

Evaluation of facial divine proportion in North Indian Population

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Abstract

Objective: To evaluate the facial divine proportion and its relationship with facial attractiveness in North Indian population. **Materials and Methods:** For evaluation of various facial proportions, standardized frontal facial photographs of total 300 subjects between 18 and 30 years of age were obtained. Black and white copies of these photographs were presented in front of an evaluation jury for assigning scores of facial attractiveness and finally 130 attractive subjects were selected. These subjects were divided into two groups, Group I (attractive females $n = 65$) and Group II (attractive males $n = 65$) and they were further analyzed for various parameters of facial proportions. Unpaired Student's t -test was used to compare both groups. **Results:** Group I showed that five of seven vertical facial proportions were close to divine proportion (1.618) whereas only two vertical proportions in Group II were close to it. Transverse facial proportions in both groups deviated more from divine proportion (1.618) and were closer to silver proportion (1.414). **Conclusions:** Most of the facial proportions of attractive females in the North-Indian population were close to the divine proportion. Thus, facial divine proportion could be an important factor in the perception of facial attractiveness of North-Indian attractive females.

Keywords: Divine proportion, facial attractiveness, North-Indian population

Introduction

Facial beauty of an individual has almost always been a reason for favorable reaction in social interaction. Many factors influence the perception of beauty, including makeup, clothing, and facial expressions. However, it is the relational proportion of our physical features which is the primary factor in determining the perception, conscious, or subconscious, of beauty.^[1] The ancient Egyptians were possibly among the first to deal with harmonious (attractive) proportions of the face and body.^[2] Various norms and standards have been proposed to describe the attractiveness of face, out of which, one of the most famous axiom is facial golden proportion. Divine proportion, golden proportion, and phi (ϕ) are the synonymous terms and geometrically it was found to be equal to 1:1.618.^[3] This golden proportion

has been considered as the ratio most attractive to the human eye and mind.^[4]

Ricketts^[5] found that the divine proportion existed in a large number of lateral and frontal cephalograms and photographs that he considered ideal. Therefore, Ricketts advocated the use of these divine proportion ratios as guides for planning orthognathic surgery. Furthermore, Marquardt^[6] developed a beauty mask based on the divine proportion, and he suggested that any face that conforms to beauty mask is likely to be beautiful irrespective of age and race.

Jefferson^[7] also believed that there is a universal standard for facial beauty regardless of race, age, sex and other variable, named as divine proportion. However, Baker and Woods^[8] found that beautiful faces may or may not exhibit ratios in the divine proportion. Therefore, more evidence is required to substantiate the true significance of this fascinating concept of divine proportion in the clinical assessment of facial esthetics.

Facial proportions are of great interest in the field of orthodontics as well as in maxillofacial and plastic surgery.^[9,10] As found in the literature,^[5,7] the values of measured proportions in beautiful faces are likely to

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approximate the divine proportion and also the divine proportion is considered as an important factor in facial esthetics. Hence, there was a need to evaluate the relationship between facial esthetics and the divine proportions. Hence, the aim of this study was to evaluate various facial divine proportions and to evaluate its relationship with facial attractiveness in North-Indian population.

Materials and Methods

The sample used for this study was taken from a randomly selected group of 300 subjects whose frontal facial photographs were taken in a photographic room of Department of Orthodontics and Dentofacial Orthopedics, by investigator himself. Ethical approval for this study was obtained from the Institutional Ethics Committee and a written; informed consent was also obtained from all the subjects.

The first selection of subjects was made according to the following inclusion criteria:

- North Indian subjects between 18 and 30 years of age
- No history of trauma to the dentofacial region
- No marked facial asymmetry
- No previous history of any facial surgery.

