UNIVERSIDADE DE SÃO PAULO
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CAMILA DA SILVEIRA MASSARO

Maturational changes of the normal occlusion: a 40-year follow-up

Alterações maturacionais da oclusão normal após 40 anos de acompanhamento

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Orientador: Profª. Drª. Daniela Gamba Garib Carreira

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...aos meus pais, Carlos e Rose,

com todo meu amor, respeito e gratidão.

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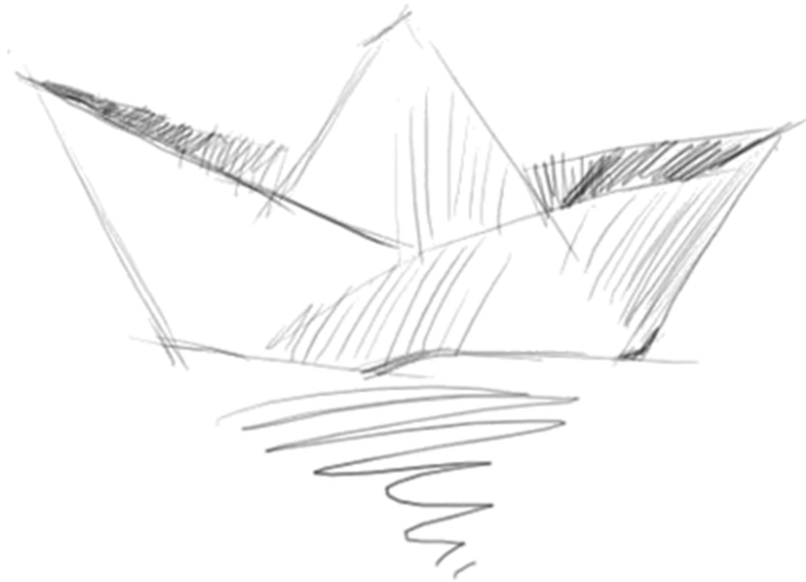

Todo abismo é navegável

a barquinhos de papel!

- Guimarães Rosa -

ABSTRACT

Maturational changes of the normal occlusion: a 40-year follow-up

Purpose: This study aimed at evaluating the changes in the dental arch dimensions, tooth size and incisor crowding in individuals with normal occlusions over a 40-year period. **Methods:** A sample of 82 White-Brazilian subjects with normal occlusion evaluated at adolescence (T1) and early adulthood (T2) was recruited for a T3 evaluation at the sixth decade of life. The exclusion criteria were history of orthodontic treatment, complete tooth loss and absence of dental model at any of the three time points. The final sample was composed by dental casts of 22 subjects (12 males and 10 females) obtained at a mean age of 13.3 years (T1), 17.8 years (T2) and 60.9 years (T3). The following variables were measured in digital casts: mesiodistal tooth size, clinical crown height, arch length, arch width, arch perimeter, palatal depth, maxillary and mandibular incisor crowding (Little's irregularity index), overjet, overbite and curve of Spee. Interphase changes were evaluated using dependent ANOVA and Tukey tests, and sex comparisons were performed using independent t-tests ($p<0.05$). **Results:** An increase of the clinical crown height in the posterior teeth and an increase of incisor crowding were found. Mesiodistal tooth size decreased from T2 to T3. A decrease of mandibular intercanine width, arch length, arch perimeter, overbite and curve of Spee was observed from 13 to 60 years of age. No changes were noted for the overjet. The palatal depth increased between 13 and 17 years and remained stable from 17 to 60 years of age. Males had a greater reduction in the overbite when compared with females. **Conclusion:** Normal occlusion subjects demonstrated dimensional changes in tooth size and alignment, overbite and arch dimensions from adolescence to late adulthood. Aging of normal occlusion might be prevented by bonding a mandibular 3x3 bar retainer during adolescence and reconstructing worn canine cusp tips during adulthood.

KEY WORDS: Dental models. Dental occlusion. Aging.

RESUMO

Alterações maturacionais da oclusão normal após 40 anos de acompanhamento

Objetivo: O objetivo deste trabalho foi avaliar longitudinalmente, dos 13 aos 60 anos, as alterações dimensionais dos arcos dentários e tamanho dentário em indivíduos com oclusão normal. **Material e Métodos:** Uma amostra de 82 indivíduos leucodermas com oclusão normal avaliados na adolescência (T1) e no início da idade adulta (T2) foi recrutada para uma terceira avaliação durante a sexta década de vida (T3). Os critérios de exclusão foram histórico de tratamento ortodôntico, perda total dos dentes e ausência de modelos de gesso em um dos três tempos. A amostra final foi composta por modelos de 22 indivíduos (12 homens e 10 mulheres) obtidos em média aos 13,3 anos (T1), 17,8 anos (T2) e 60,9 anos (T3). As seguintes variáveis foram mensuradas em modelos digitais: tamanho mesiodistal dos dentes, altura da coroa clínica, largura do arco, comprimento do arco, perímetro do arco, profundidade do palato, apinhamento dos incisivos superiores e inferiores (pelo Índice de Irregularidade de Little), overjet, overbite e curva de Spee. As alterações interfases foram avaliadas pelo teste ANOVA dependente e teste de Tukey, e as comparações entre os sexos foram realizada pelo teste t independente ($p < 0,05$). **Resultados**: Observou-se um aumento da altura da coroa clínica dos dentes posteriores e um aumento do apinhamento na região dos incisivos. O tamanho mesiodistal dos dentes diminuiu de T2 para T3. Houve uma diminuição da distância intercaninos inferiores, comprimento do arco, perímetro do arco, overbite e curva de Spee dos 13 aos 60 anos de idade. Não foram observadas alterações para o overjet. A profundidade do palato aumentou dos 13 aos 17 anos. Os homens apresentaram uma maior diminuição no overbite em comparação às mulheres. **Conclusão:** Os indivíduos com oclusão normal demonstraram alterações dimensionais no tamanho e alinhamento dos dentes, overbite e dimensões do arco da adolescência até idade adulta tardia. O envelhecimento da oclusão normal pode ser amenizado pela instalação preventiva da contenção fixa inferior (3X3) durante a adolescência e pela reconstrução das pontas de cúspide dos caninos, desgastadas durante a idade adulta.

Palavras-chave: Modelos dentários. Oclusão dentária. Envelhecimento.

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LIST OF ABBREVIATIONS AND ACRONYMS

T1	Timing 1
T2	Timing 2
T3	Timing 3
SD	Standard deviation
Mx	Maxilla
Md	Mandible
LII	Little's Irregularity Index
ICC	Intraclass Correlation Coefficients
X	Missing teeth
I	Dental implants
C	Prosthodontic crowns

LIST OF SYMBOLS

7	Second molars
6	First molars
5	Second premolars
4	First premolars
3	Canines
2	Lateral incisors
1	Central incisors
3-3	Distance between permanent canines
4-4	Distance between first premolars
5-5	Distance between second premolars
6-6	Distance between permanent first molars

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1 INTRODUCTION

1 INTRODUCTION

Craniofacial growth and development are continuous processes and maturational changes may affect the dentition and dental occlusion during adult life (BEHRENTS, 1984). While one is alive, teeth change position respecting a compensatory mechanism that aims to maintain the structural balance of the face and dentition (BJORK, 1950; BEHRENTS, 1984; PROFFIT; FIELDS JR; SARVER, 2014). Early growth, until adolescence and first two decades of life is well documented (MOORREES; CHADHA, 1965; SINCLAIR; LITTLE, 1983; BISHARA et al., 1998), and some studies extended the assessment to the third, fourth and fifth decades of life (BISHARA; TREDER; JAKOBSEN, 1994; CARTER; MCNAMARA, 1998; HENRIKSON; PERSSON; THILANDER, 2001; TIBANA; PALAGI; MIGUEL, 2004; THILANDER, 2009; HEIKINHEIMO et al., 2012; TSIOPAS et al., 2013). However, less is known about maturational changes in the late adulthood. Considering the increasing number of adult patients seeking for dental treatment and the growth of older individuals, it has become very important to understand the natural changes in the craniofacial and dental structures that may occur at the later stages of adulthood.

The untreated normal occlusion is a great reference in Orthodontics (ANDREWS, 1972), and efforts have been made to understand how normal occlusion ages (SINCLAIR; LITTLE, 1983; BISHARA; TREDER; JAKOBSEN, 1994; HENRIKSON; PERSSON; THILANDER, 2001; TIBANA; PALAGI; MIGUEL, 2004; BERG; STENVIK; ESPELAND, 2008; HEIKINHEIMO et al., 2012; TSIOPAS et al., 2013). Cephalometric studies observed craniofacial changes after adolescence and dental models showed that dentalveolar structures also continue to undergo changes in “nongrowing” individuals (SINCLAIR; LITTLE, 1983; BISHARA; TREDER; JAKOBSEN, 1994; HENRIKSON; PERSSON; THILANDER, 2001; TIBANA; PALAGI; MIGUEL, 2004; BERG; STENVIK; ESPELAND, 2008; HEIKINHEIMO et al., 2012; TSIOPAS et al., 2013).

From ages 21 to 28, a decrease of the arch perimeter and an increase in the incisor crowding and overbite were observed in Brazilian individuals with normal occlusion (TIBANA; PALAGI; MIGUEL, 2004). A cross sectional study evaluated the occlusal changes in Sweden normal occlusal individuals and found a continuously decrease of the intercanine width from 16 to 31 years (THILANDER, 2009). A longitudinal follow-up of Finnish normal occlusal subjects from 7 to 32 years showed a decrease of the intercanine distance, maxillary intermolar width, overjet and overbite after 15 years of age (HEIKINHEIMO et al., 2012). From 25 to 46 years of age, a decrease of the maxillary and mandibular intercanine widths, a decrease of the maxillary arch lengths and an increase of the mandibular incisor crowding were reported (BISHARA; TREDER; JAKOBSEN, 1994). Bishara et al. (BISHARA et al., 1996) found significant changes in the maxillary and mandibular arches in normal individuals from 25 to 45 years. An increase in crowding was described and considered part of the normal maturational process (BISHARA et al., 1996). Extending the evaluation to the sixth decade of life, Berg et al. (BERG; STENVIK; ESPELAND, 2008) performed a qualitative comparison between dental photographs of Norwegian normal occlusion individuals from 8 to 63 years, and reported a great stability of the occlusion. No report was found specifically about tooth size changes with age in individuals with normal occlusion.

