

An Analysis of Maxillary Anterior Teeth Dimensions for the Existence of Golden Proportion: Clinical Study

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Abstract:

Background: Appearance of the face is a great concern to everyone, as it is a significant part of self-image. The study analyzed the clinical crown dimensions of the maxillary anterior teeth with respect to their apparent mesiodistal widths, width-to-height ratio to determine whether golden proportion existed among the South Indian population.

Materials and Methods: A total of 240 dentulous subjects were chosen for the study (120 males and 120 females) age ranging between 18 and 28 years. Full face and anterior teeth images of the subjects were made on specially designed device resembling a face-bow, mounted onto the wall under a standard light source. The width and height of the maxillary central incisors were measured on the stone casts using a digital caliper.

Results: The mean perceived maxillary lateral incisor to central incisor width ratio was 0.67 in males and 0.703 in females. The mean perceived maxillary canine to lateral incisor width ratio was 0.744 in males and 0.714 in females. The mean width-to-height ratio of the maxillary central incisor was 79.49% in males and 79.197% in females.

Conclusion: The golden proportion was not found between perceived mesiodistal widths of maxillary central and lateral incisors and nor between perceived mesiodistal widths of maxillary lateral incisors and canines. In the majority of subjects, the width-to-height ratio of maxillary central incisor was within 75-80%. There are no statistically significant differences in maxillary anterior teeth proportions between males and females. The results may serve as guidelines for treatment planning in restorative dentistry and periodontal surgery.

Key Words: Clinical crown, dental esthetics, epidemiology, esthetics, golden proportion, smile, tooth display

Introduction

Beauty is the pleasant experience seen with subjective senses, interpreted by our associations, filtered by a philosophy of life, and felt by intuition. The essence of beauty has been sought since beginning of the time.¹ "The face excels in beauty when compared with other anatomical divisions of the human beings" - Leonardo da vinci.² For everyone, appearance of face is of great concern, as it is significant part of self-image.³ Holmes has indicated the value of the facial beauty in general and the important contribution of teeth to facial beauty by this passage "A beautiful princess would not exchange one of her upper central incisor tooth for the most precious jewels for her crown."² The maxillary anterior teeth size, shape, and arrangement is the most influential factor for harmonious appearance, particularly when viewed from front.⁴ This clinical study determined existence of golden proportion among South Indian population through analyzing the maxillary anterior teeth clinical crown dimensions with respect to their apparent mesiodistal width and width-to-height ratio.

Materials and Methods

A total of 240 dentulous subjects comprised 120 males and 120 females, with age ranging between 18 and 28 years were chosen for the study. The subjects were the students (postgraduates, undergraduates, internees, technicians), patients, and their attendants who visited the hospital. All subjects were from various places in the state of Andhra Pradesh, South India. The sample was grouped according to gender to determine the effect on the correlation of the measurements. Informed consent was obtained from all the subjects prior to their participation. The study has been approved by Institutional Ethical Committee.

The inclusion criteria were:

1. No missing maxillary and mandibular anterior teeth,
2. No gingival or periodontal conditions that alter healthy tissue-to-tooth relationship,
3. No interdental spacing or crowding,
4. No anterior restorations,
5. No history of orthodontic treatment.

The exclusion criteria were:

1. Evidence of gingival alterations or dental irregularities,
2. Loss of tooth structure because of attrition, fracture, caries or restorations,
3. Problems which affect the dentition and face.

Materials

Perforated metal stock trays, rubber bowls, curved metal spatula, straight metal spatula, alginate impression material, dental stone, dental plaster, base formers, sand paper (Figure 1) were used for making the impressions and preparing the casts. Tooth dimensions on the cast were measured using a digital caliper, pointed fine tip pen (Figure 2). The photographs were taken using head stabilizing device with nasion relator (Figure 3). Tripod stand, digital camera (Cannon, Power Shot A590 IS), a cheek retractor, stool, spirit level.

Methodology

Standardized photographs were acquired using a specially designed wall-mounted device parallel to the floor resembling a face-bow. Each subject was photographed with the head upright, with maxillary occlusal plane parallel to the floor. The ear pieces are fixed into external auditory canals, and a nasion relator attached to the nasion. Meter ruler was mounted on the face-bow assembly perpendicular to the floor to aid in the calculation of the conversion factor so that the size of the image can be correlated to the actual size of the teeth (Figure 4). For standardization of the photographs, the camera was set on to the tripod with its lens parallel to the maxillary occlusal plane and the mid-sagittal plane of the subjects. Head was aligned



Figure 1: Armamentarium for making alginate impressions and preparing study models.



Figure 2: Digital caliper and marker used for obtaining measurements from study model.

with the center of camera lens. The focal distance was also standardized which was fixed at 5 feet. The cheek retractor was used for better visibility of the maxillary anterior teeth. Full face and anterior teeth images were made under a standard light source in a frontal view.

