

BLACK SPACES BETWEEN MAXILLARY INCISORS: WHAT IS THE AESTHETIC LIMIT?

ESPAÇOS NEGROS ENTRE INCISIVOS SUPERIORES: QUAL É O LIMITE ESTÉTICO?

**Matheus Melo PITHON¹; Rogério LACERDA-SANTOS²; Jéssica Rocha BARRETO³;
Jéssica Oliveira ROCHA³; Raissa Virgínea Galvão BRASIL³; Larissa Batista WEBERLING³;
Jorge Victor Barbosa PAIXÃO³; Raldo da Silva COQUEIRO⁴**

1. Professor, Department of Orthodontics, State University of Southwest Bahia, Jéquie, BA, Brazil. matheuspithon@gmail.com; 2. Professor, Department of Dentistry, Dental School, Federal University of Juiz de Fora, Governador Valadares, MG, Brazil. lacerdaorto@hotmail.com; 3. Student of Dentistry, Department of Orthodontics, State University of Southwest Bahia, Jéquie, BA, Brazil; 4. Professor, Department of Statistics, State University of Southwest Bahia, Jéquie, BA, Brazil.

ABSTRACT: The focus of this article was evaluates the degree of perception of laypersons of different age groups with respect to smile esthetics in cases involving black spaces between maxillary incisors. Changes were made in a photograph of a smiling female patient, simulating various configurations of black spaces between maxillary incisors. For this purpose an image manipulation Photoshop CS3 was used. For evaluation black spaces of 0.5, 1.0, 1.5, 2.0, and 2.5 mm in size were created. After digital manipulation, the photographs were printed on photographic paper, attached to a questionnaire, and distributed among laypersons in the age groups of 15-19; 35-44, and 65-74. To evaluate the degree of esthetics, a scale of attractiveness was used, in which a score of 0 would represent "not very attractive", 5 "attractive" and 10 "very attractive". Fisher's exact test, Kruskal-Wallis test and Mann-Whitney test was used ($P<0.05$). Results showed that the photographs without black space and with black space of 2.5 mm were scored as the most and least attractive, respectively, by all the age groups. The degree of perception of black spaces between maxillary incisors gradually diminished as the age of the groups increased ($P<0.05$). Black spaces have a negative repercussion on smile esthetics, perceived more easily by younger persons. The larger the black space, less attractive the smile.

KEYWORDS: Orthodontics. Perception. Dental Esthetics.

INTRODUCTION

The quest for esthetics when smiling increases by the day, since a beautiful smile has been considered fundamental for the individual's good appearance and presentation. From this aspect, the facial attractiveness and esthetics, and self-esteem of the individual and his/her interpersonal relationships are directly influenced by the architecture of the smile (ELI et al., 2001; PITHON et al., 2013b). The esthetic perception varies from one individual to another, as each one has different personal experiences and social environments (FLORES-MIR et al.; 2004).

Included among the morphological requisites that interfere in the presentation of the smile are the relations between the bones and soft tissues (SANTOS; RUELLAS, 2012; PITHON et al., 2014a-b), harmony between the teeth, presence of a buccal corridor, amount of gingival exposure and the presence of diastemas at the midline (KEPIC et al., 1990; RODEN-JOHNSON et al., 2005; JORNUNG; FARDAL, 2007).

Another factor that has impact on smile esthetics is the appearance of black spaces, which show when the gingiva does not completely fill the

space above the point of contact between one tooth and another (PITHON et al., 2012b; PITHON et al., 2013a). This may occur due to gingival retraction resulting from poor hygiene habits, maladapted restorations and excessive force during tooth brushing (PITHON et al., 2013a).

The presence of black space may generate little attractiveness in smile esthetics; therefore, it is necessary to study the perceptions of individuals in different age groups, in order to evaluate the influence of these perceptions on smile esthetics. Thus, the aim of this study was to evaluate the degree of perception of laypersons of different age groups with respect to smile esthetics in cases involving black spaces between maxillary incisors.

