

# Esthetic analysis of the smile

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## Abstract

This study analyzed the esthetics components of the smile, evaluating the relationship between the curve formed by the incisal line of the anterior superior teeth and the curve of the inferior lip, the touch of this incisal line on the inferior lip, the teeth displayed during smile, the relationship between the facial midline with the arch midline, the location of the arch midline and gender differences. Eighty-eight undergraduate students of the dentistry course of the Tiradentes University were selected. Two photographs were taken (smiling face and smile) using digital camera. The statistical analysis was performed after image tracing evaluation. Results show that the coincidence of the facial midline with the arch midline occurred only on half of the students. Most of the students presented parallelism between the incisal plan and the interpupillary line. Smiles with or without touch of the incisal line on the lower lip, smiles revealing up to the seconds premolars or firsts molars, and parallel or straight smiles were also most commonly observed. The majority of the men presented centered midline arch while women presented deviation to the right. No difference was found between the distribution of the arch midline.

## Key Words:

smiling analysis, dental esthetics, esthetic

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## Introduction

Good appearance is not considered a vanity sign, but literally a need, and the dentistry has a fundamental role in obtaining it, since the face is the exposed area of the body and the mouth a prominent line<sup>1</sup>. The smile constitutes an important component in the presentation of a human being favoring his or her social acceptance. A non harmonic smile decreases the beauty of the face and it can cause discomfort in the social conviviality, as it is one of the most important facial expressions that demonstrates friendship, pleasant sensation and appreciation<sup>2</sup>.

Despite the importance of dental esthetics, little has been done to understand the role of smile's components in dental esthetics<sup>3</sup>. Esthetics in dentistry has increasingly become a major concern for the patients and often serves as a reason for seeking dental care.

The esthetic value of a cosmetic restoration may be affected by factors contributing to the composition of a pleasing smile, such as amount of gingival display, midline position, gingival architecture, clinical crown dimensions, and tooth position<sup>4-6</sup>. This emphasized the need for an interdisciplinary approach (a combination of orthodontic, periodontic, restorative, and prosthodontic treatments) to evaluate, diagnose, and resolve esthetic problems<sup>7</sup>.

One of the components which enhance dental esthetics is the coincident midlines. It serves both as an esthetic component<sup>8</sup> and an important functional component of occlusion<sup>9</sup>. It is esthetically important as midline is the most important focal spot in the smile<sup>9-10</sup> and it enhances esthetic especially when the mesial surfaces of the maxillary central incisors (anterior tooth midline) coincide with the midline of the face (facial midline)<sup>11</sup>. It is functionally important as it could be used as a clinical guide in establishing good buccal interdigitation<sup>9</sup>.

Dentists are obligated to understand beauty, harmony, balance, and proportion as perceived by the society when planning treatment<sup>12</sup>. Dentofacial attractiveness is particularly important for the psychosocial well being of an individual. People with a normal dental appearance are judged socially more attractive over than those with malocclusions<sup>13,14</sup>.

Esthetics is a primary consideration for patients seeking prosthodontic, orthodontics and restorative treatments. Toward this end, the size and form of the maxillary anterior teeth are important not only to dental esthetics, but also to facial esthetics<sup>15</sup>. The goal is to have the maxillary anterior teeth restore optimal dentolabial relations in harmony with the overall facial appearance. However, there is little scientific data in the dental literature to use as a guide for defining the proper size and shape of anterior teeth of determining normal relationships for them<sup>15</sup>. Due to the need of parameters to aid in the esthetic reconstruction of the smile and to the shortage of clinical researches relating objectives data of the composition of the smile, this paper aimed to evaluate the influence of the dental and buccal components in the facial

esthetics in young adults.

## Material and Methods

For this *in vivo* study eighty eight dental students from the Dental School of Tiradentes University (Sergipe-SE, Brazil) were selected with the following criteria:

- Absence of restorations or prosthetic crowns in the superior anterior teeth;
- Absence of abrasion, attrition or erosion in the superior anterior teeth;
- Absence of gingival retraction in the superior anterior teeth;
- Absence of erosion in the superior anterior teeth;
- Absence of gingival hyperplasia in the superior anterior teeth;
- Absence of orthodontic appliance in the superior anterior teeth;
- Absence of accentuated facial asymmetry;
- Absence diastema among the anterior superiors teeth;
- No history of facial trauma;
- No history of plastic surgery in the face.

