UNIVERSIDADE DE SÃO PAULO

FACULDADE DE ODONTOLOGIA DE BAURU

GABRIELA MANAMI NATSUMEDA

**Aging process in normal occlusion individuals: facial attractiveness perception and anterosuperior dental changes**

**Envelhecimento de indivíduos com oclusão normal: percepção da atratividade facial e alterações dentárias na região anterossuperior**

BAURU

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Tese constituída por artigo apresentada à Faculdade de Odontologia de Bauru da Universidade de São Paulo para obtenção do título de Doutor em Ciências no Programa de Ciências Odontológicas Aplicadas, na área de concentração Ortodontia.

Orientadora: Profª. Drª. Daniela Gamba Garib Carreira

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**DEDICATÓRIA**

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*"O homem não teria alcançado o possível se, repetidas vezes, não tivesse tentado o impossível."*

Max Weber

# ABSTRACT

# ABSTRACT

## AGING PROCESS IN NORMAL OCCLUSION INDIVIDUALS: FACIAL ATTRACTIVENESS PERCEPTION AND ANTEROSUPERIOR DENTAL CHANGES

**Introduction:** The aim of this study was to evaluate the influence of aging on facial attractiveness perception and the maxillary anterior teeth changes in nontreated acceptable occlusion subjects from 13 to 61 years of age. **Methods:** Facial photographs and digital casts of 24 nontreated acceptable occlusion subjects were used. Frontal and profile facial photographs taken at 13 (T1) and 61 years of age (T2) were used for the facial attractiveness evaluation. Groups of 30 orthodontists and 30 laypeople scored the facial attractiveness using a scale from 1 (an unattractive face) to 10 (a very attractive face). Raters were asked to indicate the apparent age at T2 and the most and least pleasant structures of each face. For maxillary anterior teeth evaluation, digital casts taken at 13 (T1), 17 (T2) and 61 years of age (T3) were used. The following variables were measured in the maxillary anterior teeth using digital dental models: crown width/height proportion, anterior view width, crown angulation, gingival and incisal steps between central/lateral incisors and central incisors/canines. For statistical analyses, three-way ANOVA was used to assess the influence of sex, age and rater group on facial attractiveness. Mann-Whitney test was used to compare male and female regarding the apparent age at late adulthood. For maxillary anterior teeth changes, interphase comparisons were evaluated using repeated measures analysis of variance followed by Tukey tests and Friedman tests. Sexual differences were evaluated using t tests ($p<0.05$). **Results:** Mature age was judged with lower scores on facial attractiveness (mean=5.43) by both groups compared to adolescence (mean=6.51). Facial attractiveness was not affected by sex. However, at late adulthood, female was considered younger for both groups of raters while men were assigned similarly to their actual age. Laypeople were slightly more critical than orthodontists in the assessment of facial attractiveness. Thirty percent of the raters indicated the eyes as the most pleasant region and the chin and nose as the least pleasing structures. From 13 to 61 years of age, decreases of crown width/height proportion and mesiodistal angulation of the maxillary anterior teeth were observed. The steps of the gingival margin and the incisal steps decreased during the 47-year

follow-up. **Conclusions:** From adolescence to late adulthood, the facial attractiveness slightly decreased from adolescent to mature ages. Women appeared younger than their actual age at late adulthood. untreated individuals with acceptable occlusions demonstrated changes in the maxillary anterior teeth that may impair the smile esthetics and attractiveness.


**Key words**: Normal occlusion, adults, maturation, aging.

# RESUMO

# RESUMO

## ENVELHECIMENTO DE INDIVÍDUOS COM OCLUSÃO NORMAL: PERCEPÇÃO DA ATRATIVIDADE FACIAL E ALTERAÇÕES DENTÁRIAS NA REGIÃO ANTEROSSUPERIOR

**Introdução:** O objetivo deste estudo foi avaliar a influência do envelhecimento na percepção da atratividade facial e as alterações nos dentes anterossuperiores, em indivíduos não tratados com oclusão aceitável, dos 13 aos 61 anos de idade. **Métodos:** Fotos faciais frontais e de perfil e modelos digitais de 24 indivíduos com oclusão balanceada não tratada foram utilizados. Fotografias faciais frontais e de perfil tomadas as 13 (T1) e aos 61 anos (T2) de idade foram usadas para a avaliação da atratividade facial. 30 ortodontistas e 30 leigos avaliaram a atratividade facial usando uma escala de 1 (face desagradável) a 10 (face muito agradável). Os avaliadores indicaram a idade aparente no T2 e as estruturas que mais e menos agradavam em cada face. Para avaliação dos dentes anterossuperiores, modelos digitais obtidos aos 13 (T1), 17 (T2) e 61 anos (T3) foram utilizados. As seguintes medidas foram realizadas nos incisivos centrais e laterais, e caninos superiores: proporção largura/altura da coroa, largura na vista anterior, angulação da coroa, degrau gengival e incisal entre incisivos central/lateral e entre incisivo central/canino. Para a análise estatística da atratividade facial, ANOVA a três fatores foi utilizado para avaliar a influência do sexo, idade e grupo avaliador na atratividade facial. O teste de Mann-Whitney foi usado para comparar a idade aparente em T2 entre homens e mulheres. Na análise das alterações dos dentes anterossuperiores, a Análise de Variância para medidas repetidas seguido pelo teste de Tukey e teste de Friedman foram utilizados para a comparação interfases. As diferenças sexuais foram avaliadas por meio do teste t ($p<0,05$). **Resultados:** A atratividade da idade madura foi julgada com as menores notas pelos dois grupos. A atratividade facial não foi afetada pelo sexo. No entanto, na idade adulta madura, as mulheres foram consideradas mais novas pelos dois grupos de avaliadores enquanto que os homens foram designados de forma semelhante à idade real. Os leigos foram levemente mais críticos do que os ortodontistas na avaliação da atratividade facial. Trinta por cento dos avaliadores indicaram os olhos como a estrutura mais agradável e o queixo e lábios como as

estruturas menos agradáveis. Dos 13 aos 61 anos de idade, redução na proporção largura/altura da coroa e angulação mesiodistal dos dentes anteriores foram observados. O degrau da margem gengival e bordas incisais diminuíram durante os 47 anos de acompanhamento. **Conclusões:** Da adolescência até a idade adulta tardia, a atratividade facial diminui suavemente da adolescência à idade adulta madura. Mulheres aparentam ser mais novas do que sua idade real na idade adulta madura. Indivíduos não tratados com oclusão balanceada apresentam mudanças nos dentes anterossuperiores que podem diminuir a estética do sorriso e atratividade.

**Palavras-chave:** Oclusão normal, adultos, maturação, envelhecimento.

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| T1 | Timing 1 |
| T2 | Timing 2 |
| T3 | Timing 3 |
| SD | Standard deviation |
| ICC | Intraclass Correlation Coefficients |
| ANOVA | Analysis of Variance |
| IR | Interquartile range |
| CI | Central incisor |
| LI | Lateral Incisor |
| C | Canine |
| CI/LI | Central/Lateral incisors |
| CI/C | Central incisor/canine |

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# 1 INTRODUCTION

## 1 INTRODUCTION

The aging process changes the facial and smiles esthetics,[1,2] increasing the seeking for orthodontic treatment by adult patients, for an esthetic improvement of the smile and face.[3] Facial aging is more related to the soft tissue changes,[4,5] and regarding the dental features, tooth size, wear and position are the most common alterations reported.[6-9]

During aging, facial skin wrinkling, loss of elasticity, soft tissue inferior displacements and loss of soft tissue volume occurs.[10] With these changes, elongation of the nose, flattening of the lips and increase of the soft-tissue chin are observed in aged subjects.[4,5] In addition, the upper incisor display by the upper lip decreases with aging.[5] Given these changes, facial attractiveness also decreases throughout life.[11-13] Older faces were perceived as less attractive.[14] Men with more mature features and women with youthful features were considered more attractive.[15,16] Aging was linked to the eye region, nose and mouth, indicating that esthetic procedures are more required in these regions.[17] However, there are still few studies evaluating the aging effects of facial attractiveness.

The esthetic demand of the patients regarding an attractive smile also increased. About 49% of adults seek orthodontic treatment for dental and facial esthetic improvement.[3] Therefore, the knowledge of the aging changes on teeth are important for a correct diagnosis and treatment planning for adult patients. Literature reported an increase in the clinical crown length up to 19 years of age.[2] Crown width decrease caused by interproximal attrition with age was described.[9] During the aging process, erosive tooth wear caused by acid diet, attrition and abrasion occurs.[18] Occlusal tooth wear occurs and are more prevalent in anterior than posterior teeth on middle-age adults.[7] The amount of tooth wear also influence the smile esthetics as the greater the tooth wear, the more unattractive is the smile.[19] Periodontal changes also occur with the aging process. Gingival margin continues to recede to an apical position as a person age.[20,21] Women with 50 years of age showed gingival recession around implant on maxillary anterior region.[22]

Considering the above-mentioned information about aging on facial attractiveness and dental changes, there are some questions to be answered. How the aging process impact on facial esthetics in the long-term? What are the changes that

occur in the anterior teeth over time on nontreated acceptable occlusion subjects? The aim of the present study was to evaluate the influence of aging on facial attractiveness perception and to investigate the morphological and periodontal changes of the maxillary anterior teeth expected with aging, in a sample of nontreated acceptable occlusion subjects from 13 to 61 years of age.

# 2 ARTICLES

## 2.1 ARTICLE 1

The article presented in this Dissertation was written according to the American Journal of Orthodontics and Dentofacial Orthopedics instructions and guidelines for article submission.