MATERIAL AND METHODS

In order to conduct this study, a front view intraoral photograph of a smiling female patient, aged 30 years 10 months, with normal occlusion was used. The photograph was taken with a digital camera of 10 Megapixels (Canon Rebel XTI, Tokyo, Japan), resulting in images in which only the lips, gingival tissue and teeth could be visualized. The real photograph was manipulated with the use

of a computer software program, Adobe Photoshop CS3 (Adobe Systems Inc., San Francisco, USA). The changes in the photograph were made in the region of the anterosuperior arch of the image with various compositions black spaces of different sizes. This study was approved by the Ethics Committee on Human Research, CEP/CAAE:10933512.5.0000.8815.

Six images were obtained with and without the presence of black spaces with increase in proportions: one image without the presence of black spaces (Figure 1), and the other with the presence of black spaces measuring 0.5 (Figure 2); 1.0 (Figure 3); 1.5 (Figure 4); 2.0 (Figure 5) and 2.5 mm in size (Figure 6) between the central incisors, and the black spaces performed in the lateral incisors correspond to 60% of the size of the black

spaces of the central incisors. In order to conduct the research, 3 groups with 50 individuals in each were selected from among the following age groups: 15 to 19; 35 to 44, and 65 to 74 years (ages pre-established by the World Health Organization). The invitation to participate the survey was conducted along with the direction of two campus of Southwest State University of Bahia and two state schools of the city of Jequié-BA. In which, students and officials were invited to participate spontaneously of the study, and was also presented a free and informed consent term. The images in the dimensions of 15 cm wide x 10 cm high and resolution of 500 dpi were printed on photographic paper, attached to a questionnaire and distributed among the groups of evaluators.



Figures. Modified images evaluated. (1) Without black spaces and with (2) black space of 0.5 mm, (3) black space of 1.0 mm, (4) black space of 1.5 mm, (5) black space of 2.0 mm, and (6) black space of 2.5 mm.

On the first page all the images were presented together in random sequence, together with the following questions: Can you note differences between the images? Which image do you like most and which do you like least? On a second page, the distribution of the same images was altered. This second page served to evaluate the degree of reliability of the responses given by the evaluators in the first round of evaluation. In the sequence of the research, each image was printed separately on additional pages (so that they could be evaluated individually) together with an attractiveness scale, on which 0 would represent "not very attractive", 5 "attractive" and 10 "very attractive". All the evaluators were advised not to compare the images on different sheets. The evaluation time interval for each image was limited to 60 seconds.

Data analysis

The frequencies of replies given by the participants in each age group (≤ 30 , 30-50 and > 50 years) were compared by means of the chi-square test. In cases in which the expected frequency was less than five ($n < 5$), Fisher's exact test was used.

The scores of grades awarded to each photograph were compared by means of the Kruskal-Wallis test and comparisons between pairs were performed using the Mann-Whitney test. The means of scores awarded to each photograph were calculated in each group in order to determine the Spearman correlation coefficients, to evaluate the similarity between perceptions according to the age groups. The level of significance adopted was 5% ($\alpha = 0.05$). The data were tabulated and analyzed using the software programs SPSS 21.0 (IBM Corp, Armonk, USA).

RESULTS

Of the 150 individuals, 58.7% were of the female sex (Table 1).

The results demonstrated that there was significant difference in the perception of the differences existent between the photographs, with the highest number of individuals who were unable to note the lack of similarity between the images being observed in the age groups of 65-74 years, in comparison with the younger age groups (Table 2)

Table 1. Demographic data of study participants per groups.

Characteristics	Age Group (years)		
	15-19(n = 50)	35-44(n = 50)	65-74(n = 50)
Sex			
Male	13 (26.0%)	22 (44.0%)	27 (54.0%)
Female	37 (74.0%)	28 (56.0%)	23 (46.0%)

Table 2. Participants' perception with respect to differences and their preferences as regards to the set of images in random sequence.

