The assessment of Golden proportion in primary dentition

Abstract

Background: Golden proportion is a constant ratio that exists in nature, responsible for the esthetic appeal of parts in the human body. The study was aimed to assess the existence of golden proportion in primary dentition by evaluating the average width and height ratio of maxillary anterior teeth.

Materials and Methods: A total of 200 children comprising equal number of males and females aged 3–7 years with all deciduous teeth present were randomly selected. Each participant was photographed with head upright and occlusal plane parallel to floor. Distance between the participant and camera was fixed at a working distance of 60 cm. The digital images were analyzed using imaging software (Adobe V7), the perceived widths of maxillary laterals were divided by widths of central incisor and that of canines were divided by perceived widths of lateral incisor. Maxillary arch impressions were made and casts prepared. Measurement of each anterior tooth was done using digital calipers. The measured width of lateral incisor was divided by width of central incisor and that of canine was divided by measured width of lateral incisor. Perceived and measured widths were tabulated separately. Results: The mean measured lateral incisor-to-central incisor ratio was 0.80. The mean measured canine-to-lateral incisor ratio was 1.32. The mean perceived lateral incisor-to-central incisor ratio was 0.75. The mean perceived canine-to-lateral incisor ratio was 0.90. The mean measured width-to-height ratio of central incisors was 1.14. The mean perceived width-to-height of central incisors ratio was 1.08. No significant statistical difference was observed between measured widths, perceived widths, measured width-to-height ratio, and perceived width-to-height ratios for both the sexes. There was strong correlation between these ratios and golden ratio (0.62). Conclusion: The study revealed that the golden proportion was inconsistent in terms of relative tooth width in primary dentition.

Keywords: Esthetics, golden proportion, measured widths, perceived widths, smile

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. For everyone, appearance of the face is of great concern, as it is significant part of self-image. One of the most important and critical tasks in esthetic dentistry is creating a harmonious proportion when restoring or replacing these teeth. While treating dental patients, dentist must determine the shape of the tooth and proportion in order to achieve optimal results. The esthetic value of a cosmetic restoration may be affected by factors contributing to the composition of a pleasing smile, such as amount of gingival display, midline position, gingival architecture, clinical crown dimensions, and tooth position. Maxillary anterior teeth bear a significant effect in esthetic dentistry as their facial aspects are widely visible during smiling.

Early childhood is an important stage in child’s life. Normal growth and development at this stage can be hindered by the common, but preventable, conditions of early childhood caries (ECC). ECC is a disease that causes transient disability in a child. The early loss of carious primary incisors may affect the patterns of speech by interfering with the pronunciation of tongue tip consonants (i.e., “t,” “d,” “s,” “sh” and “ch”), and the labial sounds of “f” and “v.” Other implications of the loss of primary incisors are decreased masticatory efficiency and the development of abnormal tongue habits, and potentially, subsequent malocclusion. The child may also suffer from psychological problems if aesthetics are compromised.
the modern civilized, cosmetically conscious world, well-contoured and well-aligned white teeth set the standard for beauty. Recently, more emphasis is being placed on pediatric esthetics as well. For these reasons, restoring a severely mutilated primary incisor becomes a special challenge to the dentists. A restorative technique which is able to provide efficient, durable and functional form, and which is simple to perform would enhance the management of patients presenting with carious maxillary primary incisors. Thus, a standard scale is necessary to evaluate the dimensions of primary anterior teeth for esthetic concern.