Maxillary casts preparation

Proper impression of the maxillary arch was obtained using irreversible hydrocolloid and metal stock trays; then poured immediately with dental stone. Care was taken to prevent incorporation of air bubbles by using a mechanical vibrator during preparation of the casts.

Digital analysis of mesiodistal widths of maxillary anterior teeth

The images were acquired to computer and the perceived mesiodistal width (the widest distance viewed from the front) was measured for each tooth using the horizontal measure tool of the imaging software (Adobe Photoshop CS, version 8.0) (Figure 5). The clear outlines of the mesial and distal contours of the teeth were obtained by enabling the zoom function of the program so that precise measurements were recorded. Three sets of readings were obtained, and their mean was considered for tabulation. The perceived mesiodistal widths of the maxillary lateral incisors were divided by the perceived widths of the central incisors, and the perceived mesiodistal widths of maxillary canines were divided by the perceived widths of maxillary lateral incisors. As the

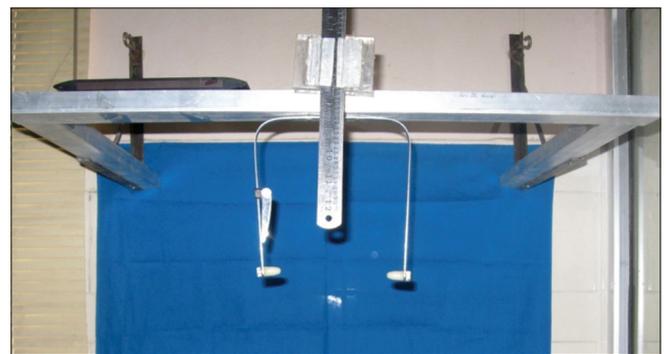


Figure 3: Head stabilizing device.



Figure 4: Subject in position for digital photograph.

conversion factor appears in both numerator and denominator of the fraction; while calculating the ratios of the teeth, it was ignored. The calculated values were tabulated and compared with the golden proportion (0.61-0.63 range was considered). Furthermore, the difference among males and females was evaluated.

Measuring of maxillary central incisor width-to-height ratio from the casts

A sharp-tipped digital caliper was used to measure the width and height of the maxillary central incisor. The maximum width measured from mesial and distal contact points of the tooth on a line perpendicular to the long axis. The longest distance from the cervical margin to the incisal edge was recorded as the height on a line parallel to the long axis. Dots were marked each on the cervical region, incisal region and mesial and distal borders, and the distance between them was measured using a digital caliper. Three readings were taken, and the mean was considered as the final value. The central incisors width-to-height ratios were calculated and compared to the 75-80% ratio proposed as most esthetically pleasing. The data obtained were tabulated and subjected to statistical analysis using unpaired *t*-test and Chi-square tests.

Results

The study showed the mean perceived maxillary lateral incisor to central incisor width ratio (Table 1) was 0.672 in males and 0.702 in females. The perceived maxillary mean canine to lateral incisor width ratio (Table 2) was 0.744 in males and 0.714 in females. The mean width-to-height ratio of the maxillary central incisor was 79.49% in males and 79.197% in females (Table 3).

Discussion

Esthetics is the prime consideration for all the patients seeking replacement of missing tooth. The width-to-height ratio of the maxillary central incisors has been suggested to be significant in terms of overall dental appearance because these teeth

normally dominate in persons smile. The central incisor is said to be in golden proportion when the coronal width-to-height ratio should be equal to 62% or 0.62.³ However, a width-to-height ratio of 75-80% has been considered to be most esthetically pleasing.^{4,5} Lower values are said to create a long narrow tooth while greater values result in a short wide tooth. Hence, in the present study we evaluated the width-to-height ratio of the maxillary central incisors and compared them with the 75-80% ratio.

According to Preston⁶ golden proportion is in the range of 0.61-0.63, the same range was considered in this study during evaluation of the data. In the present study, golden proportion between maxillary central and lateral incisor was found in 30 subjects (25%) in males and in 21 subjects (17.5%) in females; the golden proportion between maxillary lateral incisor and canine was found in 6 subjects (5%) in males and in 12 subjects (10%) in females. Similar results were found by Ali Fayyad *et al.*⁷ (in their study found 31.3% of males and 27.1% of females have golden proportion among width of central incisor to the width of the lateral incisor and 13.1% of males and 11.8% of females have the widths of their lateral incisor in golden proportion to the width of their canine), Preston⁶ (17% between central and lateral incisor and 0% between lateral incisor and canine), Mahshid *et al.*⁸ (34.1% between central and lateral incisor and <10% between lateral incisor and canine).