Replies	Age Group (years)			P-Value
	15-19	35-44	65-74	
Perceive differences				
Yes	50 (100.0%)	49 (98.0%)	33 (66.0%)	< 0.001 [†]
No	0 (0.0%)	1 (2.0%)	17 (34.0%)	
Image I like most*				
1 (without black spaces)	50 (100.0%)	42 (85.7%)	6 (18.2%)	< 0.001 [‡]
2 (0.5 black space)	0 (0.0%)	7 (14.3%)	10 (30.3%)	
3 (1.0 black space)	0 (0.0%)	0 (0.0%)	12 (36.4%)	
4 (1.5 black space)	0 (0.0%)	0 (0.0%)	4 (12.1%)	
5 (2.0 black space)	0 (0.0%)	0 (0.0%)	1 (3.0%)	
6 (2.5 black space)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Image I like least*				
1	0 (0.0%)	0 (0.0%)	0 (0.0%)	< 0.001 [‡]
2	0 (0.0%)	1 (2.0%)	1 (3.0%)	
3	1 (2.0%)	1 (2.0%)	0 (0.0%)	
4	0 (0.0%)	0 (0.0%)	6 (18.2%)	
5	2 (4.0%)	3 (6.1%)	10 (30.3%)	
6	47 (94.0%)	44 (89.8%)	16 (48.5%)	

* Answered only by individuals who perceived differences between the images; [†] Chi-square Test. [‡] Exact Fisher Test.

Among the participants who were able to note differences between the images, there was statistical difference in the proportions among the groups, both as regards the most preferred and the least preferred image. The individuals of the two younger age groups elected image 1 as the best, while the individuals in the 65-74-year age group elected images 2 and 3.

The proportion of individuals who liked image 1 most was higher in the age group from 15-19 years, in comparison with the two older age groups, and in the age group from 35-44 years, in comparison with the age group from 65-74 years. The proportion of individuals who liked image 2 most was higher in the two older age groups, in comparison with the age group from 15-19 years, and in the age group from 65-74 years, in comparison with the age group from 35-44 years, the proportion of individuals who liked images 3

and 4 most was higher in the age group from 65-74 years, in comparison with the two younger age groups.

The individuals of all the age groups elected image 6 as being the worst. However, the proportion of individuals who liked image 6 least was higher in the two younger age groups compared with the age group from 65-74 years, the proportion of individuals who like images 4 and 5 least was higher in the age group from 65-74 years, compared with the two younger age groups.

With respect to image 2, there was significant difference in the perception of the differences existent between the photographs, with the highest number of individuals who were unable to note the lack of similarity between the images being observed in the age groups of 65-74 years, in comparison with the younger age groups (Table 3).

Table 3. Participants' perception with respect to differences and their preferences as regards to the set of images in modified sequence.

Replies	Age Group (years)			P-Value
	15-19	35-44	65-74	
Perceive differences				
Yes	49 (98.0%)	49 (98.0%)	35 (70.0%)	< 0.001 [†]
No	1 (2.0%)	1 (2.0%)	15 (30.0%)	
Image I like most*				
1 (2.5 black space)	0 (0.0%)	0 (0.0%)	0 (0.0%)	< 0.001 [‡]
2 (1.0 black space)	0 (0.0%)	3 (6.1%)	15 (45.4%)	
3 (2.0 black space)	0 (0.0%)	0 (0.0%)	3 (9.1%)	
4 (without black spaces)	49 (100.0%)	44 (89.8%)	7 (21.2%)	
5 (0.5 black space)	0 (0.0%)	2 (4.1%)	8 (24.2%)	
6 (1.5 black space)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Image I like least*				
1	40 (81.6%)	31 (63.3%)	15 (45.5%)	0.004 [‡]
2	0 (0.0%)	0 (0.0%)	1 (3.0%)	
3	9 (18.4%)	13 (26.5%)	15 (45.5%)	
4	0 (0.0%)	1 (2.0%)	0 (0.0%)	
5	0 (0.0%)	1 (2.0%)	2 (6.1%)	
6	0 (0.0%)	3 (6.1%)	0 (0.0%)	

* Answered only by individuals who perceived differences between the images; [†] Chi-square Test. [‡] Exact Fisher Test.

