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Original Article

Received on 29.09.2016, **Accepted on** 05.10.2016

Indian Journal of Anatomy
Volume 5 Number 3, September - December 2016
DOI: http://dx.doi.org/10.21088/ija.2320.0022.5316.4

The Golden Proportion and Its Application to the Human Face: A Cross-Sectional Study

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Abstract

Background and Objective: The golden proportion or *phi* is 1.618. The Golden Ratio is believed to be a blueprint for facial features that conform to beauty. Our study aims at finding the ratio between the length of the face and the width of the face and correlate it with the golden ratio. *Materials and Methods:* One hundred students studying first phase of MBBS at Navodaya Medical College, Raichur were included in this study, belonging to the age group of 17 to 19 years. The length and width of the face were calculated from their black and white profile photographs using vernier calipers. *Results:* In the male group, the mean vertical length of the face was 16.44 cms (±1.31), the mean width of the face was 11.40 cms (±1.09) and the mean ratio of length to width of face was 1.45 (±0.17). In the female group, the mean vertical length of the face was 15.67 cms (±2.16), the mean width of the face was 10.58 cms (±0.71) and the mean ratio of length to width of face was 1.50 (±0.26). None of the 100 participants had the length to breadth ratio equal to golden ratio (1.61). *Conclusion:* The human face follows the golden ratio. The nearer the face size is to the golden ratio, the more attractive is the face of that person. In our study, we found that the size of the face was more close to the golden ratio in the female group than the male group. The golden ratio has been considered useful for maxilla-facial and facial plastic surgeries.

Keywords: Face; Beauty; Human; Photographs; Golden Ratio.

Introduction

Though not an understandable or quantifiable entity, everyone admires beauty and its unique balance in nature. This balance and perception of beauty has been attributed to the 'golden' number or the ratio that gives certain things their exquisiteness [1]. The "divine proportion" is one of the several terms used to describe the division of a line such that the ratio of the smaller section to the larger section is the same as that of the larger section to the whole [2]. Other names given to this ratio include the "golden proportion," and the "golden section" [3]. This ratio can be expressed mathematically as 1.618:1 or 1:0.618. There have been many claims that the divine proportion was used in Greek art and architecture by the sculptor Phidias. This has led to its nickname as the "Phi" ratio [4]. The term "divine proportion" was first used by the Italian Renaissance mathematician Fra Luca Pacioli [5,6]. Marquardt, who developed a beauty mask based on the divine proportion, showed that regardless of race or age, a face is deemed beautiful if it conforms to this beauty mask [7]. The human face must also conform to the divine proportion in order to be biologically efficient and viable. Development towards ideal proportion maximizes efficiency and health. Patients who are dolicho-facial tend to have upper airway obstructions and temporo-mandibular joint disorders [8,9,10] and patients who are extremely brachy-facial tend to have severe myofacial pain and temporo-mandibular joint disorder [11,12,13]. Thus it can be inferred that faces that do not conform to the divine proportion not only have esthetic problems but have physiologic problems as well. The introduction of a standard called the Divine Proportion for the evaluation of a profile can lead orthodontic, orthopedic and surgical treatment to obtain maximum facial beauty [14]. The human face abounds with examples of the Golden Section. The head forms a Golden Rectangle with the eyes at its midpoint. The mouth and nose are each placed at

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golden sections of the distance between the eyes and the bottom of the chin. *Phi* defines the dimensions of the human profile. Even when viewed from the side, the human head illustrates the Golden Proportion [15]. The human face has rhythm both transversely and vertically in width and height [16]. Our study aims at finding the ratio between the vertical length of the face and the width of the face and correlate it with the golden ratio as a cross sectional study in first phase MBBS students at our Medical College.