# INFLUENCE OF AGING ON FACIAL ATTRACTIVENESS PERCEPTION

## ABSTRACT

**Objective:** This study evaluated the perception of orthodontists and laypeople on facial attractiveness during aging in subjects with nontreated acceptable occlusion. **Methods:** Frontal and profile facial photographs of 24 subjects (13 male, 11 female) with nontreated acceptable occlusion taken at adolescence (mean age: 13 years) and late adulthood (mean age: 61 years) were used. Groups of 30 orthodontists and 30 laypeople scored the facial attractiveness using a scale from 1 (an unattractive face) to 10 (a very attractive face). Raters indicated the apparent age at T2 and the most and the least pleasing facial structures. Three-way ANOVA was used to assess the influence of sex, age and rater group with facial attractiveness. Mann-Whitney test was used to compare male and female regarding the apparent age at late adulthood ($p < 0.05$). **Results:** Mature age was judged with lower scores on facial attractiveness (mean=5.43) by both groups compared to adolescence (mean=6.51). Facial attractiveness was not affected by sex. However, at late adulthood, female was considered younger for both groups of raters while men were assigned similarly to their actual age. Laypeople were slightly more critical than orthodontists in the assessment of facial attractiveness. Thirty percent of the raters indicated the eyes as the most pleasant region and the chin and nose as the least pleasing structures. **Conclusions:** The facial attractiveness slightly decreased from adolescent to mature ages. Women appeared younger than their actual age at late adulthood.

## INTRODUCTION

Facial esthetics is an important factor for daily social interactions and quality of life. Mueser et al stated that the face is a slightly more important predictor of overall attractiveness than the body.[1] Dental appearance affects judgement of facial attractiveness regardless of sex and facial attractiveness.[2] However, changes in the lips and chin contribute more than teeth appearance in this domain.[3] The eyes, the oral region and the skin also significantly contribute to overall facial attractiveness.[4,5] Further, facial and smile esthetics decrease as a person get older, increasing the seeking for orthodontic treatment and rejuvenation procedures by adult patients.[6-8]

Aging is an inevitable process and most of facial changes with aging are related to the soft tissues.[9,10] A study performed from 3 to 18 years of age showed that the nose continues to growth downward and forward and the upper and lower lips

presented a constant relationship to the anterior teeth.[11] In a nontreated sample from 25 to 83 years of age, Behrents showed an elongation of the nose, a flattening of the lips and an augmentation of the chin.[9] Garib et al. evaluated a normal occlusion sample at 17 and 60 years of age and found a closure of the nasolabial angle, an upper lip retrusion and an increase of the soft-tissue chin.[10] The upper incisor display by the upper lip decreased 3.6mm in 40 years.[10] During aging, facial skin wrinkling, loss of elasticity, soft tissue inferior displacement and loss of soft tissue volume also occur.[12] The naso and mentolabial sulcus become deeper and the infraorbital rhyme more apparent.[8]

Given all these facial changes, facial attractiveness decreases throughout aging process.[13-15] There are still few studies evaluating the aging effects on facial attractiveness. A previous study showed a progressive decrease on facial attractiveness from 3 to 16 years of age assessed by psychology students.[16] From 11 to 31 years of age, facial attractiveness judged by laypeople decreased, but attractive children remained attractive as adults.[14] Older faces were perceived as less attractive.[17,18] Aging were linked to the eye region, nose and mouth, indicating that esthetic procedures are more required in these regions.[18]

Previous studies showed that female attractiveness decrease faster than in male during aging. Men with more mature features and women with youthful features were considered more attractive.[13,14,19,20] A recent study investigated the facial esthetics standards in male and female from 1940 to 2008.[15] The results showed an increased preference for fuller and more protrusive lips profiles in women.[15] Stronger chin and mandible were considered more attractive in both male and female.[21]

How the aging process impact on the facial esthetics of nontreated individuals with acceptable occlusion? Previous studies on aging assessed different age groups[17,18] or digitally manipulated images[22] and did not specify the type of malocclusion.[11,14,16] Few longitudinal studies on the same subjects have been conducted.[13-15] Therefore, the objective of this study was to evaluate the facial attractiveness at adolescence and late adulthood in untreated individuals with acceptable occlusions. The null hypothesis was that facial attractiveness was similar in both age groups.

## MATERIAL AND METHODS

This study was approved by the Ethics in Research Committee at Bauru Dental School, University of São Paulo (process number #22082119.3.000.5417). Informed consents were obtained from patients and raters.

The sample was obtained from an initial sample of 82 White-Brazilians collected from 1967 to 1974 from the files of the department of Orthodontics at the University. Frontal and profile facial photographs, dental models and cephalograms were obtained at a mean age of 13.33 years, ranging from 11.89 to 15.03 yearsT1). The individuals had a complete permanent dentition with dental and skeletal Class I relationship, absence of crossbites, normal overjet and overbite, maximum of 2mm of incisor crowding and no previous orthodontic treatment. From 2015 to 2016 (T2), the sample was recalled for the aging study. From the initial sample, 38 were reached and 27 were enrolled. The exclusion criteria were history of orthodontic treatment between T1 and T2 and complete tooth loss in one or both dental arches. The mean age at T2 was 61.27 years (ranging from 58.66 to 64.20 years). The final sample comprised 24 individuals (13 male and 11 female) with Class I facial pattern and acceptable nontreated occlusion.

Facial photographs taken at mean age of 13 and 61 years were used. The frontal and profile photographs of each timepoint were combined to consist of a pair of images and all pictures were converted to a gray scale (Figure 1). T1 and T2 photographs were randomly ordered, and a Google® forms questionnaire (LLC Google, Mountain View, CA, USA) was created to evaluate the facial esthetics and apparent age.

Potential raters were invited by e-mail and WhatsApp® messenger app to access the Google Form questionnaire by clicking a link. A sample size calculation was performed to determine the adequate number of raters. To detect a mean difference of 1 point on a scale of 1 to 10, with an estimated standard deviation of 1.28 points,[23] at a significance level of 0.05 and a test power of 80%, 27 raters was needed in each group of evaluators.

In the Google forms questionnaire, raters registered date of birth, sex, area of formal education and higher reached degree and time of experience in orthodontics (for the orthodontists). There was no time restriction for each evaluation, until the final

evaluation was submitted. Each pair of photos had a 10-point numerical scale to score the facial attractiveness. Score 1 represented "an unattractive face" and score 10 "a very attractive face". Raters were invited to indicate the most and the least pleasing facial structures of each individual in both ages. The options were skin, forehead, eyebrow, eyes, nose, cheeks, lips, chin none of the alternatives and others. Apparent age of each pair of photos was also investigated at late adulthood.

A group of 30 laypeople and 30 orthodontist raters were selected. The laypeople were defined as persons with complete higher education level, but no formation in dentistry or dental hygiene. Laypeople group was composed by 9 professionals from biomedical areas, 17 professionals from exact sciences and 4 from human science. The orthodontists were dental surgeons with complete graduate degrees in orthodontics.

**Error study**

One month after the first evaluation, 30% of the raters re-evaluated the same subjects to evaluate the precision in rating the facial attractiveness. Intra-rater reliability was assessed using intraclass correlation coefficients.[24]

**Statistical Analyses**

Normal distribution was verified using Shapiro-Wilk tests. The comparison of sex and age distribution between rater groups was evaluated using Chi-square and Mann-Whitney tests, respectively. The influence of sex, age stage and rater group on facial attractiveness were evaluated using three-way ANOVA. The apparent age at T2 was compared between male and female using Mann-Whitney tests. Statistical analyses were performed using Jamovi software (version 1.2.22). Results were considered significant at $P<0.05$.

**RESULTS**

The intraclass correlation coefficient of facial attractiveness varied from 0.77 to 0.82, showing a good intra-rater agreement. The laypeople group had significantly more men and the orthodontist group more women. Laypeople were significantly older than the orthodontists (Table I).

Regarding facial attractiveness (Table II), individuals at mature age were judged with the lowest scores (mean=5.43, SD=1.88) compared to the adolescence

(mean=6.51, SD=1.80). Laypeople were slightly more critical than orthodontists (P<0.001*), assigning mean scores of 5.68 and 6.27, respectively. Facial attractiveness was not affected by the sample's sex. The interaction between age stage, sex and type of raters showed no influence on the facial attractiveness. At late adulthood, women were judged younger than men for both groups of raters (Table III).

The eyes were considered the most pleasant structure at both ages (31.9% and 28.6%, respectively), as shown in Figure 2. At late adulthood, 22.5% of the raters reported that none of the facial structures were the most pleasant. During adolescence, the chin (25.8%) was indicated as the most least pleasant structure. On the other hand, in the late adulthood, the lips were considered the least pleasant facial structure (24.9%) followed by the nose (17%).

## DISCUSSION

The influence of orthodontic treatment on the facial attractiveness are well documented in the literature.[23,25-27] In this study, the influence of aging on facial attractiveness of nontreated individuals with balanced face and acceptable occlusion was evaluated over approximately 50 years. The difficulties for recalling the sample after 5 decades were relevant considering the subjects have changed phone numbers, address and women had adopted the marital names.