The design of the photographic setup for acquisition of standardized photographs was based on the guidelines established in previous studies.^[11,12] The digital camera (Nikon D7100 DSLR) was set on a tripod stand at a fixed distance from the subject. Subjects were seated on an adjustable stool and instructed to hold the head in natural head position by looking straight into a mirror hung on the wall at eye level. Two rulers with millimeter markings secured at a right angle to each other on a stand were kept along the side of the face of the subjects. An effort was made to keep the interpupillary line parallel to the horizontal ruler. The photographs were taken without any spectacles or sunglasses and hair covered with the surgical head cap from the hairline above. This was done to eliminate the influence of sunglasses and hair styles over the facial attractiveness. The photographs thus taken were cropped and converted into black and white images using Adobe Photoshop computer software to avoid the influence of facial complexion over the attractiveness. These black and white images were presented as slides of power point presentation in front of a panel of judges for rating the facial attractiveness of each subject. The panel of judges consisted of two clinicians (an orthodontist, a plastic surgeon) and two nonclinicians (a beautician, a lay person) for rating the facial attractiveness of each subject. Rating scale was a 10-point scale, with 10 as “most attractive” and 0 as “least attractive face.” Thus, each subject received a total score of attractiveness ranging from 0 to 40. Individuals with total score 28 or more were considered as attractive faces and considered for further analysis in the study and rest all were excluded from the study.

Thus, a second selection was made on the basis of attractiveness scores given by judges, which brought the sample to 140 subjects who were divided into two groups, Group I (attractive females $n = 75$) and Group II (attractive males $n = 65$). To prevent the variation in sample size distribution, ten subjects were randomly excluded from Group I.

Thus, the final sample consisted of 65 subjects in each Group with the total sample size of 130 subjects.

Photographic points used in the study

The following points are located on each frontal facial photograph according to definitions given by Ricketts^[3] and Mizumoto *et al.*^[12] [Figure 1]: Trichion (TR), the point at the top of the forehead at the junction (hairline) of the face and skull fascia; TS, the width of the head at the temporal soft tissue above the ears at the level of the supraorbital ridges; LC, the point at the lateral canthus of the eyes; LN, the point at the lateral rim of the nose; cheilion (CH), the point at the corner of the mouth; ME, soft-tissue menton.

Nine vertical and four transverse linear measurements of the face were taken as depicted in Figures 1 and 2.

Seven measurements of vertical facial proportion and three measurements of transverse facial proportion were taken based on previous studies.^[2,7]

Vertical facial proportions were - TR-ME: LC-ME; TR-LC: LC-ME; LN-ME: TR-LN; LC-LN: LN-ME; CH-ME: LC-CH; LN-CH: LC-LN; and LN-CH: CH-ME. Transverse facial proportions were:

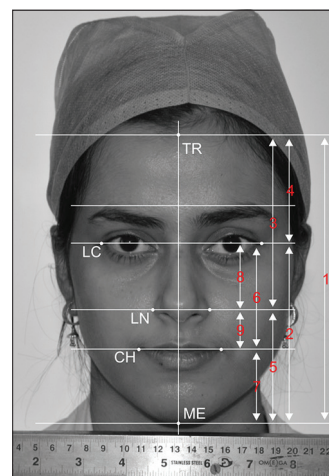


Figure 1: Photographic points and vertical linear measurements used in the study. 1: TR-ME (trichion to soft tissue menton); 2: LC-ME (lateral canthus of eye to soft tissue menton); 3: TR-LN (trichion to ala of nose); 4: TR-LC (trichion to lateral canthus of eye); 5: LN-ME (ala of nose to soft tissue menton); 6: LC-CH (lateral canthus of eye to corner of mouth); 7: CH-ME (corner of mouth to soft tissue menton); 8: LC-LN (lateral canthus of eye to ala of nose); 9: LN-CH (ala of nose to corner of mouth)

LN(right) r–(left) l: CHR–l; LCr–l: CHR–l; and TSr–l: LCr–l. Mean measurements were converted to percentages, assuming that the divine proportion 1.618 was 100%.

Another ratio, known as a silver ratio (1:1.414) was also used in this study as a measure of balanced facial proportion.

An updated version of the ImageJ computer software (version 1.47, NIH, Maryland, US) was used to take measurements and to analyze the photographs. For each photograph, the scale was set in the imageJ software based on the ruler incorporated in the photograph, keeping the unit of length as centimeter. This enabled direct and highly accurate measurements of the photographs.

The data so obtained were subjected to statistical analysis. Results were expressed as the mean (standard error of mean). Data were summarized as mean ± standard deviation from the values obtained from at least three independent experiments, in each of which triplicate samples were used. Groups were compared by unpaired Student’s *t*-test. A two-tailed *P* < 0.05 was considered statistically significant. Analyses were performed on SPSS software (Windows version 17.0, IBM Corporation, New York, US).