It is common to look for causes of failure when dental crowding and other arch discrepancies are found in the posttreatment period. However, longitudinal follow-ups of the untreated patients showed that dimensional changes can occur naturally throughout life, and may be related not only to the orthodontic intervention and to the initial malocclusion (CARTER; MCNAMARA, 1998; TIBANA; PALAGI; MIGUEL, 2004; THILANDER, 2009; TSIOPAS et al., 2013). However, there is a lack of studies extending the report to the late adulthood, mainly due to the difficulty in obtaining longitudinal data (BISHARA; TREDER; JAKOBSEN, 1994; HARRIS, 1997; CARTER; MCNAMARA, 1998; BERG; STENVIK; ESPELAND, 2008; TSIOPAS et al., 2013). The question remains: is the normal occlusion stable from the adolescence to late adulthood? Thus, the aim of the present study was to assess the maturational changes in the normal occlusion, through quantitative references of dental arch and tooth dimensions, from adolescence to late adulthood, over a 47-year follow-up.

2 ARTICLE

2 ARTICLE

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

MATURATIONAL CHANGES OF THE NORMAL OCCLUSION: A 40-YEAR FOLLOW-UP

ABSTRACT

Purpose: This study aimed at evaluating the changes in the dental arch dimensions, tooth size and incisor crowding in individuals with normal occlusions over a 40-year period. **Methods:** A sample of 82 white subjects with normal occlusion evaluated at adolescence and early adulthood was recruited for a third evaluation at the sixth decade of life. The final sample was composed by dental casts of 22 subjects (12 males and 10 females) obtained at a mean age of 13.3 years (T1), 17.8 years (T2) and 60.9 years (T3). The following variables were measured in digital casts: mesiodistal tooth size, clinical crown height, arch length, arch width, arch perimeter, palatal depth, crowding, overjet, overbite and curve of Spee. Interphase changes were evaluated using dependent ANOVA and Tukey tests ($p<0.05$). **Results:** An increase of the clinical crown height in the posterior teeth and incisor crowding were found. A decrease of mesiodistal tooth size, mandibular intercanine width, arch length, arch perimeter, overbite and curve of Spee was observed. The palatal depth increased from 13 to 17 years. **Conclusion:** Normal occlusion subjects demonstrated dimensional changes in tooth size and alignment, overbite and arch dimensions from adolescence to late adulthood.

KEY WORDS: Dental models. Dental occlusion. Aging.

INTRODUCTION

The unpredictability of occlusal changes with aging is a challenge for Orthodontics. Craniofacial growth and development are continuous processes and dimensional changes can occur naturally throughout life.[1,2] The considerable growth during the first two decades of life and the dental arches changes during this period are well documented,[3-5] and the literature indicates that the adult craniofacial structures continue to increase in size.[1,2] The study by Behrents[1] provided evidence that craniofacial growth continues in adulthood with greater changes observed for the soft than for the skeletal tissues. A forward and downward mandibular rotation in males and backward rotation in females followed by a dental compensation represented by the maxillary incisor upright were observed. After 40 years of age, only mild changes were observed until the eighth decade of life.[1]

The occlusion and arch dimensions are also influenced by aging.[1,6-11] Studies on the longitudinal changes of normal occlusion were previously conducted until the third, fourth or fifth decades of life.[2,6-12] A remarkable decrease of the intercanine width was reported.[6,8,10] The arch length and perimeter decreased from the adolescence to the fourth decade of life.[7-10,12] The arch length decrease varied from 1.0 mm to 5.7 mm.[8,12] A slight sexual dimorphism was observed with a greater maxillary arch length decrease in males.[12] The overbite and overjet changes varied.[2,4,8,10] The increase in the anterior crowding was greater in the mandibular arch compared to the maxillary arch.[4,7,8] No previous studies extended the evaluation of normal occlusion maturation to the sixth decade of life. Normal occlusion longer follow-ups are important for providing references of natural changes for comparative studies in treated individuals. A recent review about long-term stability of the orthodontic treatment reported that despite of a large number of articles published, few studies included an untreated control group.[13]

In general, tooth size has an association with age.[14] Decrease in the mesiodistal tooth size as a result of interproximal attrition with age was previously described.[14-16] Begg reported a 10.5 mm mesiodistal tooth wear in the lower arch in primitive Australian aborigines.[15,17] A mean reduction of 0.15 and 0.32 mm per tooth was described from adolescence to 50 years of age in modern civilization.[16] Changes in tooth size and clinical crown length with age were not evaluated in individuals with normal occlusion and might influence the arch dimensions and the smile esthetics.

Considering the above-mentioned concerns, this study aimed at evaluating the changes in the dental arch dimensions, tooth size and clinical crown height in individuals with normal occlusions from 13 to 60 years of age.

MATERIAL AND METHODS

This observational and longitudinal study was approved by the institutional research ethical committee and written patient consents were obtained (Process number: 43931915.4.0000.5417). The sample size calculation was based on a preliminary statistics including the first 5 individuals of the sample. For a standard deviation of 1.47 mm for mandibular incisor irregularity and a minimal interphase difference of 1.00 mm to be detected, a sample of 19 patients was required to provide a statistical power of 80% with an α of 5%.

The initial normal occlusion sample group was obtained from 1967 to 1974 and comprised 82 Brazilian-White subjects (39 males and 43 females). Dental models and cephalometric radiographs were obtained at 13 and 17 years of age. At T1, all individuals had a clinically acceptable occlusion in the complete permanent dentition, dental and skeletal Class I relationships, absence of crossbites, normal overjet and overbite and a maximum 2 mm of incisor crowding with no previous history of orthodontic treatment.[18] From April of 2015 to May of 2016, the sample was recalled and dental models were performed (T3). Thirty-eight patients were contacted and twenty-seven patients were enrolled. The exclusion criteria were history of previous orthodontic treatment from T1 to T3, complete tooth loss and absence of dental model at any of the 3 time points. The final sample comprised 22 individuals (12 males and 10 females) assessed at three age periods, as shown in Table I. The enrollment process is described in Figure 1.

All dental models were digitized using a R700 3D Scanner (3Shape A/S, Copenhagen, Denmark). Dental model measurements were performed using the software OrthoAnalyzer™ 3D (3Shape A/S, Copenhagen, Denmark). Measurements included mesiodistal tooth size (Figure 2A), cervical-occlusal crown dimension (Figure 2B), arch widths (Figure 3A), arch perimeter (Figure 3B), arch length (Figure 3C), palatal depth (Figure 3D), incisor crowding index (Figure 4A), overjet (Figure 4B), overbite (Figure 4B), and curve of Spee (Figure 4C). Absent teeth and prostheses were not considered for measurements (Table II).

Statistical Analyses

One operator (C.S.M.) performed all measurements and half of the sample was measured twice with an interval of at least 1 month. The intrarater reliability was assessed using intraclass correlation coefficients (ICC)[19] and the Bland-Altman method.[20]

Means and standard deviations were calculated for all measurements at T1, T2 and T3. For tooth measurements, the average of both sides was used. The Kolmogorov-Smirnov test showed a normal distribution for all variables and interphase changes were evaluated with dependent analysis of variance (ANOVA) followed by Tukey post hoc test. Sex comparisons were performed using independent t-test. The significance level considered was 5%. The statistical analyses were performed using software “Statistica” (Statistica for Windows version 11.0; StatSoft, Tulsa, Okla, USA).

RESULTS

Table III shows the results of the error study. All variables showed an excellent intrarater agreement, varying from 0.78 to 0.99. The variable with greater limits of agreement was the maxillary intermolar width (-2.55 and 2.48).

Tables IV and V show the interphase changes. The aging process influenced most of the variables from T1 to T3. Mesiodistal tooth size, lower intercanine width, arch length, arch perimeter, overbite and the curve of Spee decreased. On the other hand, clinical crown height, incisor crowding and palatal depth increased. The overjet and maxillary arch widths remained stable.

From 13 to 17 years old, no changes were observed for the mesiodistal tooth size, but most teeth had an increase in their clinical crown length (Table IV). Maxillary arch length and perimeter, overbite and curve of Spee decreased while the mandibular crowding and palatal depth increased from T1 to T2 (Table V).

From 17 to 60 years of age, mesiodistal tooth size, mandibular intercanine width, arch length, arch perimeter and overbite decreased. The clinical crown height of most posterior teeth and the anterior crowding increased from T2 to T3 (Table IV and V).

No sexual dimorphism was observed from T1 to T3, except for the overbite and mesiodistal size of the mandibular canine, which decreased more in males.

DISCUSSION

Accuracy and reproducibility of digital dental model measurements are well documented.[21-29] Digital dental models facilitate the landmarks demarcation and allow drawing lines, planes and transverse cross sections.[24,30] Digital dental models have been widely used and previous studies showed reproducible and reliable linear measurements.[21,27-29,31] Our study also showed an adequate intrarater reliability (Table III).