Facial attractiveness is influenced by age, sex and type of raters, as well as by the sex and age of the subjects evaluated.[17] For our study, orthodontists and laypeople were chosen to evaluate facial attractiveness with aging. The 10-point numerical scale[28] is a simple and easy method to show quantitatively the raters' opinion. The method of scoring facial attractiveness was used in previous studies showing adequate reliability.[23,25,29]

Mature age was considered less attractive than adolescence. These outcomes are in agreement with previous studies showing that facial attractiveness decreased with age.[13-15] The mean score for facial attractiveness has changed from 6.5 to 5.4 in 48 years (Table II). Considering the long interval between 13 to 61 years of age, the reduction of facial attractiveness was not remarkable. From the third decade of life and beyond, several facial changes are expected with aging as a result of skeletal support, soft tissues and skin changes.[8,12] Facial skeleton shows selective resorption at specific sites, mainly at periorbital and middle cheek.[30] The facial aging process is affected by

intrinsic factors as hormonal and biochemical changes.[8] Extrinsic factors including gravity, smoking, sun exposure and body mass index also have an influence on facial aging.[8] A drooping of the eyelids, nose, lips and cheeks occurs.[8,12,30] The fat and muscle atrophy leads to depression in the orbital and buccal areas.[8] The skin becomes thinner, less elastic, more irregular and wrinkled.[12] Submental fat excess and jowl formation are expected in the lower face and neck.[8] Excessive sun exposure and smoking accelerate the facial aging process.[31] Until the sixth decade of life, deep wrinkles in the forehead and glabella, drooping of the nose, lower eyelid and jowl formation are expected.[8] In our sample, none of the subjects underwent plastic surgery procedures, and therefore, aging effects were apparent in their faces, justifying the decreased attractiveness score at mature age. These findings are in agreement with previous studies.[17,32]

Laypeople were slightly more critical than orthodontists, in accordance to previous studies.[3,23,25] Laypeople are constantly influenced by the beauty standards imposed by the social media, which has intensified anti-aging procedures, making them more critical when considering facial appearance.[33] On the other hand, the orthodontists were more tolerant and this result might be due to their knowledge on facial aging.[10] Orthodontists may expect the soft tissue aging changes.

The apparent age is well documented on plastic surgery literature.[31,34-36] Although the soft tissue maturation changes has been emphasized in orthodontics,[11,37-40] the apparent age was rarely used in the orthodontic literature.[14,23] Assessing the apparent age of the subjects at mature ages was useful to estimate the aging effect on the facial appearance. Female were considered younger than male by both groups of raters. These outcomes are in agreement with a recent study performed in Chinese subjects from 20 to 60 years of age where men were judged older than women.[40] Other study performed in subjects from 20 to 40 years showed that facial aging of male start 10 years later than for females.[41] However, aging changes were of greater magnitude in men.[41] The attribution of older ages to men and younger ages to women is probably because women generally are more careful of health and facial appearance.[42] A comparison of facial skin in Asian women from 14 to 75 years of age showed that earlier adoption of a skincare routine were associated with less severe photodamage and may help reducing the impact of age on skin health.[43] In a sample of 45 men

between 20 and 50 years of age, 40% did not have a skincare routine and tended to avoid using skincare products that can increase a tacking sensation.[44]

Regarding the most and the least pleasant structures, the eye region was the most pleasant structure at both adolescence and late adulthood (Figure 2). This finding agrees with a recent study that showed that facial masks increase the attractiveness of relative unattractive faces, demonstrating the importance of the eye region in the perception of attractiveness.[45] The most unpleasant structure at adolescence was the chin. The chin position influences the facial attractiveness and the social perception.[46] At T1, patients that had a slight retrognathic mandible with a deeper mentolabial sulcus were assigned "unpleasant chin" for raters. A slight degree of mandibular retrusion might be present in subjects with acceptable occlusion during adolescence, even though mandibular growth is still expected at age 13.[47] A previous study assessed the influence of chin prominence on facial esthetics showing that facial esthetics decreased with chin retrusion and increased with chin protrusion.[48] At mature age, the lips were pointed as the most unattractive structure. The lips loose volume with aging becoming more retruded with a thinner vermillion.[10] The loss of volume might have influenced these outcomes.[3] Since the first decade of the XXI century, fuller and protrusive lips at all ages were preferred.[3,21,49] A previous facial attractiveness study showed that orthodontists considered the lips as the major influence for facial attractiveness.[3] Orthodontists should avoid retruding the lips to prevent aging and decrease of facial attractiveness.

In summary, this study has provided further evidence that facial attractiveness decreases with the aging process and women tend to look younger than men at late adulthood. The limitation of this study was the lack of intermediate facial pictures between adolescence and mature age. Future studies should consider a facial attractiveness follow-up every 10 years to understand in which decades a greater change occurs. Evaluators of different ages should also be selected to understand how facial attractive is perceived by each age group.

**CONCLUSIONS**

Mature age showed lower scores for facial attractiveness compared to adolescence. Women appeared to be younger than men at mature age. At adolescence and mature age, the eye region was the most pleasant structure. The

chin and lips were the most unpleasant structures at 13 and 61 years of age, respectively.

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**FIGURE CAPTIONS**

**Figure 1** – Facial photographs in frontal and lateral view taken at 13 and 61 years of age from a female (A) and male (B) subject from the sample.

**Figure 2** – Most and least pleasing structures at adolescence and late adulthood.

Figure 1
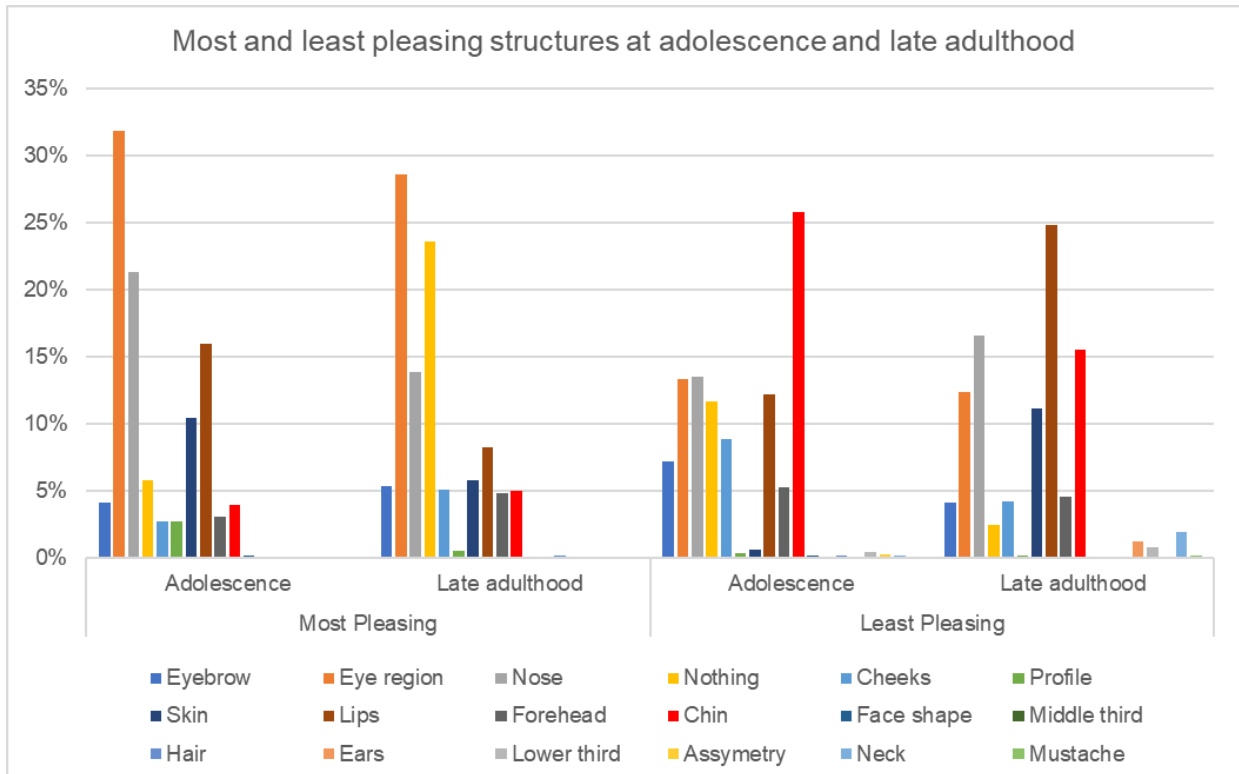
Figure 2

**Table I** – Rater groups comparison regarding sex (Chi-square test) and age (Mann-Whitney test).

| Variable | Laypeople (n=30) | Orthodontists (n=30) | P value |
|---|---|---|---|
| Male | 22 | 9 | <0.001* |
| Female | 8 | 21 | |
| Age (y) | 33.47 (SD=7.82) | 29.71 (SD=8.55) | 0.002* |

*Statistically significant at P<0.05.

**Table II** – Comparison of facial attractiveness scores considering the influence of sample age stage, sex and type of raters (three-way analysis of variance).

| Group | | Mean | SD | P value |
|---|---|---|---|---|
| **Age** | | | | |
| **Adolescence** | | 6.51 | 1.80 | <0.001* |
| **Late adulthood** | | 5.43 | 1.88 | |
| **Sex** | | | | |
| **Male** | | 5.96 | 1.93 | 0.757 |
| **Female** | | 5.98 | 1.89 | |
| **Raters** | | | | |
| **Laypeople** | | 5.68 | 1.91 | <0.001* |
| **Orthodontists** | | 6.27 | 1.88 | |
| **Age x Sex** | | | | |
| **Adolescence** | | | | |
| **Male** | | 6.49 | 1.85 | 0.657 |
| **Female** | | 6.54 | 1.73 | |
| **Late adulthood** | | | | |
| **Male** | | 5.43 | 1.87 | |
| **Female** | | 5.42 | 1.88 | |
| **Age x Raters** | | | | |
| **Adolescence** | | | | |
| **Laypeople** | | 6.19 | 1.83 | 0.457 |
| **Orthodontists** | | 6.83 | 1.71 | |
| **Late adulthood** | | | | |
| **Laypeople** | | 5.16 | 1.85 | |
| **Orthodontists** | | 5.70 | 7.87 | |
| **Raters x Sex** | | | | |
| **Laypeople** | | | | |
| **Male** | | 5.67 | 1.95 | 0.984 |
| **Female** | | 5.69 | 1.86 | |
| **Orthodontists** | | | | |
| **Male** | | 6.26 | 1.88 | |
| **Female** | | 6.28 | 1.88 | |
| **Age x Raters x Sex** | | | | |
| **Adolescence** | | | | |
| **Laypeople** | **Male** | 6.18 | 1.87 | 0.829 |
| | **Female** | 6.21 | 1.78 | |
| **Orthodontists** | **Male** | 6.80 | 1.79 | |
| | **Female** | 6.87 | 1.62 | |
| **Late adulthood** | | | | |
| **Laypeople** | **Male** | 5.17 | 1.89 | |
| | **Female** | 5.16 | 1.80 | |
| **Orthodontists** | **Male** | 5.71 | 1.80 | |
| | **Female** | 5.69 | 1.94 | |

SD = standard deviation. *Statistically significant at P<0.05.