Among the participants who were able to note differences between the images, there was statistical difference in the proportions among the groups, both as regards the most preferred and the least preferred image. The individuals of the two younger age groups elected image 4 as being the best, while the individuals in the age group from 65-74 years elected image 2.

The proportion of individuals who liked image 2 most was higher in the age group from 65-74 years, in comparison with the two younger age groups, the proportion of individuals who liked image 4 most was higher in the age group from 15-

19 years, and diminished progressively in the older age groups, the proportion of individuals who liked Image 5 most was higher in the age group from 65-74 years, in comparison with the two younger age groups.

The individuals in the two younger age groups elected image 1 as being the worst, while the individuals in the age group from 65-74 years equally elected images 1 and 3. The proportion of individuals who liked image 1 least was higher in the age group from 15-19 years and diminished progressively in the older age groups, the proportion of individuals who liked image 3 least was higher in

the age group from 65-74 years, compared with the two younger age groups (Table 4).

Table 4. Mean Scores (standard deviation) of photographs awarded by the study participants, according to age group.

Photograph	Age Group (years)			P-Value*
	15-19	15-19	65-74	
Image 1 (without BS [#])	8.97 (1.28) ^a	8.72 (2.01) ^a	9.34 (0.72) ^b	< 0.432
Image 2 (0.5 BS)	6.24 (2.20) ^a	7.16 (2.21) ^b	9.26 (0.80) ^c	< 0.001
Image 3 (1.0 BS)	4.73 (2.16) ^a	4.80 (1.92) ^a	9.14 (0.88) ^b	< 0.001
Image 4 (1.5 BS)	3.19 (1.91) ^a	3.34 (1.70) ^a	8.54 (1.40) ^b	< 0.001
Image 5 (2.0 BS)	2.62 (1.84) ^a	2.70 (1.78) ^a	8.24 (1.61) ^b	< 0.001
Image 6 (2.5 BS)	1.65 (1.75) ^a	1.56 (1.83) ^a	7.98 (1.81) ^b	< 0.001

* The scores of grades were compared by means of the Kruskal-Wallis test. BS[#]= Black Space; ^{a,b,c} Values with different superscript letters are significantly different (Mann-Whitney test).

Photographs 1 and 6 were scored as the most and least attractive, respectively by all the age groups (Table 4). The grades awarded to all the images, except image 1, presented significant difference among the age groups. The comparisons between pairs showed that individuals in the age group from 15-19 years attributed lower grades to

image 2, with the scores being progressively higher in the older age groups, individuals in the age group from 65-74 years attributed higher grades to images 3, 4, 5 and 6, compared with individuals in the younger age groups (Table 4). Perfect and positive correlation was verified between the mean grades of all the age groups (Table 5).

Table 5. Spearman's Coefficient of Correlation of the mean score for the photographs.

Age Groups	r ^{Spearman}	
	35-44 years	65-74 years
15-19 years	1.00*	1.00*
35-44 years	1.00*	1.00*

* $P < 0.001$ (2-tailed).

DISCUSSION

Smile esthetics is a factor prioritized during orthodontic treatment, in conjunction with the function of the system (PITHON et al., 2013b). This may be compromised by the presence of black spaces between the maxillary incisors (PITHON et al., 2012b; PITHON et al., 2013a). At the end of orthodontic treatment, these spaces may frequently be present. There are various factors involved in their occurrence, such as accentuated inclination of the incisors, artistic bends, elongation of the interdental gingival fibers or loss of bone mass during treatment (PITHON et al., 2012b; PITHON et al., 2013a). Other discussions have pointed out that the appearance of black spaces may also be related to poor oral hygiene, leading the loss of periodontal attachment and as a consequence, gingival recession (BURKE et al., 1994; PITHON et al., 2013a).