Materials and Methods

Our study is a cross sectional study done at Department of Anatomy, Navodaya Medical College, Raichur during October 2015 to March 2016. The study involved 50 male and 50 female students of first phase of MBBS. They were in the age group of 17 to 19 years. Subjects with gross facial deformity/ asymmetry, history of orthodontic treatment, or extraction of teeth, except for third molars or cosmetic surgeries on the face were excluded. The aim of this study was explained and informed consent was obtained from each participant. The subjects' standardized profile photographs were taken. During this procedure, the subjects were requested to adopt normal facial expression, without any asymmetry, sagittal and vertical deviations, and to maintain normal lip position (without excessive or decreased lip protrusion). The operator ensured that the subjects removed their glasses and that the subject's forehead and neck were clearly visible while the photograph was taken. The subjects' heads were oriented in the natural head position, and a standardized front profile photograph of each subject was taken using a digital camera. The distance between the photographic equipment and the subjects was 150 cm. All the photographs were taken by the same operator. In order to take the photographs in natural head position, subjects were asked to stand up and look straight into their eyes' image in the mirror located on the wall in front of them at the same level as their pupils. In this position, the lips had to be relaxed, adopting the position they normally show during the day. All 100 photographs were then converted to black and white (silhouette), using the Microsoft Office Picture Manager 2000 software program and then cropped to include only the facial outline. Following this, 4 anatomic landmarks were identified on each silhouette as follows, namely Trichion (Tr) (The superior border of the anatomical forehead, the hairline), Soft tissue menton (Me) (The most inferior point on the soft tissue chin.) and the centres of right and left ear lobules. A Vernier callipers was used to measure the dimensions of the face. The length of the face was the vertical distance in the midline of the face between the Trichion and menton. The width of the face was the horizontal distance between the centre of right and left ear lobules (Figures 1 and 2). The size of the face was the ratio between length of the face and width of the face. The mean and standard deviation of the length of the face, width of the face and the ratio was calculated using Microsoft Excel of Microsoft Office 2000 software. The Golden proportion or *phi* was 1.6. The shape of the face was normal when its size was equal to 1.6; the shape of the face was long when its size was larger than 1.6, and was short when its size was smaller than 1.6. All the measurement procedures were undertaken by the same operator and all of these processes were repeated two times to reduce errors. The statistical test applied was unpaired "t" test.

Results and Observations

Our study included 100 subjects with 50 male and 50 female students of first phase MBBS. The age of the subjects ranged from 17-19 years. Of the 50 male participants, none had the ratio equal to golden ratio. Eight (16%) males were having long face (ratio>1.6) and 42 (84%) males were having short face (ratio<1.6). In the male group, the mean vertical length of the face was 16.44 cms(±1.31), the mean width of the face was 11.40 cms (±1.09) and the mean ratio of length to width of face was 1.45 (±0.17). Of the female participants too, none had the ratio equal to golden ratio (1.61). Eighteen (36%) females were having long face (ratio>1.6) and 32 (64%) females were having short face (ratio<1.6). In the female group, the mean vertical length of the face was 15.67 cms (±2.16), the mean width of the face was 10.58 cms (±0.71) and the mean ratio of length to width of face was 1.50 (±0.26) (Table 1). When the unpaired "t" test was applied, t value was found to be 1.1381, degree of freedom was 98, standard error was 0.044 and p value was 0.2578 which is not significant as its value is more than 0.05. Thus, in our study, even though the length to breadth ratio of the face in females is more nearer to the golden proportion than in males, it is not statistically significant.

Table 1: Measurements of mean length, width and ratio of the face in male and female groups.

	Mean Length (±SD)	Mean Width (±SD)	Mean Ratio (±SD)
MALE (n=50)	16.44 (±1.31)	11.40 (±1.09)	1.45 (±0.17)
FEMALE (n=50)	15.67 (±2.16)	10.58 (±0.71)	1.50 (±0.26)

Fig. 1: Front profile silhouette of a male participant [1= trichion 2= menton 3=centre of the right ear lobule 4=centre of the left ear lobule]

Fig. 2: Front profile silhouette of a female participant [1= trichion 2= menton 3=centre of the right ear lobule 4=centre of the left ear lobule]

Discussion

Although Euclid is the oldest known writer to describe the construction of this golden proportion, the proportion was probably already known by the ancient Egyptians, since this ratio can be recognized in the large Egyptian pyramids from the 3rd millennium BC. A more accurate mathematical approach came from Fibonacci in the 12th century, in which the golden proportion was defined as phi, and was found to be equal to 1.618. The golden proportion is often associated with esthetics and harmony in many fields such as architecture, sculpture, music, poetry, the morphology of flowers, sea shells, mammals, and the human face [17].