**Table III** – Comparison between male and female for apparent age at late adulthood (Mann-Whitney tests).

| Group | Median (Mean) | IR (SD) | P value |
|---|---|---|---|
| **Laypeople** | | | |
| **Male** | 60.0 (59.9) | 10 (8.12) | <0,001* |
| **Female** | 57.0 (56.6) | 11 (7.57) | |
| **Orthodontists** | | | |
| **Male** | 62 (62.4) | 6.5 (6.47) | <0,001* |
| **Female** | 60 (60.2) | 10 (7.27) | |

IR = interquartile range. SD = standard deviation. *Statistically significant at P<0.05.

## 2.2 ARTICLE 2

The article presented in this Dissertation was written according to the American Journal of Orthodontics and Dentofacial Orthopedics instructions and guidelines for article submission.

## 2.2 ARTICLE 2

# AGING CHANGES IN MAXILLARY ANTERIOR TEETH IN UNTREATED INDIVIDUALS

## ABSTRACT

**Objective:** The aging of the occlusion and tooth wears influence the smile design This study aimed at evaluating the aging changes of maxillary anterior teeth in nontreated subjects. **Methods:** The sample comprised dental models of 23 subjects (13 male, 10 female) with acceptable occlusions, taken at 13 (T1), 17 (T2) and 61 (T3) years of age. The following variables were measured in the maxillary anterior teeth using digital dental models: crown width/height proportion, anterior view width, crown angulation, gingival and incisal steps between central/lateral incisors and central incisors/canines. Interphase comparisons were evaluated using repeated measures analysis of variance followed by Tukey tests and Friedman tests. Sexual differences were evaluated using t tests ($p<0.05$). **Results:** From 13 to 61 years of age, a decreases of crown width/height proportion and mesiodistal angulation of the maxillary anterior teeth were observed. The steps of the gingival margin and the incisal steps decreased during the 47-year follow-up. **Conclusions:** From adolescence to late adulthood, untreated individuals with acceptable occlusions demonstrated changes in the maxillary anterior teeth that may impair the smile esthetics and attractiveness.

## INTRODUCTION

The seeking for orthodontic treatment by adult patients have been largely increased in the last decades.[1] An increased awareness of the need for adequate oral health and a greater expectation for dental esthetics from the society has occurred.[1-3] Approximately 49% of adults seeking orthodontic treatment have a chief complaint related to dental and facial esthetics.[1] Maturational changes specifically at the maxillary anterior teeth should be better understand for an adequate diagnosis and treatment plan for adult patients.

In general, clinical crown size changes with aging.[4] Subjects from 11 to 19 years of age showed an increase in the clinical crown length of anterior teeth.[5] A remarkable increase of crown height was observed from 13 to 60 years of age.[6] From adolescence to mature adulthood, the crown height increased 0.22, 0.76 and 1.50mm for maxillary central incisors, lateral incisors and canines, respectively.[6] Mesiodistal crown width decreased as a result of interproximal attrition with aging.[6,7] A 10-year follow-up study in Swedish women with initial age of 48 years showed a common tendency of crown

lengthening due to significant extrusion of +0.3mm on average of the anterior maxillary teeth.[8] Gingival changes explain the clinical crown height increase with aging. From 6 to 16 years of age, gingival margin shows a continuous migration toward apical.[9] Adolescent patients at 15 years of age presented an apical migration of the gingival margin of 0.44mm in 10 years of follow-up.[10]

Despite the increasing in crown height with aging, incisal tooth wear also occurs in adult patients.[11] During the aging process, erosive tooth wear caused by acid diet, attrition and abrasion occurs.[12] Occlusal/incisal surfaces displayed high wear scores in mature adults, especially in men.[13] The amount of tooth wear also influence the smile esthetics as the greater the tooth wear, the more unattractive is the smile.[14] A decrease in the maxillary incisors exposure for the upper lip is also expected with aging impairing smile esthetics.[15] A previous study showed that the maxillary incisor display for the upper lip decreased 3.6mm from 17 to 61 years of age.[16]

However, currently few evidence on the long-term gingival changes of the maxillary anterior teeth until the seventh decade of life are available. Positional changes on the maxillary anterior teeth are expected with the aging process. Understanding the aging changes of the anterior teeth is important to an adequate diagnosis and treatment planning of mature adult patients. In addition, maturational changes of the anterior teeth can have an influence on the long-term stability of orthodontic treatment. Therefore, the objective of this study was to investigate the positional and gingival changes of the maxillary anterior teeth expected from adolescent to late adulthood in untreated subjects.

**MATERIAL AND METHODS**

This observational and longitudinal study was approved by the Institutional Ethics Committee in Human Research at Bauru Dental School, University of São Paulo (process number #22082119.3.000.5417).

The sample comprised 23 White-Brazilian nontreated subjects with normal occlusion from the files of the Orthodontic Department at age 13 years (T1), 17 years (T2) and 61 years (T3), as shown in figure 1. The mean follow-up period was 47.98 years (SD, 0.95; range, 46.44-50.37). At T1, 80 individuals were selected according to the following inclusion criteria: clinically acceptable occlusion[6,16,17] in the complete permanent teeth, dental Class I relationship, absence of crossbites, normal overjet and overbite, maximum of 2mm of incisor crowding and no previous orthodontic treatment.

The sample at T1 and T2 had been collected as a reference for facial growth studies in the Department of Orthodontics, Bauru Dental School, University of São Paulo. Patients were recalled at T3 for studying the aging of the normal occlusion. The exclusion criteria at T3 were history of orthodontic treatment and multiple or complete tooth losses. At T3, 23 patients out of 80 were found or agreed to participate.

Dental models at the three time points were digitized using an R700 3-dimensional (3D) scanner (3Shape, Copenhagen, Denmark). Dental model measurements were performed using OrthoAnalyzer three-dimensional software (3Shape) by a single examiner (G.M.N.).

The occlusal plane was used as reference for standardize the maxillary dental model position (Figure 2). The following linear and angular measurements were performed in maxillary anterior teeth: (1) crown width/height proportion, (2) mesiodistal dimension in the frontal perspective (anterior view width), (3) crown mesiodistal angulation, gingival steps (4) and incisal steps (5) between the central and lateral incisors (CI/LI) and between the central incisors and canines (CI/C) (Figure 2). The crown height was measured from the gingival zenith to the incisal edge.[5] The crown width dimension considered the maximum distance between the mesial and distal contact points of each tooth (Figure 3, A). The width/height proportion was calculated after each value was recorded.

The occlusal plane was positioned parallel to the ground for measuring the anterior view width, crown mesiodistal angulation, gingival and incisal steps (2 to 5). The mesiodistal dimension was measured in the frontal view (Figure 2, B). Crown mesiodistal angulation was evaluated using the occlusal plane and the long axis of the clinical crown. The actual angulation value was the obtained value minus 90º. (Figure 3, C). A reference line was drawn parallelly to the occlusal plane and tangent to the most cervical portion of the gingival margin of the right central incisor was positioned to evaluate the gingival and incisal steps. The gingival step considered the distance between the reference line and the most cervical region of the gingival margin of each tooth, allowing the calculation of CI/LI and CI/C gingival steps for each side (Figure 3, D). The distance between the reference line to the incisal edge of each tooth was measured to calculate the CI/LI and CI/C incisal step of each side (Figure 3, E). Negative values indicated an apical position.

**Study error**

After one month from the first measurement, 30% of the sample were randomly selected and remeasured by the same examiner (G.M.N.). The intra-examiner reliability was assessed using intraclass correlation coefficients (ICC)[18] and the Bland-Altman method.[19]

**Statistical analyses**

Normal distribution of data was evaluated using Shapiro-Wilk test. The average right and left side was used for statistics. Interphase comparisons were evaluated using ANOVA and Tukey tests or Friedman tests and Durbin-Conover tests. Comparisons between male and females were performed using t tests. All tests were performed with the Jamovi software (version 1.2.22), at $P<0.05$. A post-hoc power analysis was also evaluated using the bilateral parametric test from the GPower software (Version 3.1.9.7, Heinrich-Heine-University, Dusseldorf, Germany).

**RESULTS**

Table I shows the results of the error study. Intraclass correlation coefficients varied from 0.86 to 0.98, indicating excellent intrarater agreement. The variable with the widest limit of agreement was the canine angulation (-3.61 and 4.66). The power of the sample was 99%, considering a mean change of 1.47mm (SD=1.38) in the canine crown height variable and a 5% significance level.

The aging process influenced most of the variables from T1 to T3 (Table II). Crown width, mesiodistal angulation and gingival and incisal step decreased over time. On the other hand, clinical crown height increased. The anterior view width remained stable with no significant changes.

From 13 to 17 years of age, lateral incisors and canines showed significant width/height proportion decrease (Table II). Mesiodistal angulation decreased for all teeth. CI/C gingival step showed a significant decrease from T1 to T2.

From 17 to 61 years of age, crown mesiodistal angulation of central and lateral incisors continued to decrease (Table II). Reductions in the CI/LI gingival and incisal step and in the CI/C gingival step were observed.