Previous studies reported the difficulties related to collecting longitudinal data.[2,8,10,32,33] This study comprised an extensive follow-up period and confirmed the enrollment limitations. From the 82 individuals from the initial sample, 26.8% were enrolled after a four-decade period. Another limitation of this study was related to dental conditions at T3, when considerable tooth losses were observed (Table II). In the present study, there was a mean loss of 3.09 teeth per patient in a 47-year follow-up. Out of the 22 individuals of the sample, 27% had no missing tooth (6), 4% had only one missing tooth (1), 13% had two missing teeth (3) and 54% had three or more missing teeth (12). A previous study with 30 individuals with normal occlusion had a total of seven tooth losses from 25 to 45 years of age.[8] Our rate of tooth loss was greater when compared to that of previous studies, probably due to the longer follow-up period and older age for the final evaluation (mean of 60 years of age). Considering a photograph follow-up of 57 years (from 8 to 65 years of age) in Norwegian normal occlusion individuals, an average of 1.4 permanent teeth was missing.[33] The lower rate of tooth loss compared to our results might be related to the annual dental check-ups the Norwegian individuals were submitted to.

A significant reduction in the mesiodistal tooth size was observed over the 47-year follow-up (Table IV), corroborating previous studies that reported an interproximal wear and reduction in the tooth size.[15,16,34] However, no study followed untreated individuals with a normal occlusion. A mean reduction of 0.35 mm in the mesiodistal tooth size was found in the present study from 13 to 60 years. This finding is similar to the 0.32 mm per tooth previously found in females subjects from adolescence (14 years) to adulthood (31 to 50 years) in a previous transverse study.[16] Our results showed a smaller decrease in tooth size (2.5 mm per arch) compared to the reduction reported for a prehistorical civilization of 10.5 mm per arch.[15] No sex differences were found for interproximal tooth wear in our study, except for a greater reduction in the mandibular canines in males. Conversely, a sexual dimorphism in the mesiodistal tooth size changes was previously found with a greater tooth decrease occurring in females.[16]

Clinical crown height increased from adolescence to late adulthood (T1 to T3), except for the maxillary and mandibular central incisors (Table IV). The increase of crown height varied from 3.22 mm (maxillary second molars) to 0.55 mm (mandibular lateral incisors) and are probably related to the apical migration of the gingival level and tooth eruption.[35] Final clinical crown height is dependent upon several factors, including genetic and growing factors, occlusal and incisal wear, active and passive teeth eruptions and gingival level.[14,34-38] Our results suggest a continuing apical migration of the gingival margin from 13 to 60 years of age mostly in the most posterior teeth (Figure 5). The long-term crown height maintenance of central incisors might be related to the incisal wear. Morrow[35] found a mean increase of 0.50 mm in the clinical crown height of maxillary incisors and canines from 14 to 19 years while our results showed a mean increase of 0.77 mm for the same teeth group from 13 to 17 years.

A significant decrease was observed in the mandibular intercanine width from 17 to 60 years (0.69 mm) while no significant changes were detected for the maxillary intercanine distance (Table V). Previous study showed similar findings for an untreated normal occlusion sample assessed from 21 to 28 years (a decrease of 0.39 mm in the lower intercanine distance).[10] The greater reduction observed in the present study might be related to the longer observational period. A reduction in the intercanine distance was previously reported for both dental arches at early and late adulthoods, even though the reduction was more evident in the mandibular arch.[2,4,6,8,11,39,40] A mixed sample of normal occlusion and untreated individuals followed from 22 to 61 years old also showed a decrease of the maxillary and mandibular intercanine distance.[39] A decrease of the intercanine distance was also found from 20 to 55 years of age in untreated individuals with malocclusion.[32]

Interpremolar and intemolar distance remained stable from 13 to 60 years in both dental arches (Table V). These results are in accordance with previous longitudinal studies that showed minimal or no changes in the posterior arch widths with age.[2,6,8,10] An increase between 2 and 3 mm in the intermolar and inter first premolars width for lower and upper arches was found from 20 to 55 years in a study with mixed normal occlusion and untreated malocclusion sample.[32] Conversely, a longitudinal follow-up from 17 to 48 years observed a slight decrease for the mandibular intermolar width.[40] A possible explanation for these variabilities might be the sample features as the inclusion of untreated individuals with malocclusions, different ethnic background and different patterns for intra and extraoral muscular function.[41,42]

A statistically and clinically significant decrease of the arch length and arch perimeter was observed from 13 to 60 years of age (Table V). Maxillary and mandibular arch perimeter reduced 3.75 mm and 2.85 mm, respectively. These findings are in accordance with previous studies,[4,8,12,32,39,40,43,44] and are explained by the mesiodistal tooth size reduction, posterior tooth mesial migration and a slight lingual inclination of the incisors which occurred with age.[1,10,15,34,45-47] These reductions in the arch length and perimeter might explain the incisor crowding that appeared in normal occlusion individual during aging (Table V and Figure 6). The incisor crowding was greater in the mandibular arch and occurred predominantly between T2 and T3 (Table V). A greater incisor crowding in the mandibular arch might be associated with the abovementioned mandibular intercanine decrease. Previous studies also reported an increase of the anterior crowding in longitudinal follow-ups of normal occlusion.[4,7,8,10]

The palatal depth increased in the total observational period (2.31 mm from T1 to T3). The increase of the palatal depth corroborates with the possibility of a slow and continuous eruption of the teeth in the early permanent dentition.[9] A similar increase in the palatal depth was previously described in individuals with a normal occlusion between 16 and 31 years of age (0.10 mm/year).[9] In the present study, no significant changes were observed for palatal depth from 17 to 60 years, because the increase occurred predominantly from 13 to 17 years during the pubescent growth (Table V). The absence of significant changes in the palatal depth from 17 to 60 years can support the idea that, although growth is a continuous process, it declines with age.[1]

No changes were detected for the overjet from 13 to 60 years (Table V). The same result was previously described for different age groups in untreated individuals with[32,39,40,43] and without malocclusions.[2,8,10] These results show that despite maxillomandibular changes can continue in the adulthood,[1,2] the inclination of the incisors can compensate the changes and may result in constant values for overjet.[48] On the other hand, a slight but significant decrease in the overjet was also previously described in the second decade of life of normal occlusion individuals (from 13 to 20 years).[4] Differences in the ethnic background of the sample and age range might have contributed to the divergent results.

A significant and gradual decrease in the overbite was noted in the observational period (-0.79 mm from 13 to 17 years and -0.61 mm from 17 to 60 years) as shown in Figure 7. The T1-T2 overbite decrease may be related to the mandibular growth,[1,49,50] eruption of the second and third molars[51] and to the reduction in the depth of the curve of Spee (-0.49 mm) observed in the same period, as shown in Table V. The T2-T3 overbite reduction might be explained by the incisal wear in the central incisors with aging and residual mandibular growth.[38,49,52,53] Sinclair and Little[4] also reported a reduction in the overbite in the early adulthood (0.59 mm from 13 to 20 years). However, the studies show a high variability of overbite changes with aging reporting also increases[2,10] and stability.[1,8,32,39,40] These differences might be related to different facial growth patterns, presence of parafunctional habits, food habits and presence of untreated malocclusions in the sample.[32,38,39,49] Males showed a greater reduction in the overbite, as compared to females. These sex differences might be related to an increased incisal tooth wear in males, considering they have a stronger masticatory activity.[53-55] Another possible explanation for this sexual dimorphism might be the later mandibular growth period in males.[52]

A decrease in the Curve of Spee was observed between 13 and 17 years of age (Table V). A mean decrease of 0.49 mm can be associated to the end of the eruption of the lower second molars after 13 years.[37] Carter et al.[40] found a similar decrease in the curve of Spee from 13 to 17 years in untreated male individuals. The stability of the curve of Spee from 17 to 60 years agreed with a previous study in untreated individuals with and without malocclusions, from 17 to 48 years.[40]

An increase in the clinical crown height and dental crowding and a reduction in the mesiodistal tooth size, arch length, arch perimeter and overbite might be expected with aging in individuals with normal occlusion. As a clinical approach, a 3X3 bar retainer should also be indicated for adolescents without the need of orthodontic treatment. In addition, clinicians should be more restrained in indicating periodontal procedures for surgical crown lengthening, considering the natural increase in clinical crown height with age. Finally, procedures that minimize the incisal wear of the incisors should be considered in the dental treatment plan of adult patients, such as the augmentation of the canine tips. Further studies should evaluate the individual tooth angulation and tipping changes during the maturational process in normal occlusion. Additionally, the aging changes of the normal occlusion should be compared to aging changes of orthodontic treated occlusions.

CONCLUSION

Significant dimensional changes occur from adolescence to late adulthood:

- A decrease in the mesiodistal tooth size and an increase in the clinical crown height;
- A decrease in the lower intercanine width, arch length, arch perimeter and overbite;
- An increase in the mandibular anterior crowding.

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FIGURE LEGENDS

Fig. 1: Enrollment process.

Fig. 2: Individual tooth measurements. Mesiodistal tooth size measurement at the occlusal aspect (A). The clinical crown height was measured as the distance between the occlusal and cervical limits of the buccal aspect long axis (B).[56]

Fig. 3: Measurement of arch size. Intercanine, interpremolar and intermolar widths were measured at the level of cusp tips (A). Arch perimeter was considered the sum of the four segments from the mesial aspect of the right permanent first molar to the mesial aspect of the contralateral tooth (B). The arch length (yellow arrow) was measured on the horizontal plane from the mesial aspect of permanent first molars to a point between maxillary central incisors (C). The palatal depth (red arrow) was measured from a line passing through the mesial gingival papilla of the permanent first molars to the deepest point on the palate, perpendicularly to the arch length (D).

Fig. 4: Little's Irregularity Index was measured for upper and lower arches following Little et al.[57] and Dowling et al.[26] (A). The overbite and the overjet were measured on a slice passing through the center of the right and left maxillary central incisor (B). The mean between the right and left side was considered. The Curve of Spee was measured as the greater perpendicular distance between the buccal cusp tips of the mandibular teeth and a reference plane drawn from the central incisor edge to the distal cusp tip of the second molar (C). A mean value between the right and left sides was considered.