Results

Table 1 shows the various facial proportions in both groups. In Group I (attractive females) subjects five vertical proportions TR-ME: LC-ME, LC-ME: TR-LC, LC-CH: CH-ME, LC-LN: LN-CH, CH-ME: LN-CH were very close to divine proportion with their percentage values of 99.51, 103.21, 99.5, 101.97, and 104.45 with respect to divine proportion whereas TR-LN: LN-ME and LN-ME: LC-LN were 85.29% and 133.49% deviated from divine proportion.



Figure 2: Transverse linear measurements used in the study. 10: TS (r)–TS (l) (head width at the temple); 11: LC (r)–LC (l) (face width between both eyes); 12: LN (r)–LN (l) (width of nose); 13: CH (r)–CH (l) (width of mouth)

In Group II (attractive males), only two vertical proportions TR-ME: LC-ME and LC-ME: TR-LC were 100.74% and 101.35%, similar to the divine proportion.

In contrast to vertical facial proportions, transverse proportions CH (r–l):LN (r–l), LC (r–l):CH (r–l), and TS (r–l):LC (r–l) deviated more from divine proportion in both groups.

In Group I values were 1.32 (81.58%), 1.98 (122.37%), and 1.33 (82.20%) and in Group II these were 1.21 (74.78%), 1.9 (117.42%), and 1.41 (87.14%), respectively.

The results of Table 1 were plotted on a graph to illustrate the differences in the groups [Figures 3 and 4].

Discussion

Ricketts^[3,5] was the first orthodontist to apply divine proportion to the composition of facial hard and soft tissues. He showed that the proportions in a face generally perceived as being beautiful are intimately related to the golden ratio.

However, studies showed that there was a significant difference existing in the soft tissue morphology in various ethnic groups.^[13] Considering ethnicity, Barnes *et al.*^[14] reported that the faces of North American black men showed a strong tendency toward the golden proportion.

The size difference in facial dimensions, with the men, sized larger than the women, has been proposed by Peck and Peck^[15] and Ferrario *et al.*^[16] Therefore, both male and female subjects were considered in this study.

In this study, a panel of four judges, two clinicians, and two nonclinicians was used for rating the facial attractiveness based on Knight and Keith^[17] hypothesis who suggested that ranking the attractiveness of facial photographs by clinicians

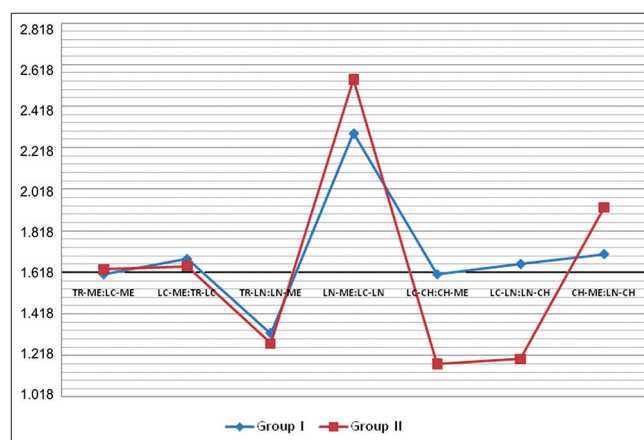


Figure 3: Deviation of vertical facial proportion from divine proportion in both groups

Table 1: Comparison of various facial proportions between the groups

Facial proportions	Group I (attractive females)		Group II (attractive males)		P ^a
	Mean±SD	% value (considering 1.618=100%)	Mean±SD	% value (considering 1.618=100%)	
Vertical proportions					
TR-ME: LC-ME	1.61±0.07	99.51	1.63±0.10	100.74	0.29 ^{NS}
LC-ME: TR-LC	1.67±0.20	103.21	1.64±0.26	101.35	0.53 ^{NS}
TR-LN: LN-ME	1.38±0.17	85.29	1.34±0.13	82.81	0.13 ^{NS}
LN-ME: LC-LN	2.16±0.54	133.49	2.37±0.60	146.47	0.04*
LC-CH: CH-ME	1.61±0.20	99.5	1.26±0.25	77.87	0.0001***
LC-LN: LN-CH	1.65±0.56	101.97	1.28±0.37	79.11	0.0001***
CH-ME: LN-CH	1.69±0.52	104.45	1.87±0.47	115.57	0.04*
Transverse proportions					
CH (r-l):LN (r-l)	1.32±0.11	81.58	1.21±0.12	74.78	0.0001***
LC (r-l):CH (r-l)	1.98±0.17	122.37	1.90±0.12	117.42	0.004**
TS (r-l):LC (r-l)	1.33±0.08	82.20	1.41±0.08	87.14	0.0001***