No sexual difference was observed, except for the canine angulation, which decreased more in women from T1 to T2 (Table III).

**DISCUSSION**

The maxillary anterior teeth are key factors for smile esthetics. This is the first study evaluating aging changes at the maxillary anterior region in nontreated subjects with acceptable occlusion. Long-term follow-ups of the occlusion in adults is challenging due to the difficulties in locating the subjects for follow-up appointments.[6,16,17] The follow-up time was approximately 50 decades in this study. The difficulties at T3 recruitment were changes in address, phone number and name due marriage. In addition, occlusal and dental status may change over time including tooth losses, prosthesis and dental restorations. In our study, the subjects who presented any of aforementioned changes in the maxillary anterior region were excluded.

From adolescence to late adulthood, the width/height proportion decreased in lateral incisors and canines from T1 to T2. The explanation is that clinical crown height increase and the mesiodistal crown width decrease during aging.[6] This result is in agreement with previous studies that reported interproximal wear and reductions of mesiodistal tooth size.[6,20,21] We speculate that no change in width/height proportion occurred in the central incisors due to a greater amount of incisal wear that compensate the changes in the gingival level. The anterior view width showed a slight decrease from T1 to T3, but without significance. This slight reduction can be explained by the mesiodistal tooth size decrease that occurs with the aging process.[6]

Crown mesiodistal angulation significantly decreased for all anterior teeth with aging. Central incisors showed a progressive angulation decrease from adolescence until the seventh decade of life. On the other hand, the lateral incisors and canines showed a decrease of the mesiodistal angulation only from 13 to 17 years of age. A previous study using digital dental models of subjects with a mean age of 70 years found a mesiodistal angulation of 1.26⁰ for maxillary central incisors, 5.46⁰ for lateral incisors and 7.84⁰ for canines.[22] The up righting of maxillary anterior teeth during aging might collaborate to the absence of late incisor crowding in the maxillary arch observed in nontreated individuals.[6]

The gingival step between central and lateral incisors decreased by 0.4mm from T1 to T3. The gingival step between the central incisors and canines also decreased by 1.2mm during the observational time.  At T3, the gingival margin of the central incisor and canines were almost at the same level. These changes are probably related to an apical displacement of the gingival margin of these teeth.[10] The apical migration

of the gingival margin of lateral incisors and canines should have been greater compared to the central incisors explaining the decrease in the gingival steps. A previous study performed in subjects from 22 to 84 years of age showed that gingival recessions in the maxilla were more common at canines and lateral incisors.[23] Thinner buccal bone thickness and less distance between cemento-enamel junction and bone crest are expected for anterior teeth with gingival recessions.[23]  If gingival recessions are more frequent in maxillary canines and lateral incisors compared to central incisors, the natural apical migration of the gingival margin during aging is also expected to be greater in these regions.

The incisal step between central and lateral incisors observed during adolescence were lost until the late adulthood (Figure 4). These findings were expected due to incisal tooth wear that occurs during aging.[11,24] Anterior teeth show a significant level of tooth wear caused by the anterior guidance.[25] Throughout life, teeth are exposed to physical injuries as parafunctional habits and regular mastication and chemical exposure including acidic drinks/foods and gastric reflux, which contributes to tooth wear.[26,27] The overbite reduction and the edge-to-edge incisor relationship are common features observed during aging, especially in men.[6,17] Consequently, the incisal edge of the maxillary incisors become at the same level and may cause a smile impairment. Previous studies on the influence of vertical position of central incisors on the smile esthetics showed that no step between the maxillary incisors was considered unattractive.[28,29] The incisal edge of the maxillary anterior teeth affected by tooth wear can be augmented in the adulthood aiming a smile esthetic improvement.[30]

From adolescence to early adulthood, the maxillary canines demonstrated a greater mesiodistal upright movement in females than males (Table III).  These differences might be explained by the late facial growth pattern. In women, the mandible rotates down and backward during aging while in men the mandible displaced forward and downward.[16,31] The greater upright movement of maxillary canine upright in woman might represent a sagittal compensation for a more convex profile. Small dental adjustments may occur to maintain an adequate occlusion in front of skeletal changes during the aging process.

Despite the limitation expected of retrospective studies as the lack of information diet and parafunctional habits, factors that can influence anterior teeth changes, this study provided important information about aging covering maturation over 48 years

following the same subjects. Future studies should compare the aging changes in maxillary anterior teeth of untreated subjects and orthodontically treated patients.

## CONCLUSIONS

From 13 to 61 years of age, the following changes occurred in the maxillary anterior teeth:

- The crown width/height proportion and mesiodistal teeth angulation decreased;

- The gingival step between central and lateral incisors and between central incisors and canines decreased;

- The incisal step between the central and lateral incisors decreased.

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**FIGURE CAPTIONS**

**Figure 1** – Maxillary digital dental models of a female subject from the sample at T1 (13 years), T2 (17 years) and T3 (61 years).

**Figure 2** – The occlusal plane. A - The occlusal plane was defined as a plane passing bilaterally through the tip of the first molar mesiobuccal cusp and through the mesioincisal point of the right central incisor.

**Figure 3** – Measurements performed in the maxillary digital dental models: (A) Crown width/height proportion. The crown height measured from the gingival zenith to the incisal edge and crown width considered the maximum distance between the mesial and distal contact points; The width/height proportion was calculated after each value was recorded; (B) Mesiodistal dimension in the frontal view, with the occlusal plane parallel to the ground; (C) Crown angulation, measured using the occlusal plane and the long axis of the clinical crown; For (D) gingival and (E) incisal level between CI/LI and CI/C, a reference line was drawn parallelly to the occlusal plane and tangent to the most cervical portion of the gingival margin of the right central incisor was positioned. (D) Gingival level considered the distance between the reference line and the most cervical position of the gingival margin; (E) Incisal level was calculated using the distance between the reference line to the incisal edge of each tooth. Negative values indicated an apical position.

**Figure 4** - Male subject at 13 (T1), 17 (T2) and 61 years of age (T3). Observe the reductions of the incisal step between the central and lateral incisors.
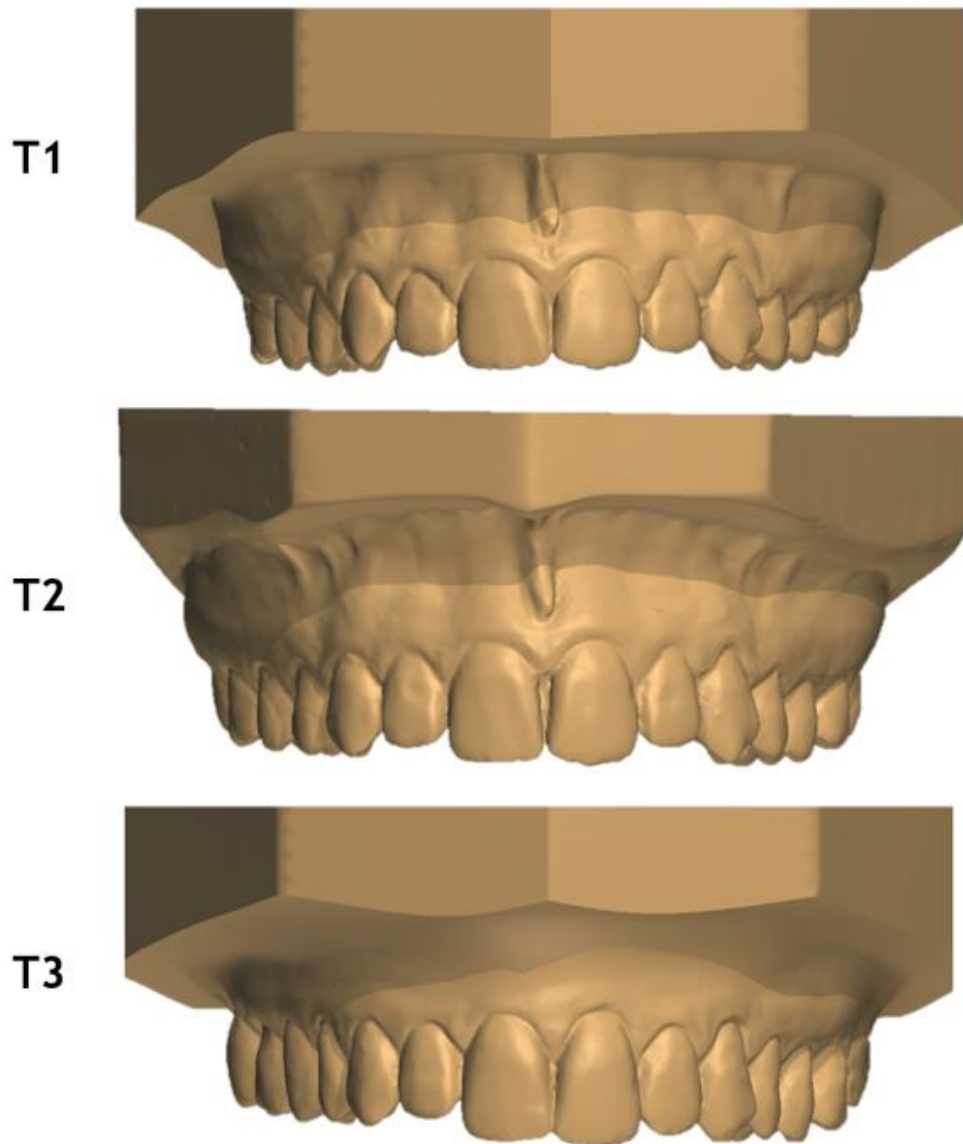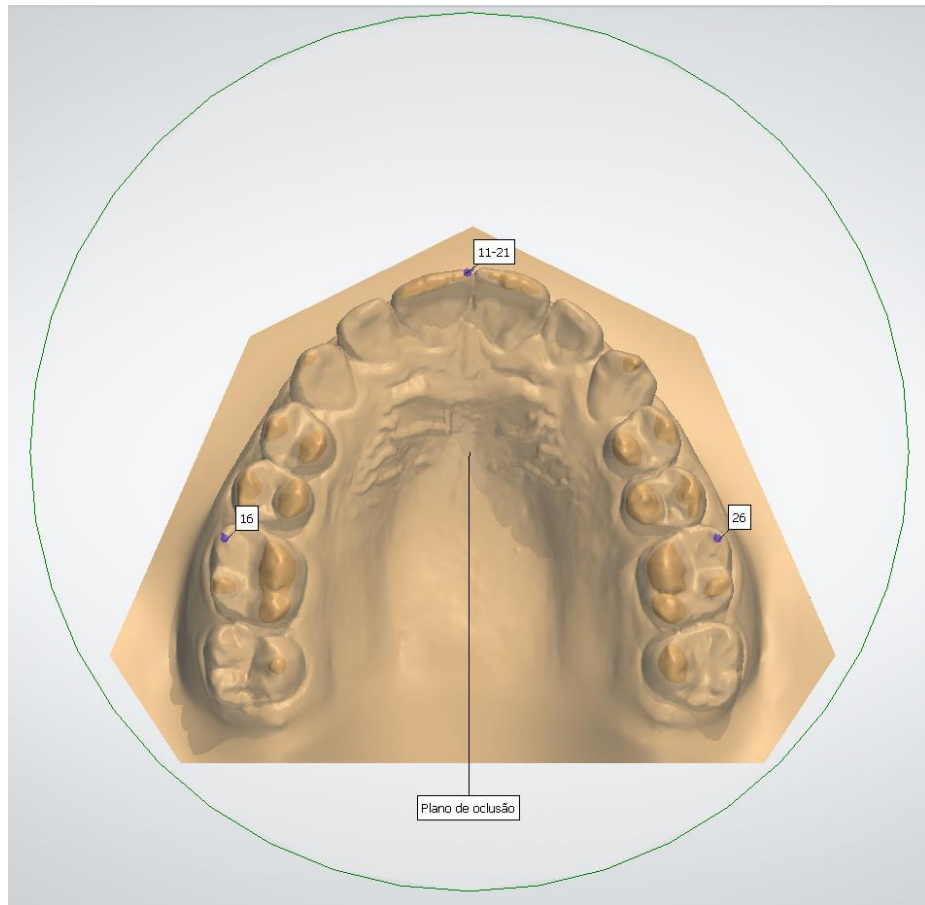
Figure 1