From the included subjects, 51 were women and 37 men and their age ranged from 18 to 25 years.

All of the subjects filled up a questionnaire and signed the consent term for treatment and research, according to declaration Helsinki II, Code of Dental Ethics (C.F.O. 179/93) and the Resolution # 196 of 10/10/1996 of the National Council of Health of the Ministry of Health. This study was approved by the committee of ethics for the research in humans of the Federal University of Sergipe.

### Standardization of photographs

Two photos were taken from each volunteer with the camera Canon Power Shot A200 (Canon Incorporation Tokyo, Japan); one showing the smiling face of the individual and one showing only the smile of the individual. To take the photos, the volunteers were seated in an up right position on an office chair, with the feet on the ground. The head was positioned without support, with Camper plan parallel to the earth and visually monitored and the individual was asked to look straight ahead to a focal point of reference to ensure the stability and reproducibility of the position (Figure 1). The focal distance of all the photos was also standardized by fixing the focus in the beginning of the procedure, in such way that there was a fixed distance between the camera and the face in all the pictures, and between the camera and the volunteers' smile.

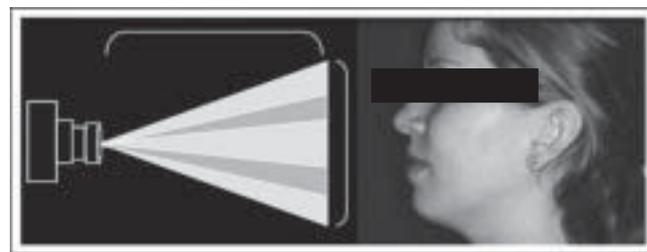


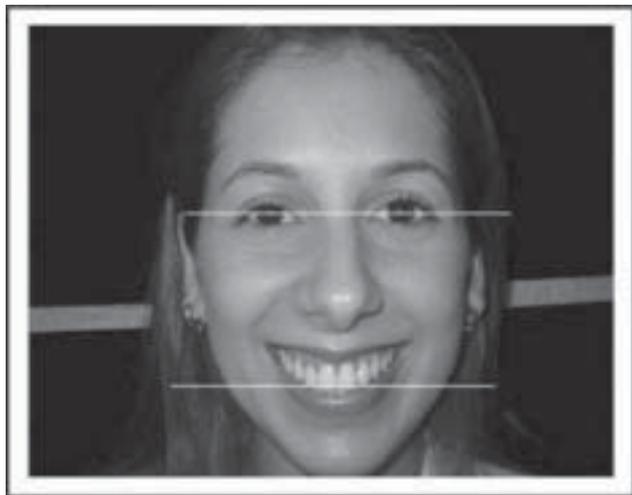
Fig.1- Standardization of Photographies.



**Fig.2-** Analysis of the coincidence between the midline of the face with the midline of the dental arch. A- Coincidence between the midlines, B- Arch midline deviated to left and C- Arch midline deviated to right.

*Analysis of the coincidence between the midline of the face with the midline of the dental arch*

In order to check the coincidence between the midline of the face and the midline of the dental arch a bisector line of the right and left pupils of the individuals was traced instead of using the nose or the chin to avoid the possible interference of deviations in them on the position of midline (Figure 2).



**Fig.3 -** Parallelism analysis of the incisal plan with the interpupillary line

*Parallelism analysis of the incisal plan with the interpupillary line*

In order to measure the parallelism of the incisal plan with the interpupillary line, a tangential line to the center of the right and left pupils was traced using the tool of PowerPoint Microsoft Office XP (Microsoft Corporation, United States) self-format, straight line. Then, this line was duplicated and moved toward the labial joint up to be tangent to the incisal border of the superior incisors. The parallelism between the two structures, or the inclination of the incisal plan was visually checked (Figure 3).

*Analysis of the relation between the arch of the smile with the curve of the inferior lip*

In order to measure the relationship between the arch of the smile with the curve of the inferior lip a tangent line was traced to the curve of the lip during the smile using the tool of PowerPoint Microsoft Office XP (Microsoft Corporation, United States) self-format, line in curve. Then, this line was duplicated and moved to the tangent of the incisal edge of the superior incisor teeth. The parallel, straight, or reverse smiles between both structures were visually checked (Figure 4).

