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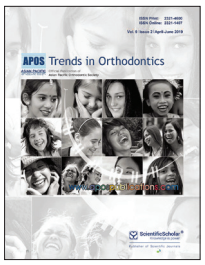

Clinical Pearl

Divine proportion of lips position within the face: A simulation experiment

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ABSTRACT

Objectives: The objective of this study was to analyze the divine proportion of lips position related to the overall face.

Material and Methods: Normative proportions were sketched in seven patterns of face on milimeter graph paper, where specific anatomical points were determined. No subjects participated in the study. The facial length was segmented into the golden ratio at point Phi (Divine proportion). Specific distances within the minor inferior subsection of the face, involving the lower and upper lips, were studied. The one-sample *t*-test was used to compare the means to the normative constant.

Results: The distance from Phi to the lower lip was 52% of the minor inferior facial section. The means of quotients relating lower and upper lips with point Phi were not statistically different to constant 1.618.

Conclusion: The lower lip stands in the midpoint of the minor inferior facial section and the divine proportion was found in the position of lips within the overall face. In a time when much importance is given to lips condition, it is suitable to the orthodontist and general dentists to recognize its natural positions on a regular basis.

Keywords: Diagnosis, Divine proportion, Simulation experiment, Closed mouth, Orthodontics

INTRODUCTION

The orthodontic mechanism has powerful demonstrations of effectiveness.[1,2] However, the retention of all permanent teeth in successful alignment may wreak havoc with a face in cases with bimaxillary protrusion.[3] The incisors' protrusion would provide a forced lip sealing, leading to hyperactive mental muscle. Although the resulting vermillon borders may get a desirable appearance, part of physiologic activities could become abnormal. The normal dental appearance needs to the achieved together with facial harmony[4,5] in the individual profile and the full-face views.[6] This affects treatment decisions and may justify orthodontic extractions or skeletal anchorage for correcting the bimaxillary protrusion. This way, the outcomes would provide better facial appearance and physiologic activities in the individuals' maturity.

The relationship of the mouth with other facial structures[5] includes multiple factors of physiology and appearance of beauty, that must be considered on the comprehensive dataset.[1] The facial proportions can be disharmonic due to incisors protrusion associated with incompetent lip

sealing.[7] The intrinsic forces from the resting posture of lips and tongue are related with dental equilibrium.[7] Forced lip sealing increases the distance between upper and lower lips in the resting. On the other hand, full upper lip borders may be related with subjective reception of the esthetic appeal.[8] The attractiveness demands on inherent requirements from nature and acquired education from nurture.[9] For this reason, this topic has been widely studied through scientific questionnaires as well as[10] measurements on photographs.[6,11] The photograph is useful to study the face harmony[1] and orthodontists should strive for the gold standard of clinical photographs.[12]

The divine proportion can be used for analyzing the facial balance on photographs.[13] Kepler argued that geometry has two great treasures: The Pythagoras' theorem and the section of a line into extreme and common ratio.[9] Although Kiekens *et al*. stated that attractive facial appearance has minimal dependence on the divine proportions,[13] Mizumoto *et al*. found normal proportions in beautiful women.[14] The faces can be segmented according to the divine proportion in two facial subsections: A greater superior and minor inferior.[14] The objective of this study was to assess the divine proportion in the longitudinal position of lips within the minor inferior facial segment.

MATERIAL AND METHODS

This simulation experiment was read and approved by the Thesis Committee Members of the School of Dentistry, Universidade Federal do Rio de Janeiro. The study was carried out on milimetric paper and did not involve any human subject. The experiment consisted on the definition of anatomical points on milimeter graph paper according to ideal facial proportions, originating seven different combinations between lips and the overall face. Crétot[15] describes the illustration of the human craniofacial architecture that represents normative proportions. Based on this method, anatomic landmarks were designed on the paper, varying proportionally to the distance Trichion (Tr) to Menton (Me).