Perception with regard to the presence of black spaces and the extent to which this interferes in esthetics may vary from one individual to another. In the literature, it is described that the

presence of these spaces between central incisors compromises esthetic perception to a large extent (PITHON et al., 2013a). However, there are no reports in the literature up to now about what the repercussion would be with regard to these black spaces between all the maxillary anterior teeth. Starting from this principle, the proposal of this study was to evaluate the esthetic perception of individuals from three different age groups (15-19, 35-44 e 65-74 years), with regard to smile esthetics in cases with different degrees of black spaces between maxillary incisors.

Some factors, such as gender and age are considered to have an influence on the esthetic perception of the smile. The present study showed no influence whatever of gender on the evaluations, however, there were statistically significant differences with regard to age (RODEN-JOHNSON et al., 2005; SOH et al., 2005; RODRIGUES et al., 2009).

For this purpose, a front view intraoral smile photograph was used, which was manipulated in order to obtain compositions of black spaces of different dimensions. These images were printed on

the same page in random order, and again on another in a different order, in order to evaluate the degree of compatibility between the evaluations. At this time, it was evaluated whether the individuals were capable of noting differences between the photographs and choosing the one that most pleased them and the one that least pleased them. This method has been described in other studies demonstrating efficacy with regard to the evaluation of perception of changes made to photographs (PINHO et al., 2007; PITHON et al., 2012a-b; PITHON et al., 2013a-b; PITHON et al., 2014c).

It could be observed that the individuals in the two younger age groups elected the image without black spaces as being the best, while individuals of the age group from 65-74 years elected the images with a black space of 0.5 and 1.0 mm as being the best. This fact may be justified by the greater prevalence of these spaces in older populations, leading the individual to thinking that this alteration is normal. The individuals of all the age groups elected the image with the black space of 2.5 mm as being the worst. These results corroborate the findings of other authors (PITHON et al., 2012b; PITHON et al., 2013a), which were able to verify that the larger the black space existent between the teeth, the worse the esthetics presented.

The findings of this study has some similarities to a search (PITHON et al., 2013a) conducted with the presence of black spaces only between the maxillary central incisors. However, the big difference observed in this study was that the age groups of 15-19 years and 35-44 years were more rigorous in assessing for the presence of black spaces, possibly due the fact that a larger number of teeth with black spaces call more attention of these groups. On the other hand, the age group of 65-74 years made a less critical assessment regarding the presence of diatemas in 4 teeth, contrary to the study realized with the presence of diatemas only between the central incisors. This suggests that the older

population considered more normal and symmetrical the presence of smaller diatemas between the 4 incisors.

In the evaluations sequence the evaluators were asked to award grades to the images individually. The degree of perception was evaluated by means of an attractiveness scale, in which 0 would represent "not very attractive", 5 "attractive" and 10 "very attractive". This method, widely used in the literature, was chosen because it was shown to be quick and simple to obtain value judgments.

The photographs without black spaces and with black space of 2.5 mm were scored as the most and least attractive, respectively, indicating the preference for the absence of black spaces by all the age groups, corroborating the findings of other studies. However, it could be observed that the individuals in the older age group awarded higher grades to all the images, a fact that may be justified by the greater prevalence of these alterations in this population, so that this leads to making this alteration appear to be normal (PITHON et al., 2013a).

The lack of perception of asymmetries by the more advanced age group may suggest that advanced age leads to a reduction in the perception of esthetic details of the smile. Whereas in the other two groups, in addition to asymmetry being very perceptible, there was less tolerance due to the low scores with regard to each image (GELD et al., 2007).

CONCLUSIONS

Black spaces between the maxillary incisors were perceived more easily by younger persons. There was a diminishing degree of perception as the age of the groups increased.

The larger the black space, the less attractive the smile was classified.

