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ORIGINAL ARTICLE

Association of gold proportion of maxillary anterior teeth and dental beauty self-perception of orthodontic patients

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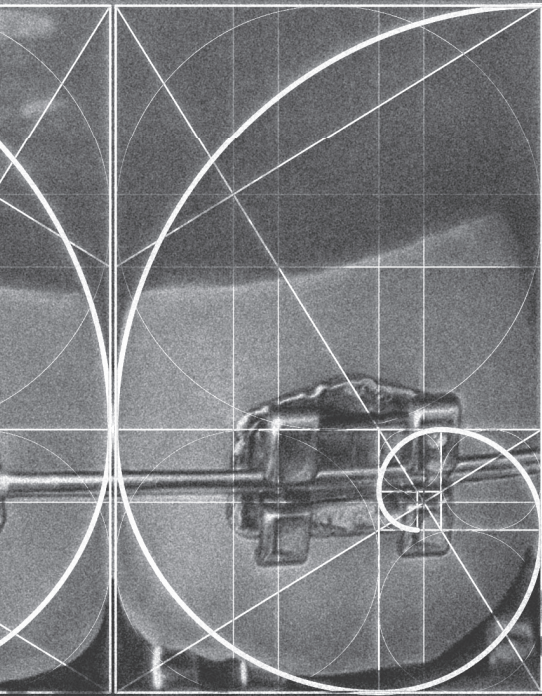
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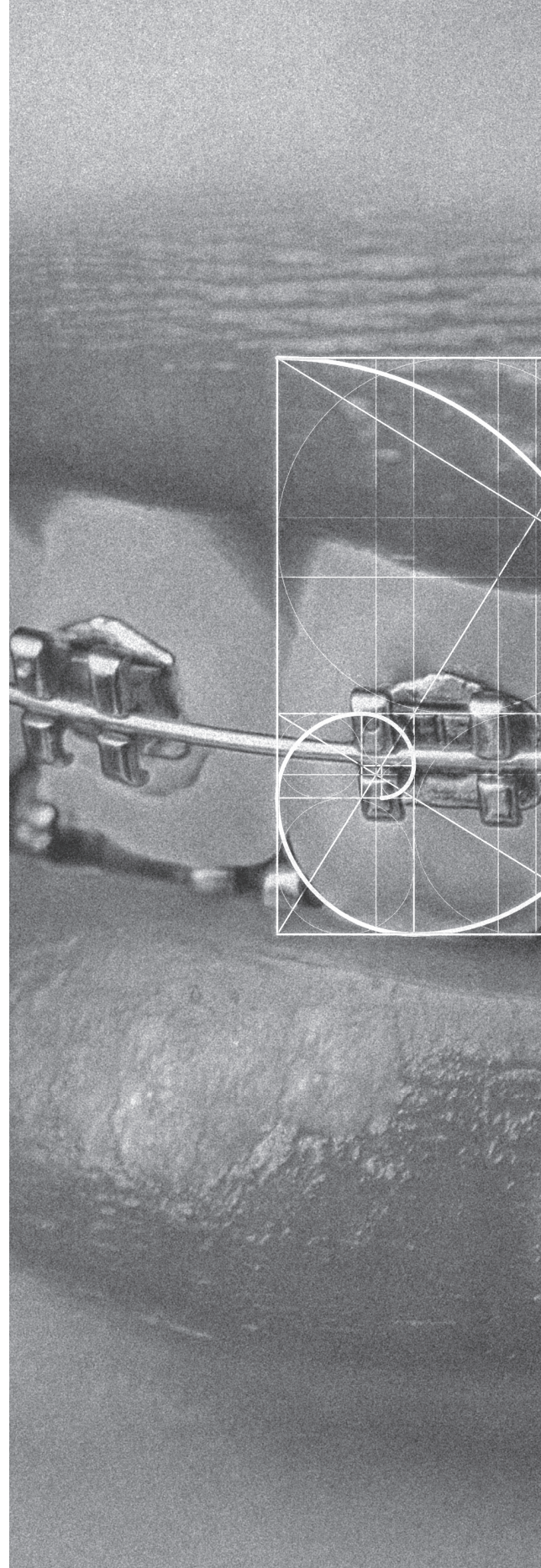
ABSTRACT: Objective: To evaluate the golden proportion of the perceived clinical crown widths of maxillary anterior teeth in orthodontic treated patients and to assess its association with self-perception of dental esthetic concerns. **Methods:** A group (n=40) of young adults with finalized orthodontic treatment had their pairs (without orthodontic treatment) selected according to gender and age using simple sample randomization. Golden proportion of the maxillary anterior teeth was measured with ImageJ software. Dental esthetic concern was determined by Oral Aesthetic Subjective Impact Scale (OASIS) questionnaire. Data comparison was carried out by Student's t-test. OASIS scores was evaluated by Mann–Whitney test. Associations were analyzed by logistic regression. All statistical procedures were carried out with α= 5%. **Results:** Golden proportion was not found between perceived mesiodistal widths of maxillary central incisors and canines in both groups (p<0,05). However, control group presented maxillary central incisors ratios statically closer to the golden proportion and 3.46 (CI:1.38–8.69) times more chance of having a greater perception of esthetic concerns (all P<0.05 vs. case). There was no significant association of the central incisor and canine proportions with dental beauty (P>0.05). **Conclusion:** Central incisor perceived width is closer to the golden proportion in orthodontic treated patients whose self-perception of dental beauty is greater. **Clinical Significance:** Patients are more satisfied with dental beauty after orthodontic treatment when central incisor crown width is closer to the golden proportion. Mathematical parameters might be useful to guide clinicians looking to restore the harmony of each dental segment separately. To patients, however, their perception of beauty is based on the overall composition of the smile. **KEYWORDS:** Dental beauty. Esthetics. Orthodontics. Golden proportion. Anthropometric analysis.

