, USA).

It was found that the data obtained showed significant results for Golden proportion and Golden percentage. The results showed statistically significant difference between genders with respect to esthetic smiles ($p \leq 0.05$) for presence of Golden percentage, Golden proportion and Red proportion.

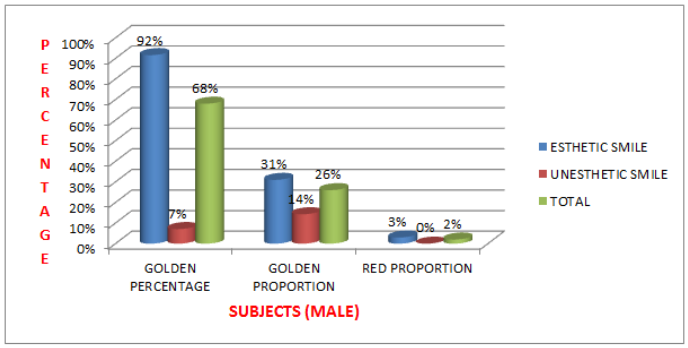
Graph 1: Comparative assessment for presence of golden percentage, golden proportion and red proportion between male and female subjects



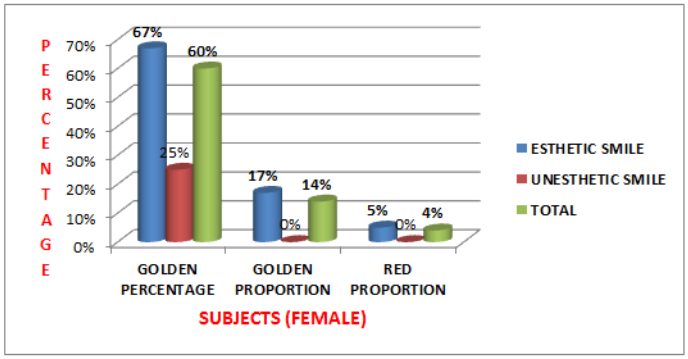
Graph 2: Presence of golden percentage, golden proportion and red proportion in subjects with esthetic and unesthetic smiles



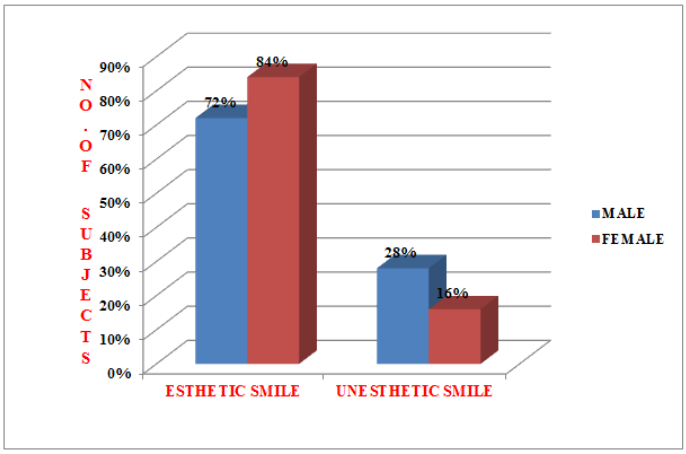
Graph 3: Comparison for presence of golden percentage, golden proportion and red proportion in MALE subjects having Esthetic and Unesthetic Smiles



Graph 4: Comparison for presence of golden percentage, golden proportion and red proportion in female subjects having esthetic and unesthetic smiles



Graph 5: Comparison of esthetic and unesthetic smiles between male and female subjects



Discussion

Smile designing is considered to be a subjective art.[5] Levin E.I. in his literature described that nature has oriented the anterior teeth to be in harmony with other features of the face with existing proportions between them.[6] Maxillary anterior teeth are important for both dental and facial esthetics. The most influential factors contributing to harmonious anterior dentition are the size, shape and arrangement of the maxillary anterior teeth, particularly the maxillary central incisors, as viewed from the front.[7] Moreover to achieve significant and reliable results, it was important to focus the present study on proportions of the upper anterior teeth, even though there are other important aspects of anterior dental aesthetics, such as tooth colour, tooth form and gingival margins.[8] Moreover, most of the literature have focused on Western population, whereas studies in asian population have been scarce.[7] The present study was done to evaluate the existence of golden percentage, golden proportion and red proportion in maxillary anterior teeth of Asian origin.

Photographs was used in the present study to analyze the harmony of facial appearance. The distance between camera and subject was fixed at working distance of 60 cm and the camera was stabilized with help of tripod, at this fixed distance. The camera was positioned and adjusted so as to obtain a sharp image of the face from the upper eyebrows to the tip of the chin (frontal view). Adobe Photoshop 7(CS2, Version 9.0) that immediately imports images taken with a digital camera was used making it possible to enlarge a photograph by its own magnification power.[7]

Using the golden percentage theory to correlate the six anterior teeth, the result of the present investigation showed the existence of golden percentage in 76% males and 72% female subjects. wherein the mean values for male and female central incisors were 22.9% and 22.7-23.1% respectively, lateral incisor 14.8-15.0% for female and 14.9-15.1% for men and canine 11.5-12.0 % for female and 11.5-11.87% for males. These data are slightly higher than those suggested by Snow who recommended a golden percentage value of 10%, 15%, 25% for canine, lateral incisor and central incisor respectively. In the present study the observation was similar to study of

Fayyad M et al. who gave 12%, 15% and 23% for canine, lateral incisor and central incisor respectively, allowing these percentages to be more applicable to natural dentition considering the ethnicity of subjects.[9]

For golden percentage clinical results for esthetically pleasing smiles showed 91.7% males and 66.7 % females, whereas for subjects with unaesthetic smile, the data revealed 8.3% males and 25% females had golden percentage. Clinical results showed statistically significant difference for presence of golden percentage in esthetic subjects. For red proportion insignificant results were obtained in both males and females having esthetic smiles. For an esthetically pleasing smile, the subjects profile image was evaluated for facial midline, lip line, smile line and line between commissures. Clinical results showed that among 50 males, 36 had esthetic smile and of 50 females 42 had esthetic smiles. Castro found in his study esthetic smiles were present in 8.1% of the 260 individuals evaluated, corresponding to 11 female and 9 male individuals. Present study observation is similar to Flore M. where in his study gender had an impact on aesthetic perception.[10]

Conclusion

In light of the results of this investigation the following conclusions can be derived:

1. Golden percentage was found to exist between perceived maxillary anterior teeth among individuals participated in the study whereas Red proportion and Golden proportion was not found to exist between the six maxillary anterior teeth.
2. Among all the subjects with esthetic smile, golden percentage was present in majority of individuals.
3. Gender has no statistically significant effect when the golden proportion, the golden percentage and the red proportion were applied.
4. It was determined that the percentage of esthetic smiles were more in females than males

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