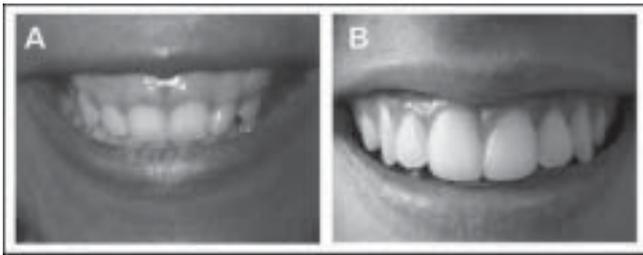
*Analysis of the distribution of teeth displayed in the smile*

A visual analysis was accomplished in order to verify the distribution of teeth displayed in the smile observing whether

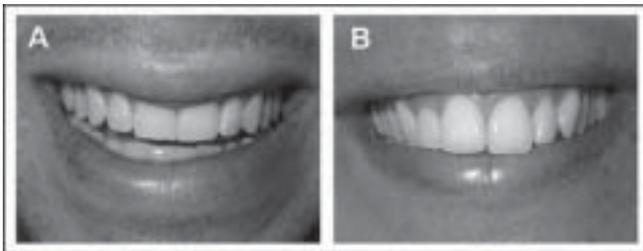


**Fig.4 -** Analysis of the relation between the arch of the smile with the curve of the inferior lip. A- Parallel smile, B- Straight smile and C- Reverse smile.

the smile comprehended up to the canines, premolars or molars (Figures 5 and 6).



**Fig.5** - Analysis of the distribution of teeth displayed in the smile. A- Smile comprehended the six anterior teeth and B- Smile comprehended the six anterior teeth and firsts pre-molars.



**Fig.6** - Analysis of the distribution of teeth displayed in the smile. A- Smile comprehended the six anterior teeth, firsts and seconds pre-molars, B- Smile comprehended the six anterior teeth, firsts and seconds pre-molars and firsts molars.

*Analysis of the distribution of incisal curve touch on the inferior lip during the smile*

A visual analysis was accomplished in order to check the

distribution of the incisal curve touch on the inferior lip observing the presence or absence of touch on the inferior lip and the superior central incisors covered by the lip (Figure 7).

*Analysis of the coincidence between the location of the dental arch midline with the contour of the filter of the lip during the smile*

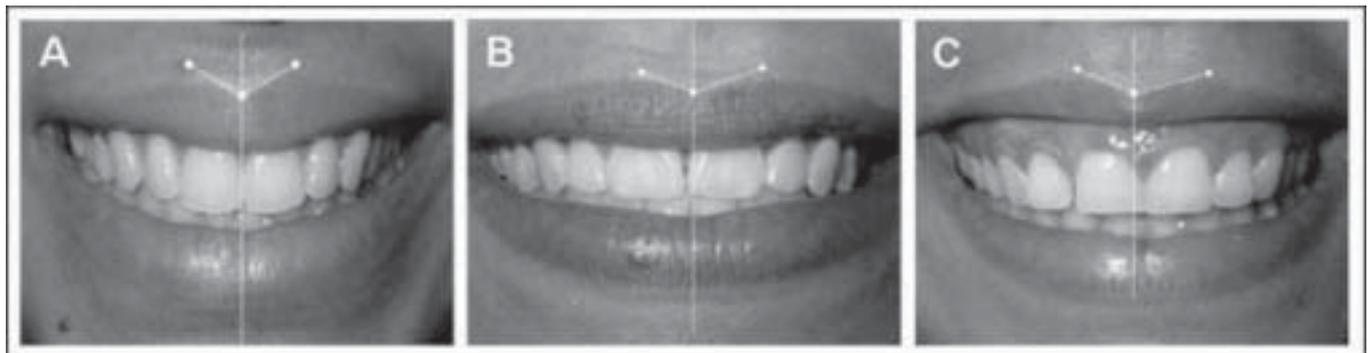
In order to measure the location of the dental arch midline a line was traced following the contour of the filter of the lip during the smile, using the tool of PowerPoint Microsoft Office XP (Microsoft Corporation, United States) self-format, straight line. This line was duplicated and moved toward the filter on the opposite side. After, a parallel line was used to mark the bisector of the filter. The location between the two structures or the right or left deviation of the midline was visually checked (Figure 8).

**Results**

The Chi-Square test ( $\chi^2$ ) was selected for the analysis of data using the level of significance of 5%. The statistical analysis was accomplished with the software Bio-Estat 2.0 (Copyright by Manuel Ayres, Civil Society of Mamirauá/CNPq, 2000). No difference was found for the presence or absence of coincidence between the midline of the face and the midline of the arch, and the results showed that there was a significant predominance of parallelism between the incisal plan and the interpupillary line ( $p=0$ ).