Fig. 5: Digitals models of a female subject (S.M.G.) from the sample at T1 (15 yrs), T2 (19 yrs) and T3 (60yrs).

Fig. 6: Six subjects illustrating the increase of the mandibular incisor crowding from T1 (first column) to T2 (second column) and T3 (third and fourth columns)

Fig. 7: Frontal images of the digital models of 5 subjects from the sample, showing the overbite continuous decrease from T1 to T3.

FIGURES

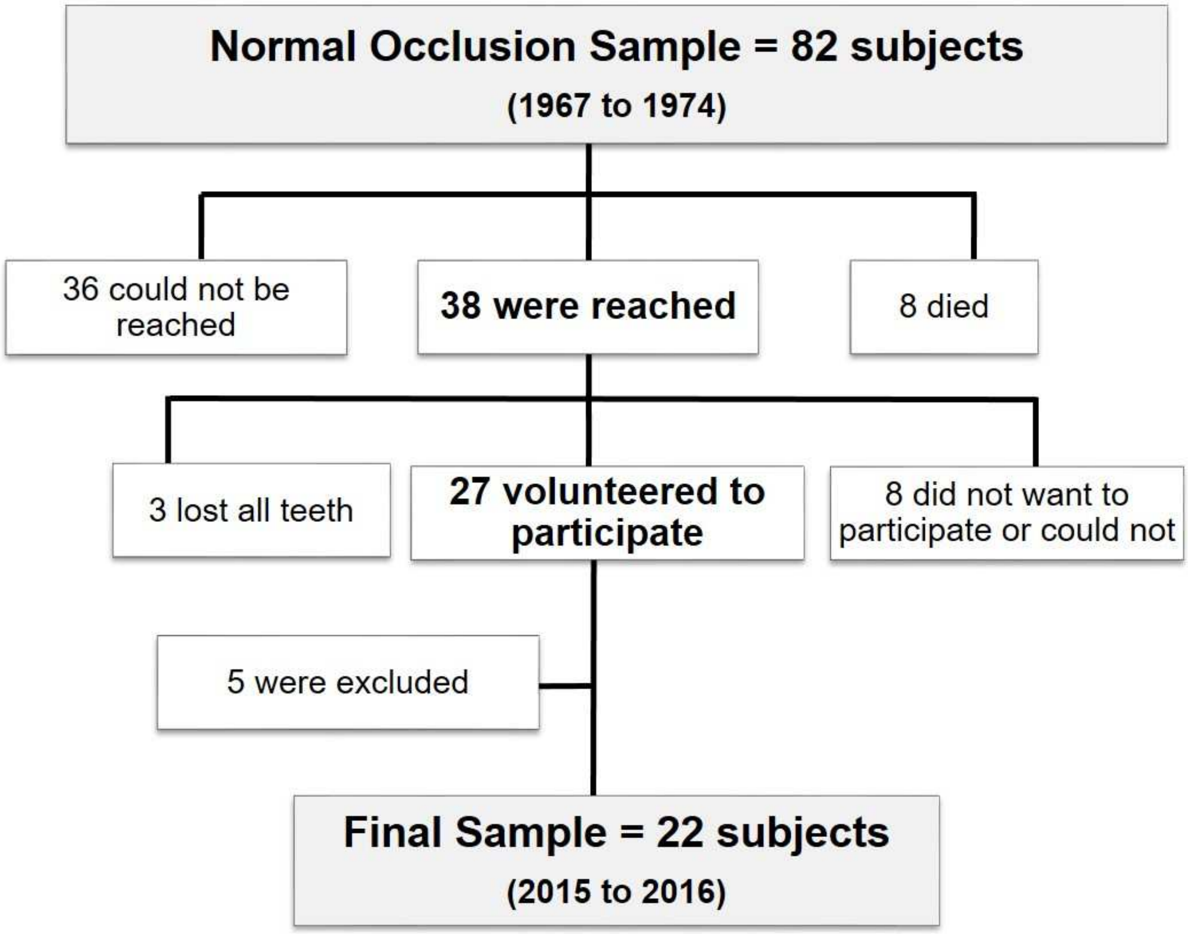


Fig. 1

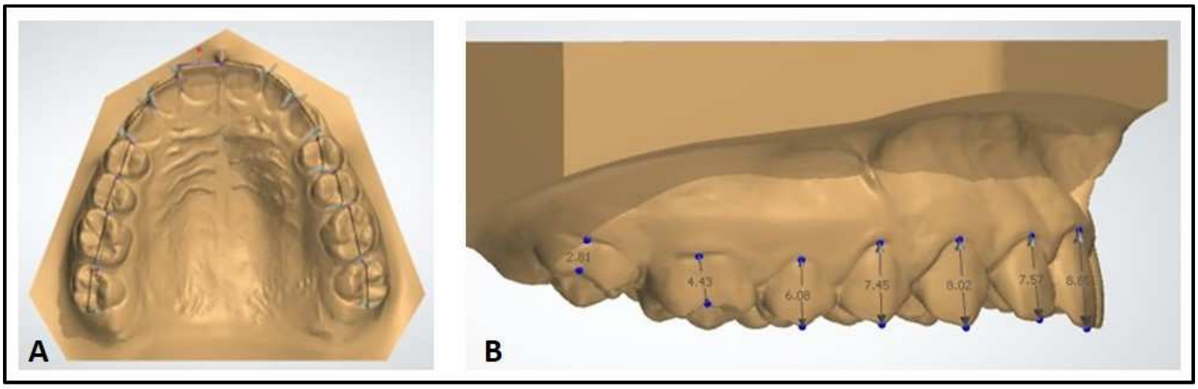
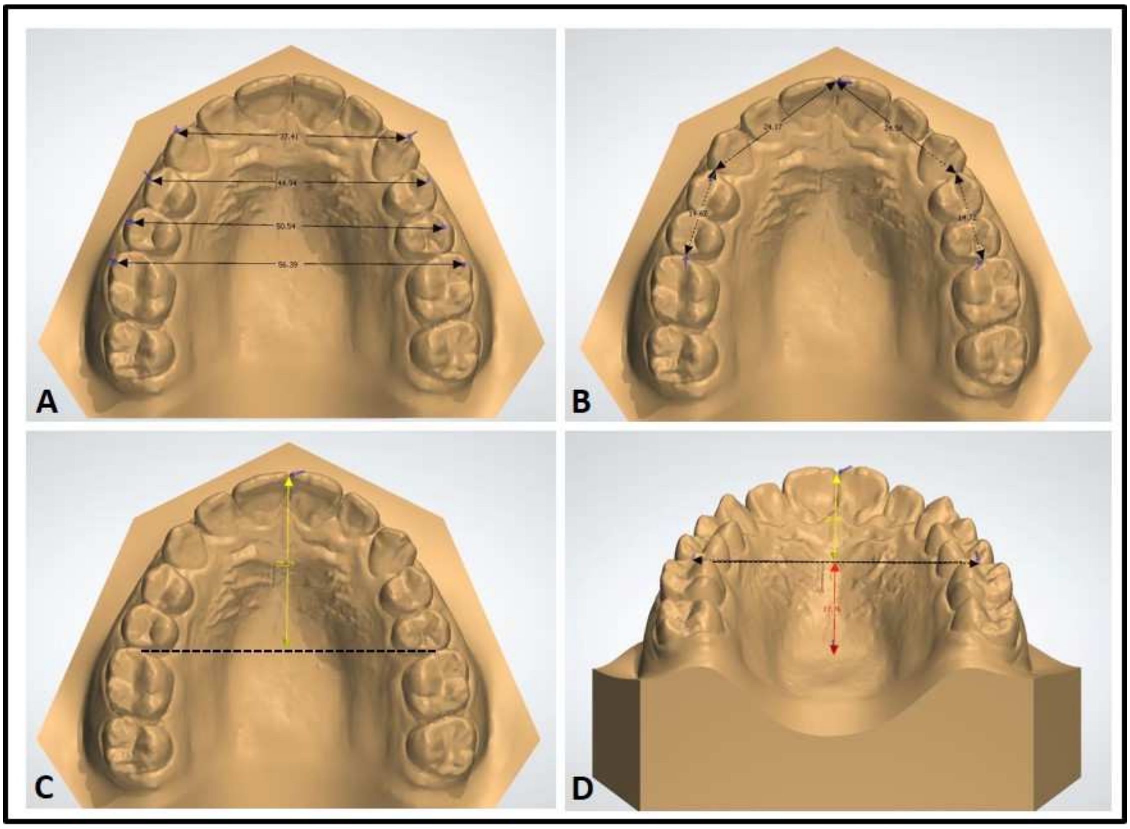