The equivalence (1:1) between the interzigomatic *Zygion* at left side-*Zygion* at right side (ZyRZyL) distance and glabela (G) to Me, GMe, [Figure 1] was the starting point to draw different facial patterns.[15] The interzigomatic distance was arbitrarily defined with 10 cm. It was the linear distance between the ZyR and ZyL sides and did not vary in the seven papers [Figure 1a]. Distances TrMe varied by calculating GMe (2/3 of facial length) at percentages 92%, 95%, 98%, 100%, 102%, 105%, 108% [Figure 1] with interzigomatic distance [Figure 1a]. The distance TrG, Tr to glabela represented the other facial third [Figure 1b].

The points, Tr, G, subnasale (Sn), and Me, were recorded at the paper in all seven variations and the facial thirds

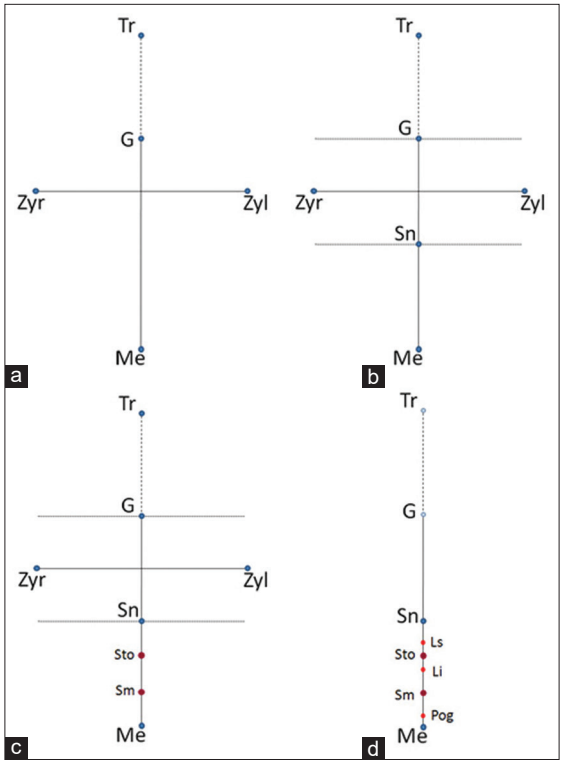

Figure 1: Sketch of human face illustrating (a) The relationship of distance ZyRZyL with GMe and the distance TrMe, (b) The vertical thirds of face, (c) The vertical thirds of line SnMe, and (d) The vertical fourths of SnPog. ZyLZyR: *Zygion* at left side-*Zygion* at right side, GMe: Glabela to menton, TrMe: Trichion menton, SnMe: Subnasale to menton, SnPog: Subnasale to pogonion.

were located: Tr to G to Sn to Me [Figure 1b]. In the lower facial third (SnMe), the points stomion (Sto) and labiomental groove (Sm) were recorded in the paper. They were located by the segmentation of SnMe into three equal parts [Figure 1c]: Sto to Sm to Me.[15] In addition, Crétot[15] postulates that distance Sn to pogonion (Pog), SnPog, can be sectioned in fourths: Sn to upper lip (Ls) to lower lip (Li) to labiomental groove to Pog [Figure 1d]. These postulates did not allow for a direct definition of the Pog. However, it is known that the distance SnSm comprises three fourths (75%) of SnPog.[15] This norm was applied to infer distance SnPog, by the mathematic rule: SnSm corresponds to SnPog, as the fraction 0.75 corresponds to 1.0. Thus, the points Ls, Li, and Pog were located in the papers according to the seven different proportions [Figure 1d].

