

Facial Morphometrics in Children with Primary Dentition and Comparison with the Golden Ratio: A Photogrammetric Study

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ABSTRACT

Background: Esthetically acceptable facial characteristics are a matter of concern even in children. Less attractive faces are considered less intelligent and are usually isolated. Scientifically beauty is defined in terms of Divine Proportions, which is an established fact in adults. However with the variation in the facial patterns in children compared to an adult, the existence of Divine Proportion of 1:1.618 in children is questionable. **Aim:** The present study aimed to evaluate the facial proportions in children with primary dentitions as measured on the silhouettes of the lateral profile and to compare the thus obtained vertical proportions with the universal norms. **Design:** 40 subjects with no history of orthodontic treatment and parafunctional habits were included in the study. Silhouettes of profile photographs of the subjects were scored by a panel of 15 judges. Based on the scoring 25 subjects with esthetically pleasing profiles were selected and vertical facial proportions were calculated on the silhouettes. **Results:** Comparison of means of the vertical facial proportion ratios with the universal norm of Divine proportion indicated statistically highly significant difference indicating the effect of growth on the establishment of divine proportion. However, the proportion on an average changed to a lesser extent during the growth period. **Conclusion:** Compared to the Divine Proportion, vertical facial proportions in children as measured on facial profiles differed significantly though to a lesser extent.

KEYWORDS: Divine Proportion, Growth and Development, Facial Growth, Facial Proportions, Primary Dentition

INTRODUCTION

“Beauty lies in the eyes of beholder” a famous quote by writer Margaret Wolfe Hungerford. This quote clearly justifies that the phenomenon of experiencing pleasure by the appreciation of beauty is a matter of an individual’s perception and may vary from person to person. Perception of beauty requires no intellectual assessment and is a reflection of one’s own assumptions hence making it difficult to be quantified. However, as per the literature, anything in balance or proper proportions is considered to be pleasing by most of the individuals. This balance or ideal proportion is referred to as Golden Proportion/ Golden Ratio/ Divine Proportion. The term “Golden Proportion” refers to the ideal proportion of 1:1.618 i.e., the ratio of the longer to the shorter part is same as the ratio of longer part to the whole.¹ Amazingly, Divine Proportion exists in smallest structures like DNA molecule to largest celestial bodies. It also exists in nature as well as in manmade monuments.

The applications of Divine Proportions in dentistry were popularized by Ricketts who suggested that the knowledge of these proportions can be utilized for orthognathic surgeries. According to Jefferson “There is a universal standard for facial beauty regardless of race, age, sex, and other variable, named as divine

proportion.”^{2,3} However, there is a great difference in the craniofacial proportions of an infant when compared to the craniofacial proportions in adults. The relation of the neurocranium to viscerocranium changes from 8 to 1 in infant to 2.5 to 1 in adult. This is true because the neurocranium changes to a larger extent in an infant when compared to that viscerocranium.⁴ Effect of growth on existence divine proportions in growing face is unclear.

Therefore, this study aimed to evaluate the facial proportions in children with primary dentitions as measured on the silhouettes of the lateral profile and to compare these proportions with the universal norms of Divine Proportion.

MATERIAL AND METHODS

The ethical clearance for conducting the research was obtained from the Institutional Ethical Committee (IEC). 40 males and females with esthetically pleasing profiles were invited to voluntarily participate in the study. The mean age of the subjects was 5.5yrs. Subjects with primary dentition only were selected as the transition from primary to early mixed dentition may have an effect on the facial proportions thereby causing dilution in the

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results. Informed consent from parents of the subjects and Informed Assent from the subjects were obtained prior to the commencement of the study. The subjects selected were neither treated orthodontically nor was there a need of the orthodontic treatment, there was no h/o trauma or surgeries in the craniofacial region.

Photographic set up: The method recommended by Riveiro et al. for photography set up was followed⁵. The set up consisted of a tripod that held 35mm DSLR camera with the 140mm lens and a primary flash. The tripod provided stability, correct height of the camera corresponding to the height of the subject. There were also 2 secondary flashes synchronized with the primary flash illuminating the background of the subject to avoid undesirable shadows casted by the profile. The leveling devices on the tripod and the camera helped to orient the correct horizontal position of the camera. The camera was used with manual settings. The subjects were instructed to stand relaxed in front of the mirror mounted on the wall opposite to the subjects. They looked into the reflection of their own eyes during the process of photography. For the ease of orienting the subject's face to the original size, the photographs were obtained with L-shaped photography scale.

All the 40 profile photographs thus obtained were converted into Silhouette images with the Adobe Photoshop version 7.0. A panel of 15 judges comprising of orthodontists, pedodontists, oral surgeons, prosthodontists, general dentists and lay person (not related to dentistry) scored these silhouettes on 100mm Visual Analogue Scale (VAS). The scale ranged from 0 (less attractive) to 100mm (most attractive). The judges evaluated to the silhouettes based on the interjaw relationship and lip position. Any scoring above 50 was considered to be esthetically acceptable. The final esthetic score for each silhouette was determined as the mean of the VAS of all the panel of judges. From the scores thus obtained 25 subjects were selected to be esthetically acceptable by the judge's panel and were considered for further analysis.