Fig. 2



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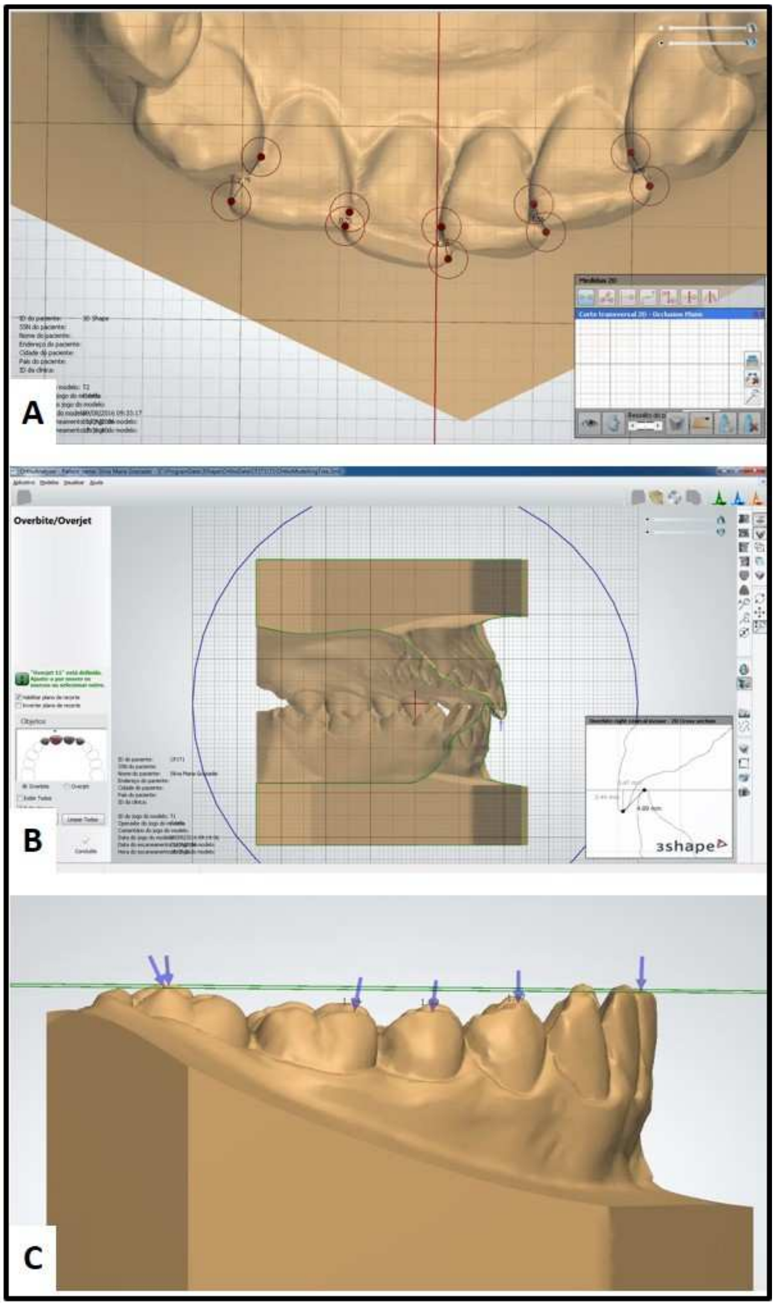