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INTRODUCTION

Morphological aspects and clinical crown mor-phometric proportions may severely harm den-tal beauty.[1] Typical anatomical characteristics that influence dental esthetics include the mean dis-crepancies of alignment, coronal width and length of the maxillary anterior tooth and, perceived width:length ratio between anterior teeth.[2-5]

Mathematical esthetic parameters that guide smile evaluation and designing may consider the perceived dimensions of the anterior teeth as a recurrent ratio among then, noted from the max-illary central incisor up to the first premolar, with the golden proportion being the most recurrent measure.[6,7] The symmetrical proportionality of the ideal smile describes a harmonious relation-ship between two unequal parts, in which the me-siodistal distance of the lateral incisor is propor-tionally equal to 61.8% of the mesiodistal distance from the central incisor; therefore, the apparent view of the canine in the smile is 61.8% of the me-siodistal distance from the lateral incisor.[8-10]

Although, different parameters of dental crown proportionality have been used to with the pur-pose of seeking an harmonious smile , the self-per-ception of dental beauty by lay individuals includes the presence of crowding, coronal disproportion, among other factors that characterizes, for exam-ple, small teeth as being unfavourable to beauty.[11] Thus, correction of imperfections or poor position-ing of the teeth stand out as one of the main objec-tives of different clinical therapies for the purpose of re-establishing the demands of balanced pro-portions in a smile.[12] Orthodontic treatment is one of the most sought-after therapies for correcting poor positioning of the anterior teeth, not only to improve smile esthetics but also to establish har-monious smile beauty. Besides function, from the clinician's perspectives, the achievement of a bi-lateral width proportionality of the anterior maxil-lary teeth may be consider as predictable factor for dental attractiveness in a given ethnic population.[13] Nevertheless, the results after the orthodontic treat-ment are still subjectively judged by the patients.[14]

However, no observational studies were found in the literature regarding the assessment of golden proportion and dental beauty in homogeneous Brazilian samples. Thus, the aim of this study was to evaluate the occurrence of golden proportion in maxillary anterior teeth of orthodontic patients and its association with self-perception of dental esthetic concern.