Figure 2
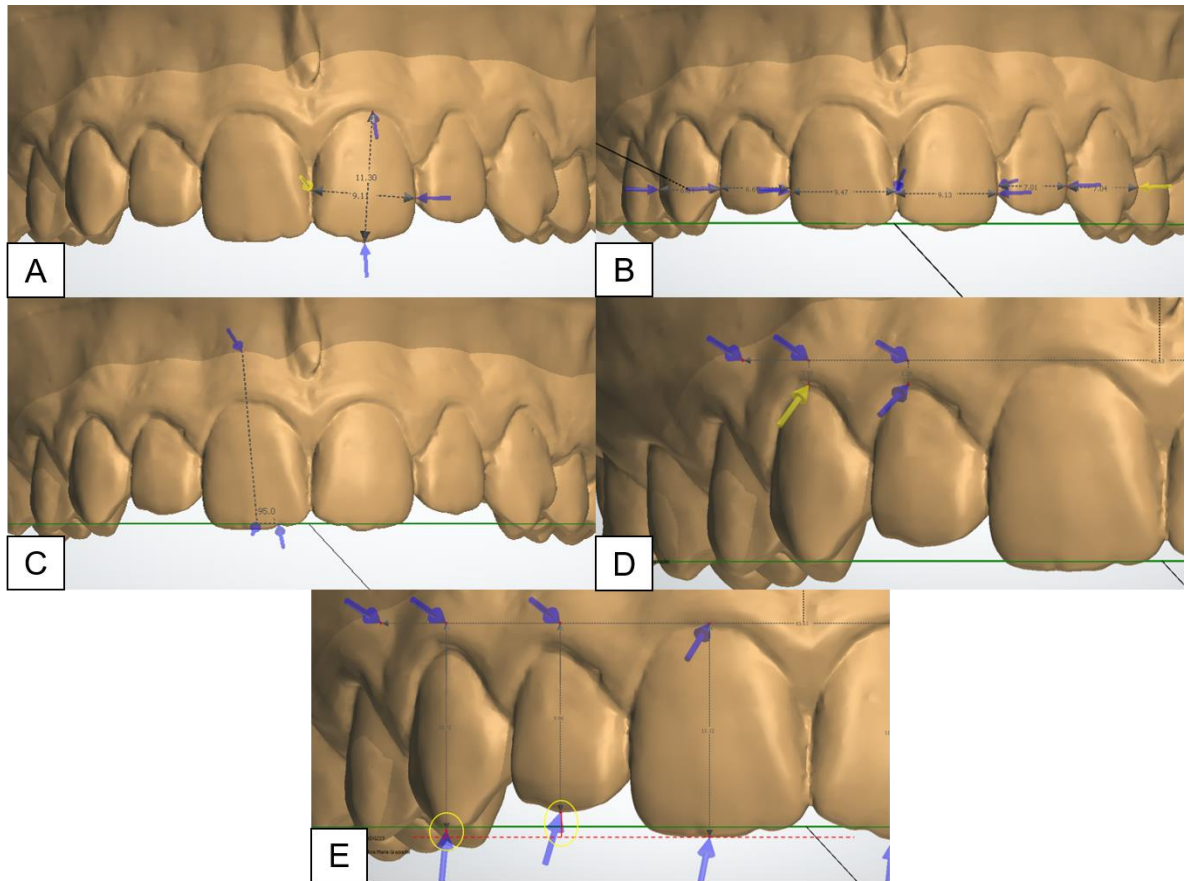
Figure 3

T1
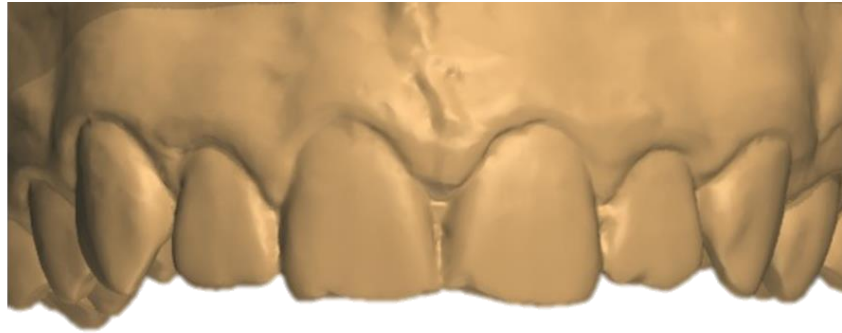
T2
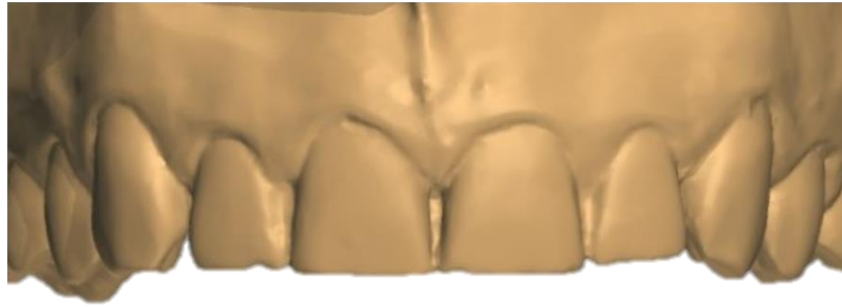
T3
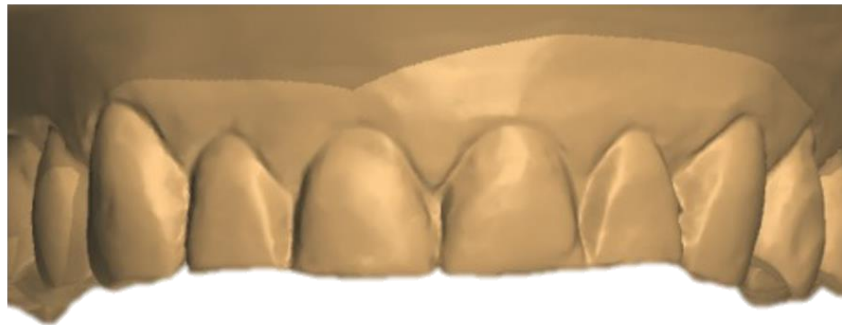
Figure 4

**Table I** – Error study (Intraclass correlation coefficients and Bland-Altman limits of agreement).

| Variable | Teeth | Measurement 1 | | Measurement 2 | | Difference | | ICC |
|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD | |
| Width/Height proportion (mm) | 1 | 0.88 | 0.08 | 0.88 | 0.10 | 0.00 | 0.03 | 0.927 |
| | 2 | 0.77 | 0.07 | 0.78 | 0.09 | 0.01 | 0.02 | 0.964 |
| | 3 | 0.81 | 0.10 | 0.83 | 0.10 | 0.01 | 0.04 | 0.930 |
| Anterior view width (mm) | 1 | 8.47 | 0.51 | 8.49 | 0.50 | 0.02 | 0.07 | 0.989 |
| | 2 | 6.29 | 0.36 | 6.28 | 0.38 | -0.01 | 0.10 | 0.960 |
| | 3 | 6.44 | 0.50 | 6.45 | 0.53 | 0.01 | 0.15 | 0.955 |
| Crown angulation (º) | 1 | 94.47 | 2.10 | 94.28 | 2.43 | -0.19 | 1.18 | 0.862 |
| | 2 | 95.16 | 3.14 | 95.47 | 3.39 | 0.31 | 1.15 | 0.933 |
| | 3 | 95.04 | 4.01 | 95.57 | 4.49 | 0.53 | 2.11 | 0.870 |
| Gingival step (mm) | 1 to 2 | 0.97 | 0.50 | 0.93 | 0.48 | -0.04 | 0.13 | 0.961 |
| | 1 to 3 | 0.80 | 0.83 | 0.79 | 0.84 | -0.01 | 0.15 | 0.984 |
| Incisal step (mm) | 1 to 2 | -0.56 | 0.32 | -0.52 | 0.35 | 0.05 | 0.05 | 0.926 |
| | 1 to 3 | 0.36 | 0.64 | 0.43 | 0.64 | 0.07 | 0.19 | 0.951 |