Fig. 4

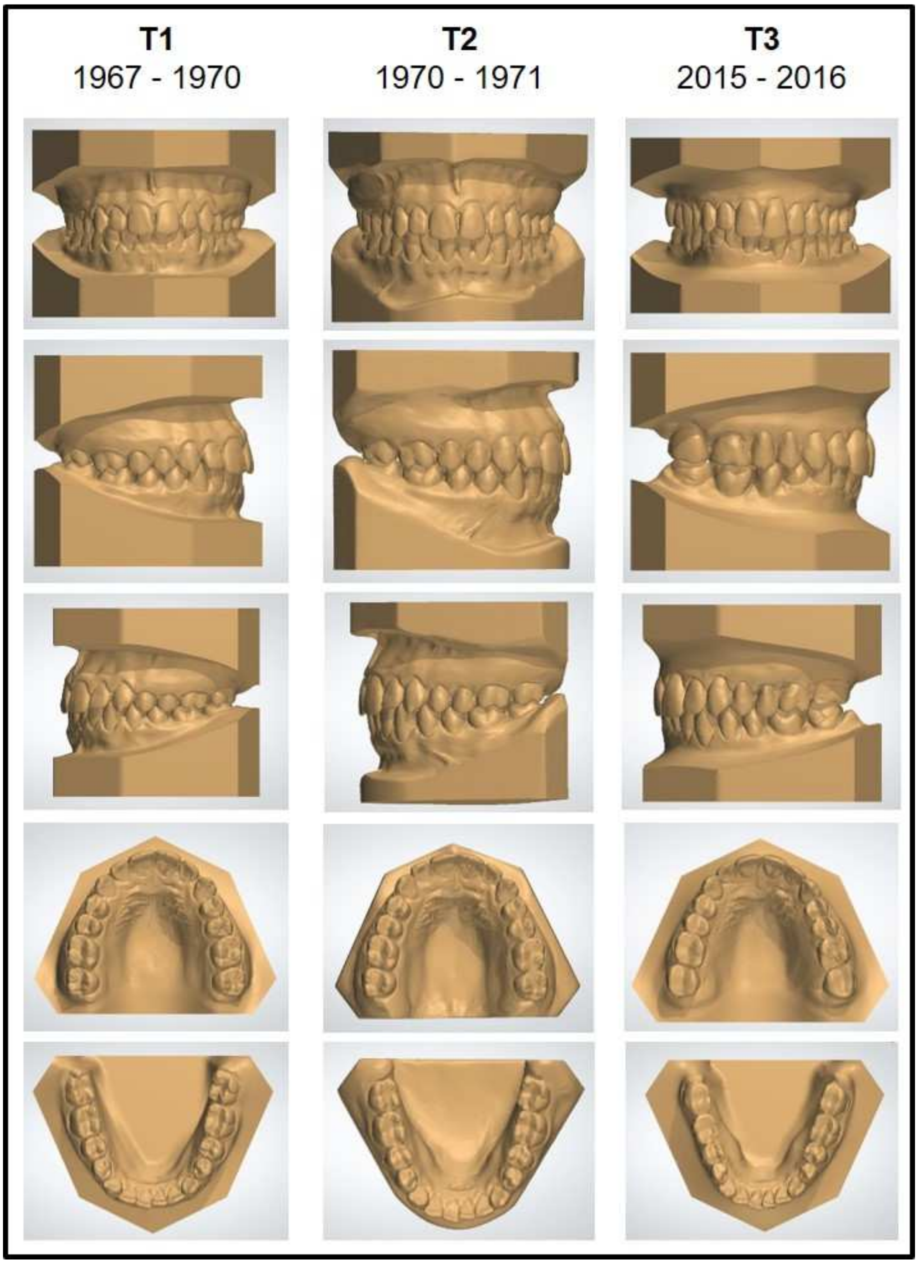

Fig. 5

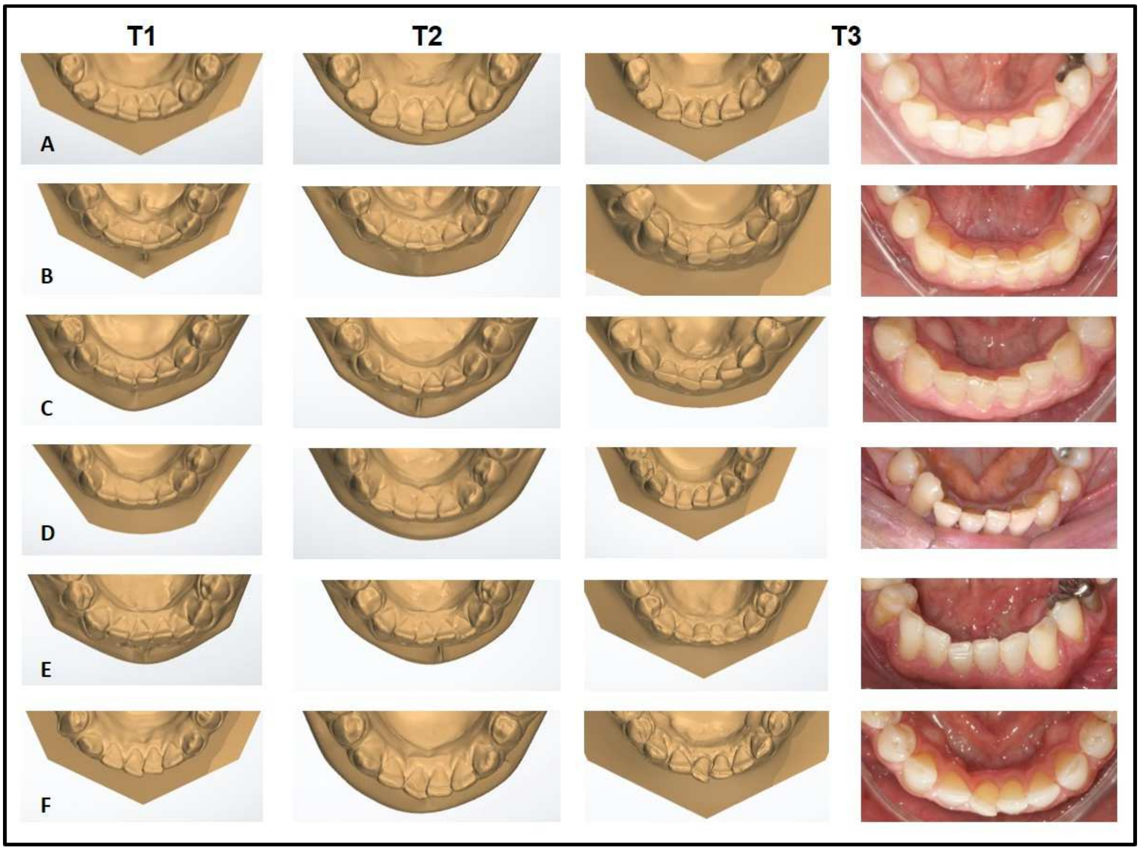

Fig. 6

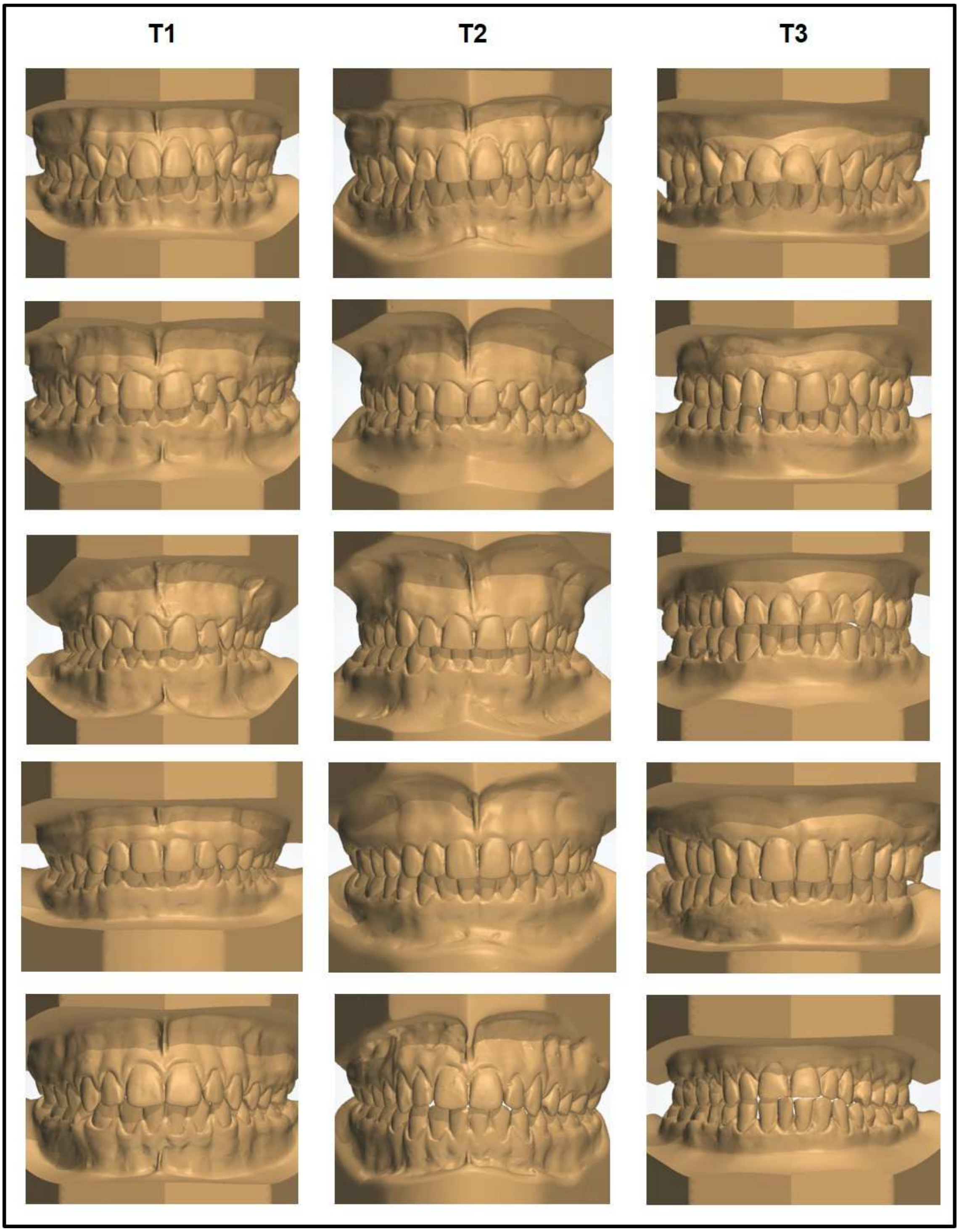

Fig. 7

TABLES

Table I: Age distributions, in years, at the three phases.

	T1 1967-1969	T2 1971-1974	T3 2015-2016	Difference (T2-T1)	Difference (T3-T2)	Difference (T3-T1)
Mean (range)	13.3 yrs (11.0 – 15.0)	17.8 yrs (16.0 – 22.0)	60.9 yrs (58.0 – 63.0)	4.3 yrs (4.0 – 4.8)	43.1 yrs (43.7 – 49.4)	47.5 yrs (44.9 – 49.4)
SD	0.9	1.3	1.0	0.3	1.2	1.0

Abbreviations: SD: standard deviation

Table II: Maxillary and mandibular missing teeth.

	Maxillary (n=64)							Mandibular (n=73)							Total	X	I	C
	Mx7	**Mx6**	**Mx5**	**Mx4**	**Mx3**	**Mx2**	**Mx1**	**Md1**	**Md2**	**Md3**	**Md4**	**Md5**	**Md6**	**Md7**	137	52	20	65
N	18	17	13	9	1	4	2	0	0	1	5	16	27	24				

Abbreviations: X=missing teeth, I=dental implants and C=prosthodontic crowns

Table III: Error study for all variables assessed with the Intraclass Correlation Coefficients (ICC) and the Bland-Altman limits of agreement (95% LoA).

Variables			1st measurement	2nd measurement	Difference	ICC	Bland-Altman 95% LoA	
			Mean (SD)	*Mean (SD)*	*Mean (SD)*		Lower	Upper
Mesiodistal tooth size	*Maxilla*	**7**	9.87 (0.53)	9.93 (0.50)	-0.05 (0.28)	0.85	-0.59	0.48
		6	10.15 (0.39)	10.25 (0.39)	-0.11 (0.13)	0.90	-0.37	0.16
		5	6.76 (0.31)	6.82 (0.40)	-0.06 (0.23)	0.78	-0.50	0.38
		4	6.92 (0.45)	7.03 (0.49)	-0.11 (0.21)	0.87	-0.52	0.31
		3	7.52 (0.37)	7.57 (0.41)	-0.05 (0.15)	0.92	-0.34	0.24
		2	6.34 (0.41)	6.49 (0.42)	-0.15 (0.20)	0.83	-0.54	0.23
		1	8.48 (0.49)	8.57 (0.54)	-0.09 (0.16)	0.93	-0.41	0.23
	Mandible	**7**	10.24 (0.61)	10.31 (0.54)	-0.06 (0.25)	0.90	-0.54	0.42
		6	10.46 (0.63)	10.57 (0.58)	-0.12 (0.17)	0.94	-0.46	0.23
		5	7.15 (0.40)	7.19 (0.42)	-0.03 (0.19)	0.89	-0.40	0.33
		4	6.92 (0.32)	7.01 (0.33)	-0.09 (0.18)	0.80	-0.45	0.27
		3	6.66 (0.40)	6.75 (0.36)	-0.09 (0.17)	0.87	-0.42	0.24
		2	5.84 (0.30)	5.90 (0.32)	-0.06 (0.14)	0.88	-0.34	0.21
		1	5.33 (0.35)	5.38 (0.34)	-0.05 (0.13)	0.91	-0.30	0.21
Clinical crown height	*Maxilla*	**7**	5.26 (1.57)	5.40 (1.48)	-0.14 (0.23)	0.98	-0.58	0.31
		6	5.79 (1.18)	5.80 (1.16)	-0.01 (0.20)	0.98	-0.39	0.37
		5	7.17 (1.40)	7.12 (1.40)	0.06 (0.21)	0.98	-0.35	0.46
		4	8.10 (1.14)	8.13 (1.12)	-0.04 (0.10)	0.99	-0.23	0.16
		3	9.47 (1.14)	9.49 (1.14)	-0.02 (0.13)	0.99	-0.28	0.24
		2	8.42 (0.97)	8.45 (0.98)	-0.03 (0.10)	0.99	-0.23	0.16
		1	9.93 (1.16)	9.98 (1.19)	-0.04 (0.07)	0.99	-0.18	0.10
	Mandible	**7**	5.26 (1.23)	5.39 (1.19)	-0.13 (0.36)	0.94	-0.84	0.59
		6	6.31 (0.94)	6.36 (0.93)	-0.05 (0.22)	0.97	-0.48	0.38
		5	7.15 (1.03)	7.19 (1.06)	-0.04 (0.12)	0.99	-0.27	0.19
		4	8.07 (0.83)	8.09 (0.82)	-0.02 (0.15)	0.98	-0.31	0.26
		3	9.39 (1.03)	9.40 (1.05)	-0.01 (0.11)	0.99	-0.23	0.21
		2	8.41 (1.06)	8.45 (1.05)	-0.04 (0.11)	0.99	-0.25	0.18
		1	8.18 (1.02)	8.24 (1.02)	-0.05 (0.11)	0.99	-0.27	0.17
Arch dimensions	*Maxilla*	3-3 width	33.26 (1.57)	33.21 (1.54)	0.05 (0.21)	0.99	-0.37	0.46
		4-4 width	41.14 (2.10)	41.04 (2.07)	0.09 (0.14)	0.99	-0.18	0.37
		5-5 width	47.32 (2.32)	47.27 (2.24)	0.06 (0.24)	0.99	-0.41	0.52
		6-6 width	52.47 (3.01)	52.51 (3.56)	-0.04 (1.28)	0.92	-2.55	2.48
		Arch length	26.39 (2,15)	25.59 (2.04)	-0.20 (0.40)	0.97	-0.99	0.59
		Arch perimeter	72.74 (3.68)	72.99 (3.55)	-0.25 (0.53)	0.98	-1.29	0.80
		Crowding	0.71 (1.08)	0.76 (1.13)	-0.05 (0.13)	0.99	-0.31	0.22
		Palatal Depth	18.01 (2.52)	18.25 (2.45)	-0.24 (0.37)	0.98	-0.97	0.48
	Mandible	3-3 width	25.44 (1.28)	25.49 (1.32)	-0.05 (0.22)	0.98	-0.47	0.38
		4-4 width	33.84 (1.91)	33.71 (1.94)	0.12 (0.30)	0.98	-0.46	0.71
		5-5 width	39.82 (2.11)	39.72 (2.01)	0.10 (0.34)	0.98	-0.56	0.76
		6-6 width	45.52 (3.11)	45.39 (3.23)	0.13 (0.33)	0.99	-0.51	0.76
		Arch length	22.82 (1.96)	23.03 (2.05)	-0.21 (0.52)	0.96	-1.23	0.81
		Arch perimeter	63.81 (3.53)	63.49 (3.51)	-0.18 (0.41)	0.99	-0.98	0.62
		Crowding	3.69 (2.48)	3.76 (2.47)	-0.07 (0.21)	0.99	-0.48	0.34
		Curve of Spee	1.61 (0.68)	1.64 (0.67)	-0.03 (0.34)	0.87	-0.69	0.63
Incisor relationship		Overjet	2.67 (1.08)	2.75 (1.03)	-0.07 (0.29)	0.95	-0.65	0.50
		Overbite	2.48 (1.23)	2.62 (1.34)	-0.14 (0.26)	0.97	-0.65	0.38

Abbreviations: *7: second molars, 6: first molars, 5: second premolars, 4: first premolars, 3: canines, 2: lateral incisors, 1: central incisors, 3-3: intercanines, 4-4: inter-first premolars, 5-5-: inter-second premolars and 6-6: intermolars.*

Table IV: Interphases comparisons for tooth measurements with dependent ANOVA and Tukey tests.