MATERIALS AND METHODS

Sample

This cross-sectional study was conducted after the Institutional Research Ethics Committee approval under protocol #22.69.013. Sample was composed by individuals who met the following inclusion criteria: presence of all maxillary anterior teeth without dental crowding, severe occlusal discrepancies, restorations, dental prostheses and coronal malformations.[15, 16] Orthodontic treated group (n=40) included individuals who had concluded orthodontic treatment with fixed appliances presenting all permanent teeth in occlusion, excepting the third molars, with molar and canines in Class I relationship, overjet and overbite of as much as 3 mm.[17, 18, 29] The eligibility criteria for the orthodontic untreated group (n= 40) were the same as those used for the treated group, except that the participants had never been submitted to fixed orthodontic treatment. The mean age for control and case groups were 26.5 and 28.9 years, respectively. The gender ratio for both groups was 1:1. Sample size was determined by the test power analysis which determined that 36.4 individuals would be capable of detecting a difference in the golden proportion of over 0.8 with (α = 0.05).

Digital analysis of the golden proportion

Impressions of the maxillary anterior teeth were taken with Speedex Coltene condensation silicone (Vigodent SA Industria e Comércio, Rio de Janeiro, Brazil) using a simultaneous impression-taking technique. To obtain casts, the impressions were poured with Durone type IV stone plaster (Dentsply, Petrópolis, Brazil), in compliance with the plaster:water ratio of 100 g:19 ml proposed by the manufacturer.

Anthropometric analysis of maxillary anterior teeth was performed as described previously with fewer modifications described ahead.[13] Briefly, the plaster casts were positioned on a Camper table with the angle of measurement of the device set to 0°. A front-view photograph of each plaster was taken by a professional Canon 5D MKII camera with a 24/105 mm lens (Canon Inc., Tokyo, Japan). The photos were taken in manual mode at a standard distance of 30 cm, without flash, with resolution set at 21.1 megapixels. All images were storage in RAW format.

To analyse the images and detect the mesiodistal width of the maxillary central incisors, lateral incisors and canines, NIH ImageJ version 1.34e software (http:rsbweb.nih.govij) packages was used. Vertical lines were demarcated on the mesial and distal perceived contours of each tooth in frontal view. The distance between the vertical lines of a certain tooth was considered its mesiodistal width in millimetres. Analysis was done in triplicate, and the mean value was considered for each mesiodistal distance.

To calculate the occurrence of the golden proportion, the following mesiodistal width measurement of the buccal surface of the six anterior maxillary teeth were taken into consideration (Figure 1). With the individual distances of central incisor, lateral incisor, and canine obtained, the formula previously described was by Jin et al (2016)[15] was applied. Briefly, the formula stablishes the maxillary anterior mesiodistal width ratios considering both, the right and left sides (Figure 2). Golden proportion occurs when the central incisor is shown to be 1.618 times wider than the lateral incisor, and the canine 0.618 times narrower than the lateral incisor (1.618:1.0:0.618, respectively).

Evaluation of dental esthetic self-perception

To evaluate the self-perception of dental beauty the volunteers answered the structured ques-
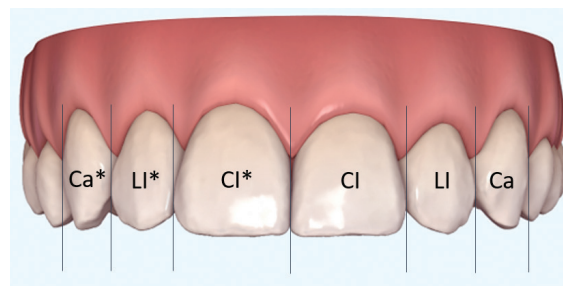

Figure 1: Perceived mesiodistal widths' measurement illustration of the left and right maxillary central incisors (CI and CI*, respectively), lateral incisors (LI and LI*, respectively) and canines (Ca and Ca*, respectively) on frontal view.

$$\text{Gold proportion of upper anterior teeth} = \frac{\dfrac{CI}{LI} + \dfrac{CI^*}{LI^*}}{2} : 1 : \frac{\dfrac{Ca}{LI} + \dfrac{Ca^*}{LI^*}}{2}$$

Figure 2: Maxillary anterior mesiodistal golden proportion formula considering the width ratios measured on frontal cast models.

tionnaire - Oral Aesthetic Subjective Impact Scale (OASIS), described previously.[19, 20] This instrument is composed by five questions about dental appearance, with psychometric responses, has a fi-

nal score that may vary between 5 and 35. The higher the scores, the higher the esthetic concern. The results of the self-applied questionnaire were categorized by means of the median obtained (in the present study equal to 10). The questionnaires were evaluated by a single researcher blinded for the experimental groups.