RESUMO: O foco deste artigo foi avaliar o grau de percepção de leigos de diferentes faixas etárias em relação à estética do sorriso em casos que envolvam espaços negros entre incisivos superiores. As alterações foram feitas em uma fotografia de uma paciente do sexo feminino sorrindo, simulando várias configurações de espaços negros entre incisivos superiores. Para este efeito, um Photoshop CS3 para manipulação de imagem foi usado. Para avaliação dos espaços negros 0,5, 1,0, 1,5, 2,0 e 2,5 mm de tamanho foram criados. Após a manipulação digital, as fotografias foram impressas em papel fotográfico, incluídas em um questionário, e distribuídos entre leigos nas faixas etárias de 15-19; 35-44 e 65-74. Para avaliar o grau de estética, foi utilizada uma escala de atratividade, em que uma pontuação de 0 representaria "não muito atraente", 5 "atraente" e 10 "muito atraente". Foi utilizado o teste exato de Fisher, teste de Kruskal-Wallis e Mann-Whitney ($P < 0,05$). Os resultados mostraram que as fotografias sem espaço negro e com espaço negro de 2,5 mm foram classificadas como as mais e menos atraente, respectivamente, por todos os grupos etários. O grau de percepção de espaços negros entre os incisivos superiores gradualmente diminui à medida que a idade dos grupos aumentou ($P < 0,05$). Espaços negros têm uma repercussão negativa na estética do sorriso, percebida mais facilmente por pessoas mais jovens. Quanto maior o espaço negro, menos atraente o sorriso.

PALAVRAS-CHAVES: Ortodontia. Percepção. Estética Dental.**REFERENCES**

- BURKE, S.; BURCH, J. G.; TETZ, J. A. Incidence and size of pretreatment overlap and posttreatment gingival embrasure space between maxillary central incisors. **Am. J. Orthod. Dentofacial Orthop.** St. Louis, v. 105, n. 5, p. 506-511, May. 1994.
- ELI, I.; BAR-TAL, Y.; KOSTOVETZKI, I. At first glance: social meaning of dental appearance. **J. Public Health Dent.** Raleigh, v. 61, n. 3, p. 150-154, Summer. 2001.
- FLORES-MIR, C.; SILVA, E.; BARRIGA, M. I.; LAGRAVERE, M. O.; MAJOR, P. W. Layperson's perception of smile aesthetics in dental and facial views. **J. Orthod.** Oxford, v. 31, n. 3, p. 204-209, Sep. 2004. <http://dx.doi.org/10.1179/146531204225022416>
- GELD, P. V. D.; OOSTERVELD, P.; HECK, G. V.; KUIJPERS-JAGTMAN, A. M. Smile attractiveness. Self-perception and influence on personality. **Angle Orthod.** Appleton, v. 77, n. 5, p. 759-765, Sep. 2007. <http://dx.doi.org/10.2319/082606-349>
- JORNUNG, J.; FARDAL, O. Perceptions of patients' smiles: a comparison of patients' and dentists' opinions. **J. Am. Dent. Assoc.** Chicago, v. 138, n. 12, p. 1544-1553, Dec. 2007. <http://dx.doi.org/10.14219/jada.archive.2007.0103>
- KEPIC, T. J.; O'LEARY, T. J.; KAFRAWY, A. H. Total calculus removal: an attainable objective? **J. Periodontol.** Chicago, v. 61, n. 1, p. 16-20. Jan. 1990. <http://dx.doi.org/10.1902/jop.1990.61.1.16>
- PINHO, S.; CIRIACO, C.; FABER, J.; LENZA, M. A. Impact of dental asymmetries on the perception of smile aesthetics. **Am. J. Orthod. Dentofacial Orthop.** St. Louis, v. 132, n. 6, p. 748-753, Dec. 2007. <http://dx.doi.org/10.1016/j.ajodo.2006.01.039>
- PITHON, M. M.; BASTOS, G. W.; MIRANDA, N. S.; SAMPAIO, T.; RIBEIRO, T. P.; NASCIMENTO, L. E., et al. Esthetic perception of black spaces between maxillary central incisors by different age groups. **Am. J. Orthod. Dentofacial Orthop.** St. Louis, v. 143, n. 3, p. 371-375, Mar. 2013a. <http://dx.doi.org/10.1016/j.ajodo.2012.10.020>
- PITHON, M. M.; RIBEIRO, D. L. R.; SANTOS, R. L.; SANTANA, C. L.; CRUZ, J. P. P. Soft tissue thickness in young north eastern Brazilian individuals with different skeletal classes. **J. Forensic Leg. Med.** Kidlington, v. 22, n. 1, p. 115-120, Feb. 2014a. <http://dx.doi.org/10.1016/j.jflm.2013.09.014>
- PITHON, M. M.; SANTOS, A. M.; ANDRADE, A. C. V.; SANTOS, E. M.; COUTO, F. S.; COQUEIRO, R. S. Perception of the esthetic impact of gingival smile on laypersons, dental professionals, and dental students. **Oral Surg. Oral Med. Oral Pathol. Oral Radiol.** New York, v. 115, n. 4, p. 448-454, Apr. 2013b. <http://dx.doi.org/10.1016/j.oooo.2012.04.027>
- PITHON, M. M.; SANTOS, A. M.; COUTO, F. S.; COQUEIRO, R. S.; FREITAS, L. M.; SOUZA, R. A.; et al. Perception of the esthetic impact of mandibular incisor extraction treatment on laypersons, dental professionals, and dental students. **Angle Orthod.** Appleton, v. 82, n. 4, p. 732-73, Jul. 2012a. <http://dx.doi.org/10.2319/081611-521.1>
- PITHON, M. M.; SANTOS, A. M.; COUTO, F. S.; FREITAS, L. M.; COQUEIRO, R. S. Comparative evaluation of esthetic perception of black spaces in patients with mandibular incisor extraction. **Angle Orthod.** Appleton, v. 82, n. 5, p. 806-811, Sep. 2012b. <http://dx.doi.org/10.2319/102611-665.1>