To evaluate divine proportions in the profile, 5 landmarks were identified as follows:

1. Trichion (Tr): The superior border of the anatomical forehead, the hairline.
2. Soft tissue nasion (N): The most concave point of the tissue overlying the area of the frontonasal suture.
3. Subnasale (Sn): A point located at the junction between the lower border of the nose and the beginning of the upper lip at the midsagittal plane.
4. Stomion (St): The median point of the oral embrasure when the lips are closed.
5. Soft tissue menton (Me): The most inferior point on the soft tissue chin

The landmarks identified were in accordance with the previous studies conducted on facial esthetics^{6,7,8}(Fig 1)

After locating the landmarks using Adobe photoshop version 7.0, the following ratios were calculated. R1 –



Fig 1: Anatomical landmarks as located on the silhouettes.

TrMe: TrSn, R2 – TrMe:NM, R3 – TrSn:SnMe, R4 – SnMe:StMe, R5 – NSn:St Me.

R1 – Physiognomical Height of the face: Height of the upper face

R2 – Physiognomical Height of the face: morphological height of the face

R3 – Height of the upper face: Height of the lower face

R4 – Height of the lower face: Height of the mandible

R5 – Nose height : Height of the mandible

The data thus obtained was subjected to statistical analysis, one sample t-test was applied to the compare the ratio in children with that of the universal norms of the divine proportion.

RESULTS

Table 1 indicates that the ratios R1,R2,and R4 were having values closer to divine proportion but none of them were coinciding with the universal norm of 1.618.

Table 2 describing the result of one sample t-test indicates that the ratios were statistically significantly different from the universal norm of 1.618 with p value \leq 0.001. Percentage deviation from the norm indicates that a very small deviation existed from the universal norm. Although the values were lying closer to the universal norm, they differed significantly from the same. The variation from the norm was more for the ratio R3 (TrSn: SnMe) and R5 (NSn:StMe).

DISCUSSION

Facial beauty and esthetics have been extensively studied by scientists, artists and clinicians and various parameters

Ratio	n	Mean	SD
R1 (TrMe: TrSn)	25	1.53	±0.04
R2 (TrMe:NMe)	25	1.56	±0.07
R3 (TrSn:SnMe)	25	1.84	±0.15
R4 (SnMe:StMe)	25	1.50	±0.05
R5(NSn:StMe)	25	1.09	±0.07

Table 1: Descriptive statistics

Variable Measured	n	df	Mean±SD	p Value	% deviation
R1 (TrMe:TrSn)	25	24	1.53±0.04	<0.001	5.4%
R2(TrMe:NMe)	25	24	1.56±0.07	<0.001	3.5%
R3(TrSn:SnMe)	25	24	1.84±0.15	<0.001	13.7%
R4 (SnMe:StMe)	25	24	1.50±0.05	<0.001	7.2%
R5(NSn:StMe)	25	24	1.09±0.07	<0.001	32.6%

Table 2: One sample t test (Test Value = 1.618)

have also been formulated to identify beauty. Dentists being the smile architects are also closely related to the construction of beauty. A literature search indicates there has been a focus on mathematical relationships in assessing beauty and the only quantifiable method of measuring beauty is by assessment of the facial proportions. Faces considered esthetic possess harmony in the various mathematical relationships and ratios. These esthetic ratios are called the Golden Ratio/ Divine Proportion.^{9,10}

As per the established facts, there is a universal standard/norm which is of biological significance in determining the facial esthetics. This standard clearly justifies that irrespective of age, gender, race and other variables, divine proportion continues to exist such that it can be considered synonymous to beauty. However the facial proportions in the children are expected to change with growth.¹¹ Hence this study determined the facial proportions in children during the primary dentition and to compare the thus obtained facial proportions with the universal norm of divine proportion.

Color and texture of hair and skin can mask the facial architecture during the assessment of proportions¹². Hence in this study, the VAS was determined on the silhouettes so as to minimize the effect of distracters and to reduce the inter-examiner bias during scoring. Similar study designs were reported to be used, and favorable results were obtained indicating that facial silhouettes can be used in the effective assessment of Divine Proportion.^{13,14} Since the Divine Proportion is expected to occur in the facial proportions of the individuals who are esthetically more acceptable, subjects were analyzed by a panel of 15 judges who scored the silhouettes on VAS for harmony in the facial proportions. Similar study designs were followed by Howells and Shaw and Phillips.^{15,16,17,18}

The results obtained from the study indicated that there was a significant difference observed in all the ratios when compared to the universal norm of Divine Proportion. However, the ratios R1, R2 and R4 were closer to the divine proportion. Ratio R3 which indicates the Height of the upper face: Height of the lower face, differed to a greater extent from the divine proportion. The eruption of permanent teeth, rotational changes occurring in the mandible as a result of growth contribute

to the proportion achieved in an adult. Hence this ratio varied to a greater extent from divine proportion as the subjects were in primary dentition.

Although statistically, means of ratio R1, R2 and R4 were very highly significantly different from the universal norm, the values were lying closer to the divine proportion indicating that the proportions do not change to a greater extent with growth. Similar conclusions were obtained by Ferring et al. Ratios R1, R2 and R4 can be considered to be putative indicators of assessment of divine proportion from the profile photographs.

CONCLUSION

As per the results obtained from the present study, it can be concluded that the growth can have an effect on the development of divine proportion, as it may not be established from birth but may gradually develop. However, the vertical facial proportions changed only slightly from childhood to adulthood. Vertical facial proportion ratio R1, R2 and R4 can be considered to be putative indicators of Divine proportion as measured from the facial profile.

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