**Fig.7** - Analysis of the distribution of incisal curve touch on the inferior lip during the smile. A- Presence of touch on the inferior lip, B- Absence of touch on the inferior lip and C- The superior central incisors covered by the inferior lip.



**Fig.8** - Analysis of the coincidence between the location of the dental arch midline with the contour of the filter of the lip during the smile. A- Coincidence, B- Right deviation of the dental arch midline and C- Left deviation of the dental arch midline.

There was higher significant prevalence for the parallel smile on the reverse ( $p=0$ ) and for the straight smile on the reverse smile ( $p=0$ ). No differences were observed between the parallel and straight smiles.

The disposition of the six anterior teeth in the smile was significantly lower than the disposition of the six anterior teeth and of the firsts premolars ( $p=0.0023$ ), of the six anterior teeth and of the firsts and seconds premolars ( $p=0$ ), and of the six anterior teeth, of the firsts and seconds premolars and of the firsts molars ( $p=0$ ).

The disposition of the six anterior teeth in the smile and of the firsts premolars was significantly lower than the disposition of the six anterior teeth and of the firsts and seconds premolars ( $p=0.0002$ ), and than the disposition of the six anterior teeth, of the firsts and seconds premolars and of the firsts molars ( $p=0.0004$ ). No difference was observed between the disposition of the six anterior teeth and of the firsts and seconds premolars, and of the six anterior teeth, of the firsts and seconds premolars and of the firsts molars.

The prevalence of the smiles with touch and without touch on the inferior lip was significantly higher than the prevalence of the smile with covering of the superior incisors by the inferior lip ( $p = 0$  and  $p = 0$ , respectively). No difference was observed in the prevalence of smiles with and without touch on the inferior lip.

No difference was observed in the prevalence of location of the midline of the dental arch.

## Discussion

In earlier studies, measurements were made using extracted teeth<sup>16</sup> but in more recent studies the clinical tooth dimensions were measured either on casts or by computer-based images or intraoral evaluations<sup>15</sup>. Brisman<sup>17</sup> evaluated the shape, symmetry, and proportion of drawings and photographs of maxillary central incisors. According Mackley<sup>18</sup>, facial esthetics is not static, and it is not limited to the measurements of a headfilm or to frontal and lateral photographs.

Recently, special attention has been paid the perceptions of laypeople and dentists when comparing altered esthetics. Espeland et al.<sup>19</sup> noted that most young adults are more concerned about the appearance of their anterior teeth than their occlusion. Thus it is not surprising that the general public considers smile the second most important feature of the face after the eyes when judging about facial esthetics<sup>3</sup>.

Several studies have been done to examine how far the maxillary midline can laterally deviate from the facial midline before achieving an unacceptable esthetic<sup>8,20</sup>. Johnston et al.<sup>20</sup> found that a dental to facial midline discrepancy greater than two millimeters is esthetically unacceptable. In a similar investigation, Kokich et al.<sup>8</sup> found that discrepancies of up to four millimeters could remain undetected.

In this *in vivo* study the analysis of the coincidence or non coincidence between the midline of the face and the midline of

the dental arch, does not show difference between the two genders. No difference was observed between the presence and absence of coincidence for the midline of the face with the midline of the arch, denoting that half of the studied subjects presented a deviation of the midline. These data are not in accordance with those found by Rifkin<sup>21</sup>, Paul<sup>22</sup> and Tipton<sup>23</sup> who have stated that the coincidence of the midline of the face with the midline of the dental arch are essential for a harmonious smile.

The parallelism of the incisal plan with the interpupillary line was also checked in this research and the significant predominance of presence of parallelism between these structures corroborates with the concepts defended by Rifkin<sup>21</sup>, Paul<sup>22</sup> and Tipton<sup>23</sup> who have reported that the parallelism between these two lines creates a general sense of harmony and a horizontal improvement in the esthetics of the face.

To appear attractive, the maxillary anterior teeth must be in proportion to facial morphology. Several anatomic measurements<sup>24-25</sup> have been proposed to aid in determining the correct size of the anterior teeth, among them the intercommissural width, bizygomatic width, and interpupillary distance. Certain authors have proposed a relationship between the width of the maxillary central incisor and the interpupillary distance.<sup>24-25</sup> Similarly, a proportional relationship between the widest part of the nose and the anterior dental arch has been reported<sup>24,26</sup>. These suggestions, however, should be substantiated by additional studies in similar populations.