**Table II –** Interphase comparison of anterior teeth measurements (ANOVA and Friedman tests).

| *Variable* | Teeth | T1 | | T2 | | T3 | | p |
|---|---|---|---|---|---|---|---|---|
| | | *Mean* | SD | Mean | SD | Mean | SD | |
| **Width/Height Proportion (mm)** | 1 | 0.90 | 0.08 | 0.82 | 0.07 | 0.88 | 0.11 | 0.119[†] |
| | 2 | 0.84[A] | 0.08 | 0.78[B] | 0.07 | 0.77[B] | 0.13 | 0.008[Ѧ] * |
| | 3 | 0.92[A] | 0.10 | 0.81[B] | 0.08 | 0.78[B] | 0.12 | <0.001[Ѧ] * |
| **Anterior view width (mm)** | 1 | 8.44 | 0.53 | 8.39 | 0.49 | 8.30 | 0.61 | 0.090[Ѧ] |
| | 2 | 6.34 | 0.48 | 6.29 | 0.34 | 6.22 | 0.46 | 0.738[†] |
| | 3 | 6.50 | 0.60 | 6.47 | 0.55 | 6.40 | 0.57 | 0.433[Ѧ] |
| **Crown angulation (⁰)** | 1 | 4.95[A] | 2.13 | 3.74[B] | 1.80 | 2.01[C] | 2.62 | <0.001[†] * |
| | 2 | 6.83[A] | 3.00 | 5.13[B] | 2.54 | 4.67[B] | 4.05 | 0.001[Ѧ] * |
| | 3 | 7.29[A] | 5.02 | 5.19[B] | 4.36 | 7.03[AB] | 3.62 | 0.025[Ѧ] * |
| **Gingival step (mm)** | 1 to 2 | 1.04[A] | 0.50 | 0.91[A] | 0.50 | 0.65[B] | 0.53 | 0.002[Ѧ] * |
| | 1 to 3 | 1.30[A] | 0.83 | 0.83[B] | 0.82 | 0.15[C] | 0.90 | <0.001[Ѧ] * |
| **Incisal step (mm)** | 1 to 2 | -0.67[A] | 0.33 | -0.64[A] | 0.33 | -0.40[B] | 0.42 | <0.001[Ѧ] * |
| | 1 to 3 | 0.21 | 0.69 | 0.42 | 0.51 | 0.44 | 0.60 | 0.138[Ѧ] |

Different letters in the same row indicate statistically significant differences by Tukey test or Durbin-Conover tests.
1. central incisors; 2. lateral incisors; 3. canines. SD = Standard deviation.
Ѧ. repeated-measures ANOVA test; †. Friedman test.
∗Statistically significant at $P < 0.05$.

**Table III** – Male and female changes comparisons (t-tests).

| Variable | Teeth | T2-T1 | | | | p | T3-T1 | | | | p | T3-T2 | | | | p |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Female | | Male | | | Female | | Male | | | Female | | Male | | |
| | | Mean | SD | Mean | SD | | Mean | SD | Mean | SD | | Mean | SD | Mean | SD | |
| **Width/Height Proportion (mm)** | 1 | -0.05 | 0.04 | -0.03 | 0.06 | 0.516 | -0.02 | 0.14 | 0.00 | 0.06 | 0.741 | 0.03 | 0.12 | 0.03 | 0.07 | 0.983 |
| | 2 | -0.05 | 0.04 | -0.05 | 0.06 | 0.775 | -0.08 | 0.12 | -0.05 | 0.12 | 0.621 | -0.02 | 0.11 | 0.00 | 0.13 | 0.715 |
| | 3 | -0.11 | 0.10 | -0.09 | 0.07 | 0.499 | -0.16 | 0.13 | -0.12 | 0.13 | 0.540 | -0.04 | 0.09 | -0.03 | 0.12 | 0.806 |
| **Anterior view width (mm)** | 1 | -0.03 | 0.21 | -0.06 | 0.14 | 0.635 | 0.02 | 0.39 | -0.27 | 0.28 | 0.066 | 0.05 | 0.46 | -0.20 | 0.23 | 0.091 |
| | 2 | -0.08 | 0.23 | -0.03 | 0.35 | 0.673 | -0.18 | 0.42 | -0.08 | 0.50 | 0.620 | -0.09 | 0.28 | -0.05 | 0.36 | 0.756 |
| | 3 | 0.03 | 0.18 | -0.06 | 0.33 | 0.433 | -0.01 | 0.26 | -0.16 | 0.51 | 0.421 | -0.04 | 0.35 | -0.10 | 0.49 | 0.772 |
| **Crown Angulation (º)** | 1 | -1.46 | 1.65 | -1.02 | 2.02 | 0.589 | -3.20 | 2.97 | -2.72 | 2.51 | 0.681 | -1.74 | 3.49 | -1.70 | 1.93 | 0.970 |
| | 2 | -1.95 | 2.41 | -1.50 | 2.06 | 0.639 | -3.50 | 2.85 | -1.12 | 3.12 | 0.074 | -1.55 | 2.48 | 0.38 | 3.05 | 0.117 |
| | 3 | -3.99 | 5.31 | -0.64 | 1.77 | 0.045* | -1.81 | 4.11 | 0.93 | 3.67 | 0.106 | 2.17 | 3.72 | 1.57 | 3.50 | 0.697 |
| **Gingival step (mm)** | 1 to 2 | -0.11 | 0.34 | -0.14 | 0.43 | 0.861 | -0.36 | 0.57 | -0.41 | 0.68 | 0.832 | -0.24 | 0.44 | -0.27 | 0.54 | 0.898 |
| | 1 to 3 | -0.42 | 0.33 | -0.48 | 0.75 | 0.830 | -1.10 | 1.09 | -1.17 | 1.08 | 0.877 | -0.67 | 0.96 | -0.68 | 0.81 | 0.966 |
| **Incisal step (mm)** | 1 to 2 | -0.08 | 0.21 | 0.10 | 0.19 | 0.079 | 0.09 | 0.33 | 0.39 | 0.36 | 0.056 | 0.18 | 0.31 | 0.29 | 0.36 | 0.464 |
| | 1 to 3 | 0.08 | 0.37 | 0.29 | 0.60 | 0.334 | -0.03 | 0.65 | 0.42 | 0.63 | 0.104 | -0.11 | 0.62 | 0.13 | 0.51 | 0.317 |

∗Statistically significant at P<0.05.

# 3 DISCUSSION

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Few studies evaluated facial attractiveness and maxillary anterior teeth changes longitudinally and in the same individuals.[2,12] The difficulties for recalling the sample after 5 decades were relevant considering the subjects have changed phone numbers, address and women had adopted the marital names.

The aging process influenced on facial attractiveness and maxillary anterior teeth morphology and periodontal position. Mature age was considered less attractive than adolescence. These outcomes are in agreement with previous studies showing that facial attractiveness decreased with age.[11-13] This is expected since several soft tissue changes are predictable with aging. The skin becomes thinner, less elastic, more irregular and wrinkled.[10] Submental fat excess and jowl formation are expected in the lower face and neck.[23] Women appeared to be younger than men, agreeing with previous studies showing that aging on male are of greater magnitude.[24] This can be explain by the fact that women generally are more careful of health and facial appearance.[25]

Regarding the maxillary anterior teeth changes, the crown width/height proportion decreased and is probably due to the clinical crown height increase and the width decrease during aging.[8] Crown mesiodistal angulation significantly decreased from 13 to 61 years of age. Central incisors showed a progressive angulation decrease until the seventh decade of life, while lateral incisors and canines showed significant decrease only from 13 to 17 years of age. This may be due to dental accommodation that occurs as teeth erupt.[26] There was a decrease on gingival step between CI/LI and CI/C. These changes are probably related to an apical displacement of the gingival margin of these teeth.[20] The apical migration of the gingival margin of lateral incisors and canines should have been greater compared to the central incisors explaining the decrease in the gingival steps.[27] Regarding the incisal step, only central to lateral incisors step showed a significant decrease and might be due to the tooth wear.[7,28] Throughout life, teeth are exposed to physical injuries as parafunctional habits and regular mastication and chemical exposure including acidic drinks/foods and gastric reflux, which contributes to tooth wear.[29,30] The incisal edge of the maxillary anterior teeth affected by tooth wear can be augmented in the adulthood aiming a smile esthetic improvement.[31]

In summary, our study provided further evidence that facial attractiveness decreases and some significant dental and periodontal changes occur with the aging process. Knowing that the laypeople's opinion is not always the same as the orthodontists can make the professional more flexible during treatment planning. In addition, orthodontist should avoid procedures that accelerate the aging process and must consider the natural aging changes that occur in the maxillary anterior teeth.