Phidias, a Greek sculptor and mathematician, first discovered phi, commonly known today as the Golden Ratio. Phidias studied the phenomenon of phi in various Greek sculptures, but Leonardo Da Vinci coined the term "Golden Ratio" by using it in some of his most famous works: "The Last Supper" and "Mona Lisa." In the portrait of Mona Lisa, the wife of an affluent Florence businessman, Da Vinci included numerous examples of the Golden Ratio, as he believed that the Golden Ratio represented an aesthetic bond between humanity and nature [18].

Since research of multiple cultures indicates that there is common consensus on the rating of facial beauty, golden ratio seems to be an indication of recurrent underlying factors [19]. Could it be that human beauty is not appraised by fanciful whims, but rather, determined by a scientific basis? The answer lies, once again, in the Golden Mean. What is Ö? Not only is it the most attractive number in the world, but it is the essence of beauty itself. Beauty is 1.618033 989…trailing off into infinity [20].

The age group of subjects in this study was 17 to 19 years because, between the ages of 14 to 24, the mature face is usually quite attractive in a nurturing way for parents and in a sexually attractive way for a mate. From about 24 years of age, the post pubescent adult face begins to slowly and progressively become less attractive [14]. The present study used silhouettes for evaluating the divine proportion in profiles because this eliminated all extrinsic and intrinsic distracting variables (such as hair style, make-up, skin complexion) that could influence an evaluator's judgement [14]. Barrer and Ghafari assessed profile silhouettes before and after orthodontic treatment. Their results also supported the use of the silhouette in the evaluation of profiles [21].

In our study, none of our 100 participants had the length to breadth ratio equal to golden ratio (1.61). However, the ratio was more nearer to the golden ratio in females (1.50) compared to the males (1.45). As the ratio of the length of the face to the width of the face gets closer to the golden ratio, both male and female images are viewed as more attractive [22]. Also, the human male face is considered to be generally less attractive than the human female face in the post pubescent period [7]. In our study, even though the length to breadth ratio of the face in females is more nearer to the golden proportion than in males, it is not statistically significant. A larger study is required in this regard to get better conclusions.

Besides the beauty aspects of it, the golden ratio has health implications. Golden Proportion has been considered useful for maxillofacial surgery [23]. Individuals with an abnormal size of the face may be at risk of developing maxillofacial, jaw, respiratory, occlusal, and sleep disorders due to disproportionate face size and tooth size. This simple technique of applying the golden proportion to the face and identifying individuals with any values larger or smaller than it in mass surveys in order to determine the individuals and the percentage in a given population at risk of respiratory and jaw disorders facilitates early preventive and corrective interventions so that the population can lead a healthy and normal life [15].

However, there are some studies which tell that golden ratio is uncommon in humans. The study done by Ricketts supports that the Golden Ratio is not common in humans and is therefore only an artistic and architectural concept [24]. A study conducted by Mos et al. had similar conclusions as they found that even professional models did not resemble the Golden Ratio [25].

Though the present study attempted to investigate the relationship of measured proportions in facial profiles to the divine proportion, considering the numerous factors which are influential in determination of beauty of a profile, it may be concluded that if the divine proportion is to be used as an aid to treatment planning, it should perhaps be used along with other factors [14]. We have taken only the length to width ratio of the face in our study. The overall attractiveness of the face is decided by several other ratios in the face in combination. A further study taking into account several ratios of the face using a bigger sample size is advised.

Conclusion

In our study, none of our 100 participants had the length to breadth ratio equal to golden ratio. However, when females are compared to males, it is obvious that they are more aesthetically pleasing as they have an overall average ratio that is closer to the Golden Ratio than males do. With recognition of this golden proportion principle, these relationships can be employed by the clinician on the practical basis and objective relationships can be assessed and planned.