The evaluation of the relation between the arch of the smile and the curve of the inferior lip revealed higher significant prevalence of the parallel smile over the reverse ( $p=0$ ) and of the straight smile over the reverse smile ( $p=0$ ). Differences were not observed between the parallel and straight smiles, opposed to the findings of Tjan et al.<sup>27</sup> that 84,8% of the people presented parallel smile, and to the ideas of Morley<sup>28</sup> and of Ackerman et al.<sup>29</sup>, that have reported that the parallelism between the arch of the smile and the inferior lip is indispensable for an esthetic smile.

Dentofacial attractiveness is particularly important to a person's psychosocial well being. People with a normal dental appearance are judged more socially attractive over many personal characteristics than those with malocclusions<sup>3</sup>. According to Dierkes<sup>30</sup>, the beauty of the face can be broken down into horizontal, vertical, and transverse components, and all of these must harmonize with the contours of the face to produce a beautiful smile. Dierkes<sup>30</sup> also stated that when components of esthetics are contemplated, arch width is rarely a consideration, but he pointed out that altering the arch width in turn changes the gingival smile line, which is the relationship of the upper lip to the gingival line of the maxillary incisors. Therefore, Dentists are obligated to understand beauty, harmony, balance, and proportion as perceived by society

when planning treatment<sup>3,12</sup>.

Concerning the disposition of teeth in the smile, this study did not show differences among the smiles until the seconds premolars and the smile until the firsts molars. Unlike what was found by Tjan<sup>27</sup>, who verified a difference of 36,91% among the smiles, being 40,65% of smiles comprehending up to the seconds premolars and 3,74% of the people presenting disposition of the teeth to the firsts molars. No difference was observed in this study, regarding both genders. This corroborates with Tjan<sup>27</sup> who did not find statistical differences in their work. The smallest sample found in this study, was the exhibition of six anterior teeth during the smile. These data are in accordance with the findings of Tjan<sup>27</sup> when they report that in their research they found only 7,01% of smiles showing the anterior teeth.

Another aspect checked in this research was the touch of the incisal curve on the inferior lip during the smile. It was studied the prevalence of smiles with touch and without touch on the inferior lip in relation to the smiles with covering of the superior incisors by the inferior lip ( $p = 0$  and  $p=0$ , respectively). No difference was observed in the prevalence of smiles with and without touch on the inferior lip ( $p=0.4477$ ), contrary to the findings of Tjan<sup>27</sup> who reported that 46,61% of the people presented the maxillary anterior teeth touching the inferior lip. Morley<sup>28</sup> stated that for a smile to be esthetically pleasant the incisal curve can not touch the inferior lip.

In this study the location of the midline of the dental arch was analyzed, considering as reference the filter of the lip. No difference was verified in the prevalence of the location of the midline of the dental arch, either centralized or moved to one or the other side. These data are not in accordance with those exposed by Tjan<sup>27</sup> and Cavalcante<sup>1</sup> who have stated that the midline of the dental arch should be centralized in the smile in order to have a greater harmony.

Levin<sup>5</sup> indicated that the most harmonious recurrent tooth-to-tooth ratio was of the "golden proportion". Conflicting reports indicate that the majority of beautiful smiles did not have proportions coinciding with the golden proportion formula<sup>5,10</sup>. Recently, the "recurring esthetic dental proportion" concept was introduced, stating that clinicians may use a proportion of their own choice, as long as it remains consistent, proceeding distally in the arch<sup>15,31</sup>.

According to the data analyzed in this paper, esthetics is quite empiric subject and harmony is not always a mathematical issue. The traces of the face and of the smile are valid just as guidelines for esthetic reconstruction, but the individual characteristic of each patient should be taken in consideration. Based on the results found of this research, concluded that: 1) The coincidence of the midline of the face and the midline of the arch, is just present in half of the studied population; 2) Most of the studied population presents parallelism of the incisal plan with the interpupillary line; 3) Most of the studied population presents parallel or straight smiles; 4) Most of the

students presents smiles up to the seconds premolars or until the firsts molars and both genders do not differ regarding the distribution of the teeth displayed in the smiles; 5) Most of the studied population presents smiles with or without touch on the incisal curve on the inferior lip, considering the smiles with covering of the superior incisors.

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