PITHON, M. M.; SANTOS, R. L.; SAMPAIO, G. A.; MENEZES, I. H.; COQUEIRO, R. S. Anteroposterior and Vertical Changes in Skeletal Class II Patients Treated With Modified Thurow Appliance. **Braz. Dent. J.** Ribeirão Preto, v. 25, n. 2, p. 170-174, Mar. 2014b.

PITHON, M. M.; SILVA, I. S.; ALMEIDA, I. O.; NERY, M. S.; SOUZA, M. L.; BARBOSA, G.; et al. Photos vs silhouettes for evaluation of profile esthetics between white and black evaluators. **Angle Orthod.** Appleton, v. 84, n. 2, p. 231-238, Mar. 2014c. <http://dx.doi.org/10.2319/051513-373.1>

RODEN-JOHNSON, D.; GALLERANO, R.; ENGLISH, J. The effects of buccal corridor spaces and arch form on smile esthetics. **Am. J. Orthod. Dentofacial Orthop.** St. Louis, v. 127, n. 3, p. 343-350, Mar. 2005. <http://dx.doi.org/10.1016/j.ajodo.2004.02.013>

RODRIGUES, C. D. E. D.; MAGNANI, R.; MACHADO, M. S.; OLIVEIRA, O. B. The perception of smile attractiveness. **Angle Orthod.** Appleton, v. 79, n. 4, p. 634-639, Jul. 2009. <http://dx.doi.org/10.2319/030508-131.1>

SANTOS, R. L.; RUELLAS, A. C. O. Dentofacial characteristics of patients with Angle Class I and Class II malocclusions. **Dental Press J. Orthod.** Maringá, v. 17, n. 46, p. e1-46.e7, Mar/Apr. 2012.

SOH, J.; CHEW, M. T.; WONG, H. B. A comparative assessment of the perception of Chinese facial profile esthetics. **Am. J. Orthod. Dentofacial Orthop.** St. Louis, v. 127, n. 6, p. 692-699, Jun. 2005. <http://dx.doi.org/10.1016/j.ajodo.2004.02.018>