Statistical analysis

Comparisons of the perceived dental proportions between groups and with the golden proportion was carried out by using Student's t-test and t-test for one mean value, respectively. Differences between groups regarding OASIS scores was assessed by Mann–Whitney test. Association of the independent variables (gender, orthodontic treatment and dental proportions) with OASIS was analysed by logistic regression, estimating the odds ratio with the respective confidence intervals of 95%. All analyses were performed in SAS software (SAS Institute Inc., Cary, NC, USA, Release 9.2, 2010) considering a level of significance of 5%.

RESULTS

No association was found between the self-perception of dental attractiveness and the golden proportion of the central incisors and canines (P>.05) (Table 1). Furthermore, as regards the self-perception of dental attractiveness, individuals who had received orthodontic treatment presented 3.46 (CI: 1.38–8.69) times more chance of their oral condition having a greater impact on their perception of attractiveness (P<.05) when compared with those who had never been submitted to orthodontic treatment. Gender was not associated with the occurrence of the golden proportion of maxillary anterior teeth, or even the OASIS scores (P>.05). The highest self-perception of dental beauty score was presented by the orthodontic treated group (12: 4–23; median: minimum–maximum) when compared with the untreated group (8: 5–18) (P=.0032) (Figure 3).

Individuals submitted to orthodontic treatment presented significantly higher proportions of central incisors than those without orthodontic treatment (P<.05), with values closer to those of the golden proportion (Figure 4), in spite of the two groups differing significantly from the golden proportion (P<.05). For the proportion of the canines, no significant difference was observed between the groups, with the two groups differing

significantly from the golden proportion (P<.05), as may be observed in Fig. 5. Thus, the individuals who were submitted to orthodontic treatment presented a greater proximity to the golden proportion of their clinical crown dimensions of the maxillary anterior teeth with respect to their apparent mesiodistal widths than those who had not undergone orthodontic treatment.

Table 1: Results of OASIS associations (Oral Aesthetic Subjective Impact Scale) with the other evaluated variables.

Variable	Category	n (%)	OASIS		*OR ($IC95%)	p-valor
			≤10[#]	>10[#&]		
Gender	Female	40 (50,0)	22 (55,0)	18 (45,0)	0,82 (0,34-1,97)	0,6545
	Male	40 (50,0)	20 (50,0)	20 (50,0)	Ref	
Orthodontically treated	No	40 (50,0)	27 (67,5)	13 (32,5)	Ref	
	Yes	40 (50,0)	15 (37,5)	25 (62,5)	3,46 (1,38-8,69)	0,0082
Central incisors proportion	≤1,51[#]	40 (50,0)	22 (55,0)	18 (45,0)	Ref	
	>1,51[#]	40 (50,0)	20 (50,0)	20 (50,0)	1,22 (0,51-2,94)	0,6545
Canines proportions	≤0,77[#]	40 (50,0)	22 (55,0)	18 (45,0)	Ref	
	>0,77[#]	40 (50,0)	20 (50,0)	20 (50,0)	1,22 (0,51-2,94)	0,6545

*Odds ratio; $confidence intervals of 95%. &Reference level - highest impact. #Mediana. OASIS: Oral Aesthetic Subjective Impact Score.

Table 2: Mean (standard deviation) of the proportion of central and canine incisors, depending on the group, compared to the golden proportion.