References

1. Yahya H. Fibonacci numbers: A measure of beauty. Available from: http://www.islamonline.netfaithandscience/medicine.
2. Runion GE. The Golden Section. Palo Alto, CA: Dale Seymour, 1990; 1–2.
3. Herz-Fischler R. A Mathematical History of Division in Extreme and Mean Ratio. Waterloo, Ontario: Wilfred Laurier; 1987; 164–70.
4. Cook TA. The Curves of Life. New York, NY: Dover, 1914:420.
5. Taylor RE. No Royal Road. Chapel Hill, NC: North Carolina University Press, 1942; 251–87.
6. Morison S. Fra Luca de Pacioli. New York, NY: Kraus. 1969: 1–29.
7. Marguardt SR. The Golden Decagon and human facial beauty. J Clin Orthod. 2002; 36: 339-47.
8. Timms DJ, Trenouth MJ. A quantified comparison of craniofacial form with nasal respiratory function. Am J Orthod Dentofacial Orthop.1988; 94(3): 216-21.
9. Weimert T. JCO/Interveiws Dr. Thomas Weimert on airway obstruction in orthodontic practice J Clin Orthod. 1986; 20(2): 94 – 104.
10. Champagne M. Upper airway compromise (UAC) and the long face syndrome. J Gen Orthod. 1991; 2(3): 18-25.
11. Zarb GA, Speck JE. The treatment of tempero mandibular joint dysfunction: a retrospective study. J Prosthet Dent. 1977; 38(4): 420 - 32.
12. Van Sickels JE, Ivey DW. Myofacial pain dysfunction: A manifestation of the short- face syndrome. J Prosthet Dent. 1979; 42(5): 547-50.
13. Abadi BJ, Okeson JP. Alteration of vertical dimension in the treatment of craniomandiibular disorders. J of Craniomandibular Pract. 1983;1 (4): 54-9.
14. S. Rupesh et. al. The role of divine proportion in the perception of beauty: A cross sectional study. Amrita Journal of Medicine. 2014; 10(1): 22-27.
15. P. Saraswathi. The golden proportion and its application to the human face. Eur J Anat. 2007; 11 (3): 177-180.
16. Laxmikanth SM, Raghavendra SR. Golden proportion: A review. J Adv Clin Res Insights. 2014; 1: 25-29.
17. Markowsky G. Misconceptions about the golden ratio. Coll Math J. 1992; 23: 2-19.
18. Saumya Goel and Rahman Tashakkori. Correlation Between Body Measurements of Different Genders and Races. *In* J. Rychtá¡r et al. (eds.), Collaborative Mathematics and Statistics Research, Springer Proceedings in Mathematics & Statistics; Springer International Publishing Switzerland; 2015: 109.
19. M. Bashour. An Objective System for measuring Facial Attractiveness. Plastic and Reconstructive Surgery. 2006 Sep 1; 118(3): 757–774.
20. K. Gibran, *The Prophet*. (New York: Alfred A. Knopf

Inc., 1923).

21. Barrer JG, Ghafari J. Silhouette profiles in the assessment of facial esthetics: A comparison of cases treated with various orthodontic appliances. Am J Orthod. 1985; 87(5): 385- 91.
22. Schmid, Kendra; Marx, David; and Samal, Ashok, "Computation of a Face Attractiveness Index Based on Neoclassical Canons, Symmetry, and Golden Ratios". CSE Journal Articles. 2008; 92: 2710-2717.
23. Kawakami S, Tsukada S, Hayashi H, Takada Y And Koubayashi S. Golden proportion for maxillofacial surgery in Orientals. Ann Plast Surg. 1989; 23: 417-425.
24. Ricketts RM .The biologic significance of the divine proportion and fibonacci series. Am J Orthod. 1982; 81(5): 351–370
25. Moss JP, Linney AD, Lowey MN. The use of three-dimensional techniquesin facial esthetics. In: Seminars in orthodontics. Royal London Hospital Medical School, England, vol 1. Elsevier, 1995; 94–104.