All the seven sketched distances, TrMe, were divided by the divine proportion (1.618) and the point Phi was recorded. Two subsections of the face were originated [Figure 2]: Distance between point Tr and Phi (TrPhi) (greater superior) and PhiMe (minor inferior). That correspond to each other as TrMe corresponds to TrPhi.[16] At the minor

inferior subsection, the distances Phi to lower lip (PhiLi), Phi to upper lip (PhiLs) and the lower to upper lips (LsLi) were measured in the seven combinations [Figure 2]. The measures were paired together respectively to the calculation of the quotients PhiLi: PhiMe, PhiLi: PhiLs, and PhiLs: LiLs.

Statistical analysis

The one-sample *t*-test was used to compare the mean of percentages PhiLi: PhiMe to the constants 0.50, 0.51, 0.52, successively, and the means of the fractions PhiLi: PhiLs and PhiLs: LiLs to the golden ratio (1.618).

RESULTS

The values TrPhi (greater superior segment) and PhiMe (minor inferior segment) ranged from 8.6 to 10.1 cm and 5.2 to 6.2 cm, respectively [Table 1]. The average distance between the superior and inferior lips was 1.1 + 0.06 cm (centimeters). The mean of proportion PhiLi: PhiMe was statistically different to constants 0.50 and 0.51, but it was not statistically different to constant 0.52. The means of fractions PhiLi: PhiLs and PhiLs: LiLs were not statistically different from the divine proportion within 95% of confidence interval. Standard deviations were depicted together with the means [Table 2].

DISCUSSION

On the facial evaluation of a patient, either the traditional analysis of facial thirds or the divine proportion of the facial length[14] are meaningful [Figure 3]. The lower lip was located slightly displaced downward to the midpoint of the minor inferior subsection of the face. Moreover, there was divine proportion in the position of lips within the context of the overall face [Table 2].

This may be useful to assess facial harmony on photographs.[6] A degree of bias is expected, due to errors in photographs[12] and difficulties to locate points and distances.[11] First, a gold standard is needed for clinical photographs[12] and, second, potential bias should be carefully judged. One way to control this factor is to capture consecutive shots in every recording.[17] Possibly, the divine proportion of lips can be studied on computed tomography imaging in future researches.

As divine proportion is poorly related to facial attractiveness[4,13] and these data are merely theorized norms,[15] may we accept that a clinical dilemma exists: If divine proportion could not impact the attractiveness[18] and esthetics,[4,13] what would impact it? The answer to this question may be evasive if cultural factors were disregarded.

Further considerations on temporal concepts of art[5] and subjective perceptions shall be an important component

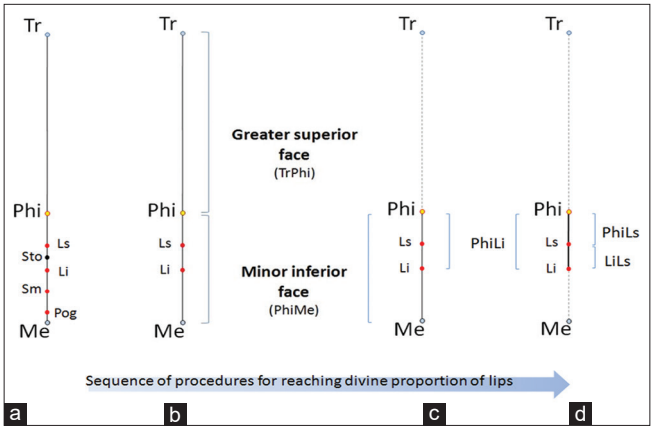

Figure 2: The line TrMe segmented into (a) The golden section at point Phi, and the distances (b) PhiMe, (c) PhiLi, and (d) PhiLs and LiLs were defined. TrMe: Trichion menton, PhiMe: Distance between point Phi and Me, PhiLi: Distance between point Phi and Li, PhiLs: Distance between point Phi and Ls, LiLs: Distance between point Li and Ls.

Table 1: Descriptive statistics expressing the variability of studied dimensions in the facial sketches.