Golden proportion is based on the theory that a relationship exists between the beauty in nature and mathematics. It states that the width of maxillary lateral incisor, when viewed from front, should be in golden proportion to the width of the maxillary central incisor. Thus, the width of the maxillary lateral incisor should be 62% the width of the maxillary central incisor and the width of the maxillary canine should be 62% the width of resulting lateral incisor. Golden percentage proportion given by Snow states that the width of maxillary central incisor should be 25% the intercanine distance, when measured from distal of canine on one side to the distal of canine on the contralateral side in the frontal view. The width of maxillary lateral incisors and canines should be 15% and 10%, respectively, of the intercanine distance. Preston studied the existence of golden proportion in natural dentition and found that only 17% of the maxillary lateral incisors’ width was in golden proportion with the width of maxillary central incisors and none of the canines’ width was in golden proportion to the width of maxillary lateral incisor. He proposed Preston’s proportion, that is, the width of maxillary lateral incisor should be 66% the width of central incisors and the width of the maxillary canines should be 55% the width of maxillary central incisors in the frontal view. It has been advocated that the proportions of the teeth are important to achieve smile unity. The recurring esthetic dental proportion was proposed by Ward based on the different heights of the maxillary anterior teeth.

Although there are numerous studies determining the existence of golden proportion in the permanent dentition among various population groups, there are less consistent data available with respect to primary dentition. Hence, the present investigation was aimed to assess the existence of golden proportion in deciduous maxillary anterior teeth in 3–7-year-old children of West Godavari district, Andhra Pradesh, India.

Materials and Methods

The study comprised 200 children of age ranging from 3 to 7 years with equal distribution of males and females. The sample population was chosen randomly. The sample was grouped according to gender to determine the effect on the correlation of the measurements. Informed consent was obtained from all the participants before their participation. The study had been approved by institutional ethical committee.

The selection criteria required the children to have all natural primary anterior teeth without any restorations. Children with evidence of gingival alterations, loss of tooth structure because of attrition, and fracture or caries were not enrolled in the study.

The study specific armamentarium used included perforated metal stock trays, rubber bowls, curved metal spatula, straight metal spatula, alginate impression material, dental stone, dental plaster, base formers, sand paper, digital camera, cheek retractor, and metal scale [Figure 1]. Each subject was photographed with the head upright and occlusal plane parallel to the floor. 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 [Figure 2]. The digital photographic images were transferred to computer and the perceived mesiodistal width was measured for each tooth using the horizontal measurement tool of the imaging software (Adobe Inc San Jose California, US, 2005) [Figure 3]. 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. The perceived widths of the maxillary lateral incisors were divided by that of central incisor and the perceived widths of canines were divided by that of lateral incisor.

The height of the central incisors was also measured using the horizontal measure tool of the imaging software (Adobe Photoshop CS, version 7.0). The central incisors width-to-height ratios were calculated and tabulated.

Impressions of the maxillary arch were made with irreversible hydrocolloid and casts were poured using...
dental stone. Care was taken to prevent incorporation of air bubbles by using a mechanical vibrator during preparation of the casts [Figure 4]. A sharp-tipped digital caliper was used to measure the widths of central, lateral incisors, and canines. The measured width of lateral incisor was divided by that of central incisor and the measured width of canine was divided by that of lateral incisor. The perceived and measured widths were tabulated separately. The difference among males and females was also compared.

A sharp-tipped digital caliper was used to measure the width and height of the maxillary central incisor. The maximum width was 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 [Figures 5 and 6]. The central incisors width-to-height ratios were calculated and tabulated. The difference of the central incisors width-to-height ratios among males and females was also compared.

**Data analysis**

The obtained data were analyzed using SPSS software version 20 (IBM SPSS Statistics 20). Unpaired *t*-test was applied for the correlation of measured data.

The mean measured lateral incisor-to-central incisor ratio was 0.80 and it was observed in a total of 82 (41%) participants, of which 36 (72%) were male and 46 (92%) female [Table 1]. The mean measured canine-to-lateral incisor ratio was 1.34 that was observed in a total of 48 (24%) participants, of which 21 (42%) were male and 27 (54%) female [Table 2].

The mean perceived lateral incisor to central incisor ratio was 0.75 that was observed in a total of 64 (32%) participants, of which 36 (72%) were male and 28 (56%) female [Table 3]. The mean perceived canine-to-lateral incisor ratio was 0.90 that was observed in a total of 49 (24%) participants, of which 19 (38%) were male and 30 (60%) female [Table 4].