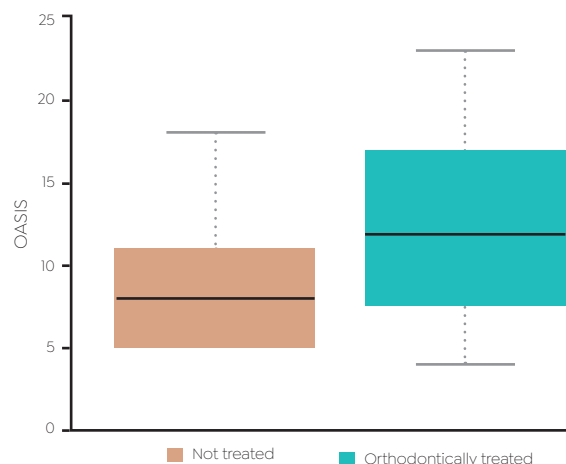| Group	Central incisors proportion	Canines proportions
Not treated	1,44 (0,18)	0,80 (0,10)
Orthodontically treated	1,57 (0,14)	0,75 (0,12)
Golden proportion	1,618	0,618
p-value (between groups)	0,0009	0,0951
p-value (Golden proportion) – not treated	<0,0001	<0,0001
p-value (Golden proportion) – treated	0,0381	<0,0001

Figure 3: Box plot of OASIS in function of the history of orthodontic treatment.

DISCUSSION

Golden proportion was not absolutely achieved in the sample population, in accordance with previous studies.[9,21-23] Besides it have been suggested[24-28] the use of mathematical canons as predictable parameters for obtaining pleasant maxillary anterior teeth, the golden proportion probably not occur in the major portion of the population due to the wide degree of interethnic variability, a remarkable characteristic of the Brazilian population.[29]

The results obtained demonstrate that the individuals submitted to orthodontic treatment, presented greater proximity to the golden proportion of the central incisors and canines (1.57:1:0.75) when compared with the Control Group (1.44:1:0.80). The mesiodistal width of the central incisors was slightly narrower and that of the canines slightly wider than the values suggested by the golden proportion, corroborating the data from previous observations.[10] The fact that the central incisor and canine ratios were shown to be closer to the values of the golden proportion may indicate that orthodontic treatment had only a small effect on the visible tooth surfaces proportions evaluated.

Although the concepts of dental symmetry and proportionality are characteristics associated with greater predictability in the promotion of dental attractiveness[28, 30], these are not systematically sought in orthodontic treated patients. This evidences are of clinical significance since it reasserts that orthodontic therapy must exceeds the simple application of morphometrical canons for the correction of occlusal dysplasia's.[31,32]

Besides dental proportions play different roles in the perception of dental beauty by orthodontists and lay people,[33] asymmetrical proportions of the maxillary anterior teeth are considered unattractive[34] and may even have a negative influence on the psychosocial condition of patients.[35] Nevertheless, in the present study, there was no significant association of the golden proportion with the self-perception of beauty (OASIS) (P>.05). The contribution of other determinants such as dental colour and shape, mesiodistal coronal angulation, labiolingual coronal angulation, lip position, gingival design and buccal corridor may be related to this non-association observed in the present study.[36,37] That is, the self-perception of dental aesthetics is not necessarily correlated with an ideal smile de-

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scribed in terms of anthropometric ratios, which may be evident by the absence of parameters considered promoters of dental attractiveness.[13]

The unachieved association of golden proportion of maxillary anterior teeth with self-perception of dental beauty may also derive from the long-term of visual perception acceptance of malocclusion conditions.[6,14,18] However, the disassociation of dental beauty cannons with laypersons dental beauty perception may not be totally considered. Shifting in maxillary visual proportions, even during the retention status, compromising the stability of orthodontic treatment outcome have shown to promote unsatisfactory perception of dental appearance.[17]

The results of the present case-control study indicate that individuals who were submitted to orthodontic treatment were noted to present 3.46 (CI: 1.38–8.69) times more chance of considering their dental aesthetics positive (P<.05), irrespective of gender or presence of the golden proportion. This could possibly explain the assumption that irrespective of the degree of severity of occlusal disorders[38] or orthodontic therapeutic approach,[39] young adults have their self-perception of dental aesthetics enhanced by the simple fact of been submitted to orthodontic treatment.

CONCLUSIONS

The present investigation demonstrates that the self-perception of dental attractiveness is not associated with the occurrence of the anthropometric ratios established by the golden proportion. In addition, the self-perception of dental attractiveness was higher in the population who had been submitted to orthodontic treatment. This outcome may be caused by the fact that the ratios of the apparent view of the maxillary anterior teeth were closer to the golden proportion.

ACKNOWLEDGMENT

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