^aUnpaired t-test; *P<0.05 just significant; **P<0.01 moderately significant; ***P<0.001 highly significant; ^{NS}Nonsignificant. SD: Standard deviation

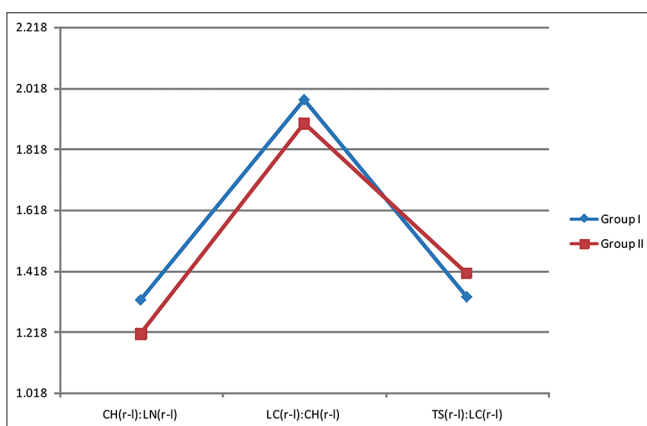


Figure 4: Deviation of transverse facial proportion from divine proportion in both groups

and nonclinicians could be used as a standard against which facial attractiveness could be assessed.

Table 1 showed that among the vertical facial proportions in Group I (attractive females), five proportions (TR-ME: LC-ME, LC-ME: TR-LC, LC-CH: CH-ME, LC-LN: LN-CH) out of seven were close to golden proportion. Mizumoto *et al.*^[12] observed almost similar result in their study in Japanese women.

Group II (attractive males) showed more deviation and only two vertical proportions (TR-ME: LC-ME, LC-ME: TR-LC) were close to golden proportion. Kawakami *et al.*^[18] also reported that deviations from divine proportion were more in males as compared to female subjects. Omotoso^[19] *et al.* also showed that there was bisexual variation in upper and lower face height.

In contrast to vertical facial proportion, transverse proportions were deviated more from divine proportion in

both groups. The value of LC (r-l):CH (r-l) in Groups I and II deviated more (122.3% and 117.4%, respectively) and could indicate small Mouth width with normal eye width. The CH (r-l):LN (r-l) ratios were smaller than divine proportion in both groups (1.32 and 1.21, respectively). This smaller ratio might predict the combination of small mouth width and average nose width. The values of TS (r-l):LC (r-l) was also smaller than divine proportion in both the groups (1.33 and 1.41, respectively). These smaller values were more close to the Silver ratio (1.414). The silver ratio was introduced by Yanagi.^[20] He reported about a historical Japanese painting and temple built in 607 AD designed with both golden (1:1.618) and silver (1: 1.414) ratios. Mizumoto *et al.*^[12] also found the same result of transverse facial proportion for Japanese women.

The findings of the present study partially agree with previous studies^[3,5] who believed that the facial beauty is directly related to the divine proportion however the results of our investigation showed that a relationship exists between the divine proportion and the perception of beauty.

The weakness of this study was smaller sample size selected from single place only (KGMU, Lucknow, UP) which could not be taken as a representation of whole North-indian population. This study also failed to include the nonattractive subjects and its facial proportions comparison with the attractive subjects. Hence, that norms of various facial proportions could be established for the North-Indian population.

Conclusion

The present study showed that most of the facial proportions of attractive females of the North-Indian population were

close to the divine proportion (1.618). However, some parameters for the lower facial width and height deviated from the divine proportion whereas the facial proportions of attractive males showed more deviation from divine proportion. Thus the facial divine proportion could be an important factor in the perception of facial attractiveness of North-Indian attractive females.

Transverse facial proportions were closer to silver proportion (1.414) rather than divine proportion (1.618) in both attractive females and attractive males.

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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Nil.

Conflicts of interest

There are no conflicts of interest.

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