Variables		T1		T2		T3		P
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Mesiodistal tooth size								
Maxillary	**7**	10.01^{A}	0.48	9.95^{A}	0.47	9.54^{B}	0.43	<.001*
	6	10.15^{A}	0.39	10.04^{A}	0.36	9.73^{B}	0.43	<.001*
	5	6.91^{A}	0.40	6.79^{A}	0.37	6.44^{B}	0.35	<.001*
	4	7.07^{A}	0.37	6.97^{A}	0.43	6.71^{B}	0.41	<.001*
	3	7.71^{A}	0.40	7.68^{A}	0.40	7.34^{B}	0.43	<.001*
	2	6.51^{A}	0.42	6.47^{A}	0.42	6.29^{B}	0.35	<.001*
	1	8.41^{A}	0.46	8.33^{A}	0.48	8.09^{B}	0.51	<.001*
Mandibular	**7**	10.38^{A}	0.54	10.31^{A}	0.55	10.10^{B}	0.66	<.001*
	6	10.78^{A}	0.74	10.70^{A}	0.70	10.29^{B}	0.71	<.001*
	5	7.22^{A}	0.32	7.18^{A}	0.31	6.86^{B}	0.43	<.001*
	4	7.10^{A}	0.37	7.03^{A}	0.33	6.72^{B}	0.35	<.001*
	3	6.78^{A}	0.40	6.72^{A}	0.37	6.46^{B}	0.32	<.001*
	2	5.91^{A}	0.32	5.87^{A}	0.29	5.69^{B}	0.27	<.001*
	1	5.37^{A}	0.30	5.34^{A}	0.27	5.11^{B}	0.31	<.001*
Clinical crown height								
Maxillary	**7**	4.09^{A}	0.48	4.89^{B}	0.47	7.31^{C}	1.27	<.001*
	6	4.81^{A}	0.60	5.50^{B}	0.66	7.62^{C}	0.85	<.001*
	5	5.91^{A}	0.57	7.00^{B}	0.70	8.97^{C}	1.00	<.001*
	4	7.13^{A}	0.64	8.06^{B}	0.79	9.16^{C}	1.32	<.001*
	3	8.28^{A}	1.01	9.41^{B}	1.11	9.78^{B}	1.42	<.001*
	2	7.81^{A}	0.68	8.45^{B}	0.73	8.57^{B}	1.22	0.001*
	1	9.32^{A}	0.90	9.87^{B}	0.97	9.54^{AB}	1.33	0.027*
Mandibular	**7**	4.43^{A}	0.60	5.17^{A}	0.81	6.57^{B}	1.22	<.001*
	6	5.52^{A}	0.48	6.29^{B}	0.37	7.06^{C}	0.98	<.001*
	5	6.22^{A}	0.53	7.11^{B}	0.63	7.77^{C}	1.30	<.001*
	4	7.42^{A}	0.71	8.15^{B}	0.58	8.45^{B}	1.15	<.001*
	3	8.53^{A}	0.87	9.60^{B}	0.84	9.63^{B}	1.19	<.001*
	2	7.83^{A}	0.69	8.29^{AB}	0.67	8.38^{B}	1.28	0.016*
	1	8.00	0.64	8.19	0.73	7.98	1.20	0.502

Abbreviations: SD: standard deviation, 7: second molars, 6: first molars, 5: second premolars, 4: first premolars, 3: canines, 2: lateral incisors,1: central incisors

Different letters indicate statistically significant differences;

** Statistically significant at p<0.05.*

Table V: Interphase comparisons for arch dimensions, crowding and incisors relationship with dependent ANOVA and Tukey tests.

Variables	T1		T2		T3		p
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Maxilla							
6-6 width	52.42^{A}	3.93	52.34^{A}	3.19	52.84^{A}	3.20	0.759
5-5 width	47.47^{A}	2.47	47.46^{A}	2.13	47.48^{A}	2.58	0.998
4-4 width	41.45^{A}	2.16	41.14^{A}	1.99	40.82^{A}	1.93	0.232
3-3 width	33.21^{A}	2.12	33.47^{A}	1.90	33.06^{A}	2.15	0.300
Length	27.38^{A}	1.63	26.27^{B}	1.72	25.17^{C}	2.08	<.001*
Perimeter	74.45^{A}	3.26	73.34^{B}	3.34	70.70^{C}	3.30	<.001*
Anterior Crowding	0.37^{A}	0.74	0.67^{A}	1.08	1.49^{B}	1.30	<.001*
Palatal depth	16.92^{A}	1.93	18.66^{B}	2.24	19.23^{B}	2.56	<.001*
Mandible							
6-6 width	44.74^{A}	3.66	45.14^{A}	3.26	45.44^{A}	2.11	0.692
5-5 width	40.14^{A}	2.40	40.15^{A}	2.53	40.89^{A}	3.20	0.390
4-4 width	34.39^{A}	2.09	34.00^{A}	1.81	33.78^{A}	2.35	0.261
3-3 width	25.50^{A}	1.48	25.45^{A}	1.52	24.76^{B}	1.52	0.001*
Length	23.48^{A}	1.60	22.77^{A}	1.75	21.71^{B}	1.88	<.001*
Perimeter	64.99^{A}	3.52	63.99^{A}	2.83	62.14^{B}	3.12	<.001*
Anterior Crowding	2.26^{A}	1.96	3.13^{B}	2.20	4.67^{C}	2.52	<.001*
Curve of Spee	2.02^{A}	0.76	1.53^{B}	0.64	1.16^{B}	0.45	<.001*
Anterior relationship							
Overjet	2.81	0.66	2.36	0.72	2.75	1.19	0.071
Overbite	3.13^{A}	0.96	2.34^{B}	1.20	1.73^{C}	1.31	<.001*

Abreviations: 3-3: intercanines, 4-4: inter-first premolars, 5-5: inter-second premolars and 6-6: intermolars.
Different letters indicate statistically significant differences.
**Statistically significant at p<0.05.*

3 DISCUSSION

3 DISCUSSION

The present study recalled untreated subjects with a normal occlusion at early permanent dentition (T1) in their sixth or seventh decade of life (T3) aiming at evaluating time effects in their dental arches. All individuals had a third pair of dental casts, obtained at 17 years old (T2), to minimize the growth effects. Longitudinal follow-ups are a modality of study that provides a high level of scientific evidence. However, there are difficulties related to collecting longitudinal data, as previously reported, and shown in the present study (BISHARA; TREDER; JAKOBSEN, 1994; HARRIS, 1997; CARTER; MCNAMARA, 1998; BERG; STENVIK; ESPELAND, 2008; TSIOPAS et al., 2013).

Regarding the methodology, all variables were measured on digital models. Digital assessments have been widely used in Orthodontic researches, allowing measurements with high accuracy and reproducibility (ZILBERMAN; HUGGARE; PARIKAKIS, 2003; QUIMBY et al., 2004; COSTALOS et al., 2005; DALSTRA; MELSEN, 2009; LEIFERT et al., 2009; DOWLING et al., 2013). The error study showed an adequate intrarater reliability and confirmed the reproducibility of digital dental model measurements.

Important changes were observed from 13 to 60 years of age. The literature shows that the craniofacial skeleton continues to increase in size, even in the adulthood (BEHRENTS, 1984; BISHARA; TREDER; JAKOBSEN, 1994), and aging changes can affect the dental arches (BISHARA et al., 1989; BISHARA; TREDER; JAKOBSEN, 1994; BISHARA et al., 1996; BISHARA et al., 1997; CARTER; MCNAMARA, 1998). Therefore, current results corroborated previous studies showing that the human craniofacial skeleton and dental arches undergo visible changes as they grow, adapt and age. Most of the variables were influenced by the aging process, except for some arch width and overjet. Considering the total observational period, mesiodistal tooth size, lower intercanine width, arch length, arch perimeter, overbite and the curve of Spee decreased. On the other hand, clinical crown height, incisor crowding and palatal depth increased. Tooth wear, tooth eruption and gingival migration influenced the changes in tooth size (VAN DER LINDEN, 1978; LOE; ANERUD; BOYSEN, 1992; D'INCAU; COUTURE; MAUREILLE, 2012). Lower intercanine width, arch length and arch perimeter decreased from 13 to 60 years, but no more than 4 mm. Previous studies also observed a gradual reduction of arch dimensions with age (BISHARA et al., 1997, 1998; TIBANA; PALAGI; MIGUEL, 2004). Clinically, the reduction in the dental arches dimensions may be associated with mesiodistal tooth size reduction, posterior tooth mesial migration and a slight lingual inclination of the incisors which take place in time (DOWNS, 1938; BEGG, 1954; BEHRENTS, 1984; SOUTHARD; BEHRENTS; TOLLEY, 1990; VARRELA, 1990; TIBANA; PALAGI; MIGUEL, 2004; D'INCAU; COUTURE; MAUREILLE, 2012), resulting in an increase in maxillary and mandibular anterior crowding, as observed in the present study.