The mean perceived lateral incisor to central incisor width ratio was found to be 0.672 in males and 0.702 in females in the present study. Similar results were observed by Preston⁶ (0.66) and Mahshid *et al.*⁸ (0.67). The mean perceived canine to lateral incisor width ratio was found to be 0.744 in males and 0.714 in females, this ratio was much lower than those identified by Preston⁶ (0.84), and Mahshid *et al.*⁸ (0.87 in males and 0.85 in females). No statistical significant difference was observed between perceived mesiodistal widths of maxillary anterior teeth between males and females.

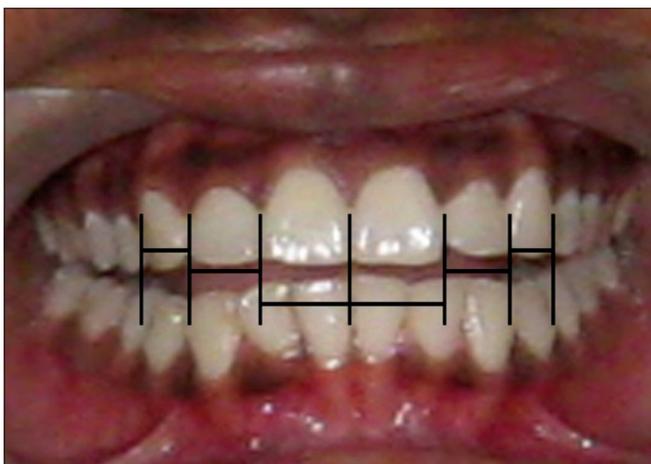


Figure 5: Perceived mesiodistal widths of the maxillary anterior teeth.

Table 1: Mean perceived width of lateral incisor/central incisor in males and females as analyzed by unpaired *t*-test.

Sex	N	Mean±SD	Comparison	Significance
Male	120	0.672±0.054	<i>t</i> =4.085; <i>P</i> =0.001	Significant
Female	120	0.703±0.063		

Table 2: Mean perceived width of canine/lateral incisor in males and females as analyzed by unpaired *t*-test.

Sex	N	Mean±SD	Comparison	Significance
Male	120	0.744±0.084	<i>t</i> =2.644; <i>P</i> =0.009	Not significant
Female	120	0.714±0.095		

Table 3: Mean width to height ratio of maxillary central incisor in males and females as analyzed by unpaired *t*-test.

Sex	N	Mean±SD	Comparison	Significance
Male	120	79.491±6.342	<i>t</i> =0.67; <i>P</i> =0.05	Not significant
Female	120	79.197±4.834		

Castro *et al.*⁹ in their study evaluated the width-to-height proportions of maxillary central incisor using a probe (intra-orally) and a boley gauge (extra-orally on casts), Sterrett *et al.*¹⁰ used caliper to measure the dimensions on the casts, Magne *et al.*¹¹ done the measurements on extracted teeth using imaging software. However, in the present study, the measurements were done on the stone casts using a digital caliper (read up to 0.01 mm).

In the present study, 66 (55%) male subjects and 69 (57.5%) female subjects were found to have their coronal width-to-height ratio of the maxillary central incisors within the 75-80%. Similar results were obtained by Castro *et al.*⁹ (in their study 57.14% central incisors have their width-to-height ratio within 75-80% ratio). The mean width-to-height ratio of the maxillary central incisors was found to be 79.5% in males and 79.2% in female. Similar results were obtained by Magne *et al.*¹¹ (the mean width-to-height ratio of maxillary central incisor was found to be 78%). The results did not coincide with the studies by Sterrett *et al.*¹⁰ (the mean width-to-height ratio in their study was 85% in men and 86% in women), and Hasanreisoglu *et al.*¹² (88% ratio in men, 91.2% ratio in women). There is no statistical significant difference in the ratio of width-to-height of maxillary central incisor between males and females.

Geometrical or mathematical relationship between teeth is an important determinant to achieve an esthetic restorative result.^{13,14} Statistically reliable relationship will be helpful to support the existing relationship theories. Even though literature suggests using golden proportions develops pleasing proportions, the results of the present study show that golden proportion did not exist between the perceived widths of the maxillary anterior teeth. Larger sample size, with different ethnic origin multicenter studies, is essential to prepare Indian standards.

Conclusion

Esthetics in dentistry cannot be justified mathematically; individuals should not be standardized in the same way. Although we dentists should follow some fundamental guidelines in esthetic treatment planning, it should be acknowledged that esthetics varies greatly from person-to-person. It is, therefore, important to consider the dento-facial

specificities of each individual and the various natural teeth proportions during restoration or replacement of the maxillary anterior teeth. In addition, individual cultural characteristics and perceptions of beauty must be considered.

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