# 4 FINAL CONSIDERATIONS

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The aging process influences on facial attractiveness and several changes occur in the maxillary anterior teeth on nontreated acceptable occlusion subjects. Mature age was judged with lower scores on facial attractiveness compared to adolescence. Facial attractiveness was not affected by sex. However, at late adulthood, female was considered younger than their actual age when compared to men. Laypeople were slightly more critical than orthodontists in the assessment of facial attractiveness. Thirty percent of the raters indicated the eyes as the most pleasant region and the chin and nose as the least pleasing structures. Maxillary anterior teeth changes were crown width/height proportion, mesiodistal angulation, gingival and incisal steps decrease. No changes were observed for the anterior view width.

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# APPENDIX

**APPENDIX A - DECLARATION OF EXCLUSIVE USE OF THE ARTICLE 1 IN DISSERTATION/THESIS**

We hereby declare that we are aware of the articles "Influence of aging on facial attractiveness perception" will be included in Dissertation of the student Gabriela Manami Natsumeda and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.

Bauru, March 2th, 2022.

Gabriela Manami Natsumeda
Author                                          Signature

Daniela Gamba Garib Carreira
Author                                          Signature

**APPENDIX B - DECLARATION OF EXCLUSIVE USE OF THE ARTICLE 2 IN DISSERTATION/THESIS**

We hereby declare that we are aware of the articles "Longitudinal changes in maxillary anterior teeth on normal occlusion subjects" will be included in Dissertation of the student Gabriela Manami Natsumeda and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.
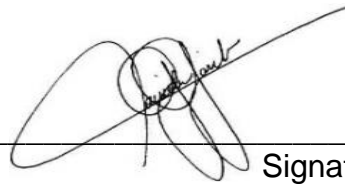
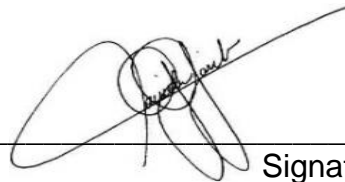Bauru, March 2th, 2022.

Gabriela Manami Natsumeda
Author                                                              Signature

Daniela Gamba Garib Carreira
Author                                                              Signature

# ANNEXES

**ANNEX A** – Ethics Committee approval, protocol number 22082119.3.0000.5417

## USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

Plataforma Brasil

### PARECER CONSUBSTANCIADO DO CEP

**DADOS DO PROJETO DE PESQUISA**

**Título da Pesquisa:** Envelhecimento de indivíduos com oclusão normal: percepção da estética facial e alterações dentárias na região anterossuperior

**Pesquisador:** Gabriela Manami Natsumeda

**Área Temática:**

**Versão:** 3

**CAAE:** 22082119.3.0000.5417

**Instituição Proponente:** Universidade de Sao Paulo

**Patrocinador Principal:** Financiamento Próprio

**DADOS DO PARECER**

**Número do Parecer:** 3.834.719

**Apresentação do Projeto:**

Segundo a pesquisadora, a preocupação com a estética facial e do sorriso aumentaram crescentemente na Ortodontia. No entanto, as alterações naturais das características estéticas foram pouco estudadas durante o processo de maturação da oclusão. Assim, o objetivo desse estudo consiste em avaliar longitudinalmente, em indivíduos com oclusão normal aos 13 e 61 anos, a agradabilidade da estética facial e as alterações posicionais e periodontais dos dentes anterossuperiores. A amostra desse estudo será composta por fotografias faciais e modelos digitais de indivíduos com oclusão normal, tomados aos 13, 17 e 61 anos de idade. As fotos faciais frontal e lateral, tomadas aos 13 e 61 anos, serão analisadas, de modo embaralhado aleatoriamente por idade, por 20 leigos e 20 ortodontistas. Os avaliadores analisarão a foto de frente e perfil, atribuindo scores de 1 (esteticamente desagradável) a 10 (esteticamente agradável) para cada indivíduo, indicando as estruturas faciais que mais e menos agradam em cada face. Nos modelos dentários digitais serão avaliados, nos três tempos, a altura e largura da coroa,

proporção largura/altura da coroa, largura em vista frontal, simetria incisal e gengival, degrau incisal e gengival, angulação e inclinação da coroa. Análise dos resultados: As

alterações da agradabilidade facial dos 13 aos 61 anos, bem como as diferenças entre os avaliadores, serão avaliadas pelo teste t. As variáveis quantitativas obtidas nos modelos dentários serão testadas quanto a suade Variância (ANOVA) e teste Tukey. Diferenças sexuais para os

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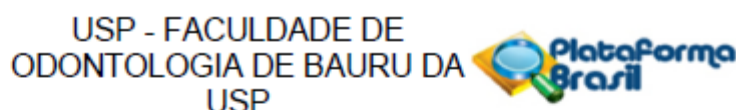
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parâmetros quantitativos serão analisadas por meio do teste t. Os resultados serão considerados com nível de significância de 5%.

**Objetivo da Pesquisa:**

Em uma amostra de indivíduos com oclusão normal dos 13 aos 61 anos de idade, o presente projeto será dividido em duas etapas, e seus objetivos são:

- Avaliação da percepção da estética facial, aos 13 e aos 61 anos, por leigos e ortodontistas;

- Avaliar as alterações posicionais e periodontais dos dentes anterossuperiores aos 13, 17 e 61 anos de idade.

**Avaliação dos Riscos e Benefícios:**

Riscos: O incômodo relacionado a esta pesquisa consiste no preenchimento de um questionário despendendo tempo do profissional, levando, aproximadamente, 20 minutos. Os riscos para os participantes desta pesquisa são mínimos. Uma vez que, apesar da confidencialidade dos dados preenchidos pelos profissionais e codificação dos mesmos pelo pesquisador responsável, os dados serão enviados por fontes secundárias por parte

dos profissionais que optarem em contribuir com a pesquisa.

Benefícios: Os participantes não serão beneficiados diretamente com os resultados desta pesquisa. Porém, com a conclusão da mesma, serão beneficiados indiretamente com o ganho do conhecimento dos ortodontistas com relação à estética facial e alterações posicionais que ocorrem durante o envelhecimento da oclusão normal.

**Comentários e Considerações sobre a Pesquisa:**

Considerações descritas no item "conclusões".

**Considerações sobre os Termos de apresentação obrigatória:**

Todos as retificações sugeridas foram realizadas.

**Recomendações:**

Sem recomendações.

**Conclusões ou Pendências e Lista de Inadequações:**

Referido projeto já analisado anteriormente fora considerado com PENDÊNCIA para que a pesquisadora retificasse os TCLEs constantes no projeto.

Em retorno para nova análise, foram realizadas as retificações e esclarecimentos necessários, razão pela qual sou de parecer que o projeto seja considerado APROVADO.

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**Considerações Finais a critério do CEP:**

Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 05/02/2020, com base nas normas éticas da Resolução CNS 466/12. Ao término da pesquisa o CEP-FOB/USP exige a apresentação de relatório final. Os relatórios parciais deverão estar de acordo com o cronograma e/ou parecer emitido pelo CEP. Alterações na metodologia, título, inclusão ou exclusão de autores, cronograma e quaisquer outras mudanças que sejam significativas deverão ser previamente comunicadas a este CEP sob risco de não aprovação do relatório final. Quando da apresentação deste, deverão ser incluídos todos os TCLEs e/ou termos de doação assinados e rubricados, se pertinentes.

**Este parecer foi elaborado baseado nos documentos abaixo relacionados:**

| Tipo Documento | Arquivo | Postagem | Autor | Situação |
|---|---|---|---|---|
| Informações Básicas do Projeto | PB_INFORMAÇÕES_BÁSICAS_DO_P ROJETO_1415902.pdf | 16/01/2020 12:02:58 | | Aceito |
| TCLE / Termos de Assentimento / Justificativa de Ausência | 5_TCLE_questionario2.pdf | 16/01/2020 11:59:39 | Gabriela Manami Natsumeda | Aceito |
| TCLE / Termos de Assentimento / Justificativa de Ausência | 5_TCLE_oclusao_normal2.pdf | 16/01/2020 11:59:14 | Gabriela Manami Natsumeda | Aceito |
| Outros | Oficio_Respostas_CEP2.pdf | 16/01/2020 11:58:17 | Gabriela Manami Natsumeda | Aceito |
| Outros | 5_Dispensa_TCLE_Oclusao_Normal.pdf | 14/11/2019 13:46:51 | Gabriela Manami Natsumeda | Aceito |
| Projeto Detalhado / Brochura Investigador | 6_Projeto_Doutorado_CEP.pdf | 13/11/2019 22:38:52 | Gabriela Manami Natsumeda | Aceito |
| Cronograma | Cronograma_Projeto1.pdf | 13/11/2019 22:38:26 | Gabriela Manami Natsumeda | Aceito |
| Outros | 7_Check_list_assinado.pdf | 18/09/2019 12:11:59 | Gabriela Manami Natsumeda | Aceito |
| Outros | 4_Termo_uso_arquivo_assinado.pdf | 18/09/2019 12:11:40 | Gabriela Manami Natsumeda | Aceito |
| Outros | 2_Carta_Encaminhamento_Termo_Aqui ecencia_CEP_assinado.pdf | 18/09/2019 12:11:00 | Gabriela Manami Natsumeda | Aceito |
| Declaração de Pesquisadores | 3_Declaracao_compromisso_pesquisad or_assinado.pdf | 18/09/2019 12:10:09 | Gabriela Manami Natsumeda | Aceito |
| Folha de Rosto | 1_Folha_de_rosto_assinada.pdf | 18/09/2019 | Gabriela Manami | Aceito |

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| Folha de Rosto | 1_Folha_de_rosto_assinada.pdf | 12:06:36 | Natsumeda | Aceito |
|---|---|---|---|---|

**Situação do Parecer:**
Aprovado

**Necessita Apreciação da CONEP:**
Não

BAURU, 12 de Fevereiro de 2020

Assinado por:
Ana Lúcia Pompéia Fraga de Almeida
(Coordenador(a))

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