Variability in the studied distances			
	Facial sketches (*n*=7)		
	Mean±SD (cm)	Minimum (cm)	Maximum (cm)
Arbitrary distances			
TrMea	15.0±0.8	13.9	16.2
TrPhi	9.3±0.5	8.6	10.1
PhiMe	5.7±0.35	5.2	6.2
Measured distances			
PhiLi	3.0±0.17	2.80	3.20
PhiLs	1.8±0.11	1.70	2.00
LiLs	1.1±0.06	1.05	1.20

TrMe: Trichion menton, TrPhi: Distance between point Tr and Phi, PhiMe: Distance between point Phi and Me, PhiLi: Distance between point Phi and Li, PhiLs: Distance between point Phi and Ls, LiLs: Distance between point Li and Ls

of our practice.[1] Otherwise, the facial divine proportion in the position of lips may indicate the balance of intrinsic forces, while lip incompetence may result on unbalanced proportions, when hyperactive mental muscle can be found.[19,20]

A few golden proportions influence the facial esthetic reception in adolescents.[13] Great facial variability is reported in adults with significant difference in gender groups and with a tendency to diverge with the golden proportion.[18] The divine proportion was found in the face of Japanese woman orthodontic treated patients, magazine models group, and well-known actresses, without significant difference between Japanese and white woman.[14] The male esthetic appeal has

Table 2: Comparisons between means of the ratios with single values that represent normative constants.

Differences between means and the normative fractions			
	Facial Sketches (*n*=7)	**Test value (constant)**	***P*-value***
	Means+SD (quotients)		
Quotients			
PhiLi: PhiMe	0.521±0.004	0.50	<0.001
		0.51	<0.001
		0.52	0.512
Means of proportions			
PhiLi: PhiLs	1.610±0.009	1.618	0.055
PhiLs: LiLs	1.639±0.023		0.052

*One-sample *t*-test. PhiLi: PhiMe: Quotient between distances PhiLi and PhiMe, PhiLi: PhiLs: Quotient between distances PhiLi and PhiLs, PhiLs: LiLs: Quotient between distances PhiLs and LiLs

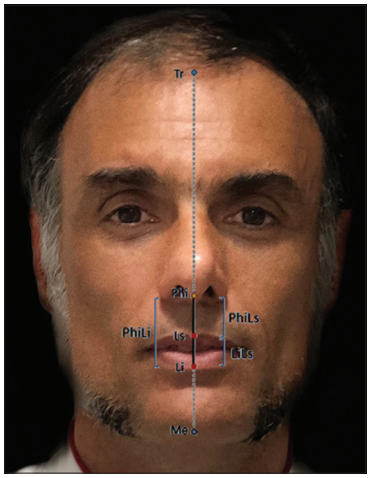

Figure 3: The theorized norms employed to a subject, whose dimensions were not measured to obtain the findings.

changed into full lip borders.[8] This may be explained by a greater racial diversity among the fashion models, under the influence of designers such as Giorgio Armani, Calvin Klein, and Ralph Lauren.[8] More recently, media influencers, such as, the Kardashians sisters and their successor, Kendall Jenner, have contributed to the current appeal of esthetics.

Finally, acceptable ranges of golden rate are needed to assess individual cases. The Phi is calculated through the equation $(1 + \sqrt{5})/2$, when consecutive results from an additive series are alternatively greater than and less than Phi.[9] This fact may explain the standard deviation found in this theorized data. We recommend that an acceptable range of facial divine proportion comprised values, from 1.600 to 1.667.[21] Naturally, people should judge every case for what constitutes the essence of the esthetic appeal resulting from simple mathematics.[9] Clinical studies should be conducted to corroborate the present ideal norms, which were simulated in milimeter graph paper.

CONCLUSION

The divine proportion was detected in the human face, when the lower lip was positioned at the midpoint of the minor inferior facial length. The upper lip was related with lower's lip position according to the divine proportion within the facial overall context.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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