The mean measured width-to-height ratio was 1.14 that was observed in a total of 74 (37%) subjects, of which 25 (50%) were male and 49 (98%) female [Table 5].
The mean perceived width-to-height ratio was 1.08 that was observed in a total of 47 (24%) subjects, of which 28 (56%) were male and 17 (34%) female [Table 6].

There was no statistical significant difference observed between measured widths, perceived widths, measured width-to-height ratio, and perceived width-to-height ratios for both the sexes. However, a positive correlation was found between measured and perceived width ratios to measured and perceived width height ratios for both the sexes.

**Discussion**

Restoring primary anterior teeth that are grossly destructed owing to caries is very challenging for the pediatric dentist. A mathematical or geometrical relationship between teeth is thought to provide a template to achieve an esthetic restorative result. One of the most important tasks in esthetic dentistry is creating harmonious proportions between the widths of maxillary anterior teeth when restoring or replacing these teeth. It is helpful if statistically reliable relationships existed to support existing relationship theories. The golden proportion is a main guideline introduced to facilitate this process. Maxillary anterior tooth proportion has been proposed to be related to a golden proportion. Levin was the first to assert the existence of the golden proportion. This proportion was employed to determine the relationship between maxillary anterior teeth width. The central incisor is said to be in golden proportion when the coronal width-to-height ratio is equal to 62% or 0.62 in case of adults. A width-to-height ratio of 75%–80% has been considered to be most aesthetically pleasing.

The results of the present study showed varied existence of the mean measured maxillary lateral incisor-to-central incisor width ratio which was 0.80. The mean perceived maxillary lateral incisor-to-central incisor width ratio was found to be 0.75 and that of maxillary canine-to-lateral incisor width ratio was found to be 1.34 followed by maxillary canine-to-lateral incisor width ratio was 0.92. The measured width-to-height ratio of the maxillary central incisor was 1.14 and perceived width-to-height ratio of the maxillary central incisor was 1.09. There was no statistical significant difference between males and females. However, there was a strong correlation between these ratios and Golden ratio (0.62). In a similar study, Sandeep et al. aimed to analyze the clinical crown dimensions of the maxillary anterior teeth with respect to their apparent mesiodistal widths and width-to-height ratio to determine whether golden proportion existed among the South Indian adult population. The mean perceived maxillary lateral incisor-to-central incisor width ratio was 0.67 in males and 0.70 in females. They concluded that golden proportion was neither found between perceived mesiodistal widths of maxillary central and lateral incisors nor between widths of maxillary lateral incisors and canines. The observations, although reported in adult population were in accordance with the findings of the present study in primary dentition.

| Table 1: Mean measured lateral incisor to central incisor ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 0.80  |
| Female    | 100| 0.80  |

| Table 2: Mean measured canine-to-lateral incisor ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 1.34  |
| Female    | 100| 1.34  |

| Table 3: Mean perceived lateral incisor-to-central incisor ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 0.75  |
| Female    | 100| 0.75  |

| Table 4: Mean perceived canine-to-lateral incisor ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 0.90  |
| Female    | 100| 0.90  |

| Table 5: Mean measured width-to-height ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 1.14  |
| Female    | 100| 1.14  |

| Table 6: Mean perceived width-to-height ratio |
| Sex       | n  | Ratio |
|-----------|----|-------|
| Male      | 100| 1.08  |
| Female    | 100| 1.08  |
**Conclusion**

The study revealed that the golden proportion was inconsistent in terms of relative tooth width in primary dentition. Although golden proportion is a useful tool in esthetic/cosmetic dental treatment planning, the correlation was found to be insignificant between the obvious width and height of primary anterior teeth.

**Recommendation**

Most of the research conducted till date is focused mainly on permanent dentition pertaining only to adults. This dictates the need to address the esthetic concern even in children who are not only miniature adults. Apart from the esthetic and functional benefits, restoring anterior teeth to acceptable dimensions may contribute to psychological well-being of the child.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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