One limitation of this study was the tooth loss in the sample (72 teeth in 22 patients). Permanent tooth loss was more prevalent in the posterior region and in the mandibular arch. Previous study in Norwegian subjects found a mean tooth loss rate of 1.4 teeth in a normal occlusion sample at 65 years of age (BERG; STENVIK; ESPELAND, 2008). Usually, the generation of our sample shows a high rate of dental caries and tooth extraction because these individuals did not experience water fluoridation, fluoride dentifrices, changes in perception of oral health and oral hygiene, and a regular use of dental services and technologies (PETERSEN et al., 2004; PETERSEN; YAMAMOTO, 2005).

Significant changes were found in tooth and dental arch dimensions from 13 to 60 years of age. A 3x3 bar retainer can be indicated in normal occlusion in order to prevent the late mandibular incisor crowding in individuals with a high oral hygiene level. Further studies should analyze the skeletal and facial changes with aging in individuals with normal occlusion. It is also suggested that changes in normal occlusion individuals be compared with those of treated individuals. A 3D digital superimposition of the digital models would allow a clear and didactic view of the time effects in dental arches.

4 FINAL CONSIDERATIONS

4 FINAL CONSIDERATIONS

It is very important to understand what naturally occurs with tooth and dental arches with age, since the aging process may change or maintain the dental relationship. The long-term follow-up of individuals with normal occlusion showed significant dimensional changes from 13 to 60 years of age. Therefore, changes in tooth size, overbite and arch dimensions might be expected with aging, from adolescence to late adulthood.

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APPENDIX

APPENDIX A - Declaration of exclusive use of article on dissertation

DECLARATION OF EXCLUSIVE USE OF THE ARTICLE IN DISSERTATION

We hereby declare that we are aware of the article "MATURATIONAL CHANGES OF THE NORMAL OCCLUSION: A 40-YEAR FOLLOW-UP" will be included in the Dissertation of the student *Camila da Silveira Massaro* and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.

Bauru, 30 de novembro de 2016.

Camila da Silveira Massaro Author	Signature
Daniela Gamba Garib Carreira Author	Signature
Felicia Miranda Author	Signature
Guilherme Janson Author	Signature
Arnaldo Pinzan Author	Signature
Renato Rodrigues de Almeida Author	Signature
Décio Rodrigues Martins (*in memorian)* Author	

ANNEXES

ANNEX A – Ethics Committee approval, protocol number 43931915 4 0000 5417.

FACULDADE DE ODONTOLOGIA DE BAURU-USP

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação da maturação da oclusão normal e da oclusão tratada após 40 anos de acompanhamento

Pesquisador: Felicia Miranda

Área Temática:

Versão: 1

CAAE: 43931915.4.0000.5417

Instituição Proponente: Universidade de Sao Paulo

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.051.388

Data da Relatoria: 29/04/2015

Apresentação do Projeto:

O Projeto de pesquisa "Avaliação da maturação da oclusão normal e da oclusão tratada após 40 anos de acompanhamento" de autoria de Felícia Miranda e Camila da Silveira Massaro com orientação da Profa. Dra. Daniela Gamba Garib Carreira e do Professor Colaborador: Prof. Dr. Guilherme Janson O objetivo deste estudo será comparar as alterações maturacionais da oclusão normal e tratada, no período de 40 anos, por meio de mensurações dimensionais e referenciais qualitativos.

A amostra será selecionada a partir de um grupo de 82 pacientes brasileiros, de origem mediterrânea, que apresentavam oclusão normal, cujos modelos iniciais foram coletados na década de 70. As documentações ortodônticas presentes no Arquivo da Disciplina de Ortodontia da Faculdade de Odontologia de Bauru / USP serão analisados visando a obtenção de uma amostra composta de indivíduos de ambos os sexos. Para a coleta

dessa amostra, foi utilizado como critério de inclusão no grupo: a presença de um modelo de gesso inicial, dentadura permanente completa (todos os dentes em oclusão com exceção aos terceiros molares), presença de todos os dentes permanentes, presença de uma relação molar e relação canino de Classe I, ausência e/ou apinhamento suave, trespasse vertical e horizontal positivos (dentro dos parâmetros normais), e não tratados ortodonticamente. Durante os anos de

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ANNEX A – Ethics Committee approval, protocol number 43931915 4 0000 5417.

FACULDADE DE ODONTOLOGIA DE BAURU-USP

Plataforma Brasil

Continuação do Parecer: 1.051.388

2015 e 2016, esses pacientes serão recrutados para realização de modelos dentários. O grupo de oclusão tratada será selecionado também a partir do Arquivo da disciplina de Ortodontia da Faculdade de Odontologia de Bauru / USP. Serão selecionados indivíduos de ambos os sexos, que apresentaram uma relação molar de classe I e tenham sido tratados ortodonticamente sem a necessidade de extrações dentárias na década de 70. Esses pacientes serão convidados a participar da pesquisa e modelos de gesso serão tomados, aproximadamente 40 anos após o término do tratamento ortodôntico. Após a seleção de toda a amostra e obtenção dos modelos de gesso. A amostra será dividida em Grupo oclusão normal (ON) e Grupo oclusão tratada (OT). Os dois grupos serão divididos em 2 subgrupos, sendo eles: T1, referente aos modelos de gesso iniciais (década de 1970) e, T2, referente aos modelos de gesso recentes (2015 a 2016).
Os critérios de exclusão
utilizados para ambos os grupos será: qualquer procedimento ou tratamento ortodôntico realizado entre T1 e T2, perdas dentárias, reabilitações protéticas extensas ou doenças periodontais severas com migrações dentárias patológicas. Assim, o grupo ON será composto por 24 indivíduos pertencentes à amostra de oclusão normal da FOB-USP, com dentadura permanente completa, Classe I de Angle, sem apinhamento e perfil agradável. O grupo OT será composto por 24 pacientes pareados por sexo e idade com o grupo ON com má oclusão de Classe I e que foram tratados sem extrações dentárias na década de 70. Os modelos de gesso de T1 e T2 serão identificados e digitalizados por meio do scanner óptico
3Shape R700 3D (3Shape A/S, Copenhagem, Denmark). As imagens serão salvas e analisadas pelo software OrthoAnalyzerTM 3D (3Shape A/S, Copenhagen, Denmark). A análise constará de duas etapas. Na primeira etapa serão mensurados as seguintes variáveis em T1 e T2: trespasse horizontal e vertical, índice de irregularidade de Little, rotação de dentes posteriores, profundidade do palato, curva de Spee, comprimento, largura e perímetro dos arcos dentários. Na segunda etapa os modelos de T1 e T2 serão avaliados e comparados utilizando o Objective Gradind System do American Board of Orthodontics e As seis chaves da oclusão normal de Andrews. Adicionalmente, os modelos digitais obtidos em T1 e T2 serãosobrepostos para avaliação tridimensional das alterações dentárias e simetria das alterações em cada hemi-arco dentário. Para a análise estatística da primeira etapa serão calculados as médias e desvio-padrão das variáveis nos dois tempos de avaliação, em ambos os grupos de estudo. Asalterações interfases serão avaliadas por meio do teste t pareado e as comparações intergrupos e entre os sexos por meio do teste t independente.
Será adotado um nível de significância de 5%. E, para a segunda etapa, a comparação interfases

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ANNEX A – Ethics Committee approval, protocol number 43931915 4 0000 5417.

FACULDADE DE ODONTOLOGIA DE BAURU-USP

Continuação do Parecer: 1.051.388

será realizada pelo teste de Wilcoxon e acomparação intergrupos das alterações entre T1 e T2 será pelo teste de Mann-Whitney e Qui-quadrado, o nível de significância adotado será de 5%.

Objetivo da Pesquisa:

O objetivo deste trabalho será avaliar longitudinalmente a maturação da oclusão desde o período da adolescência até a quinta década de vida, por
meio de referenciais qualitativos e quantitativos.

Avaliação dos Riscos e Benefícios:

Riscos:
O procedimento de moldagem é bem estabelecido na ortodontia como uma ferramenta importante para o diagnóstico, plano de tratamento e
avaliação da finalização. Apesar desse procedimento fornecer um pequeno desconforto, sua realização é comum entre indivíduos que tenham sido
diagnosticados ou tratados ortodonticamente. O principal risco presente seria causado pela sensibilidade do indivíduo causando sensação de ânsia,
sendo facilmente controlado pelas orientações dadas pelo profissional no momento do procedimento.
Benefícios:
Os resultados desse estudo contribuirão para elucidar as alterações no posicionamento dentário e formato do arco produzida pela natureza em
longo prazo em oclusões funcionalmente normais e poderão influenciar o planejamento e metas terapêuticas do tratamento ortodôntico em pacientes
adultos

Comentários e Considerações sobre a Pesquisa:

Trata-se de um estudo observacional, longitudinal e prospectivo (Coorte).
Trabalha-se com a hipótese nula de que não existem diferenças nas mudanças maturacionais ocorridas na oclusão normal natural e na oclusão tratada.

Considerações sobre os Termos de apresentação obrigatória:

Toda documentação necessária foi apresentada.

Recomendações:

Não se aplica

Conclusões ou Pendências e Lista de Inadequações:

Não há.

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ANNEX A – Ethics Committee approval, protocol number 43931915 4 0000 5417.

FACULDADE DE ODONTOLOGIA DE BAURU-USP

Plataforma Brasil

Continuação do Parecer: 1.051.388

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

Considerações Finais a critério do CEP:

Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 29.4.2015, 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.

BAURU, 06 de Maio de 2015

Assinado por:
Izabel Regina Fischer Rubira Bullen
(Coordenador)

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ANNEX A – Ethics Committee approval (research team).

MINISTÉRIO DA SAÚDE - Conselho Nacional de Saúde - Comissão Nacional de Ética em Pesquisa – CONEP

PROJETO DE PESQUISA ENVOLVENDO SERES HUMANOS

Projeto de Pesquisa: Avaliação da maturação da oclusão normal e da oclusão tratada após 40 anos de acompanhamento

Informações Preliminares

Responsável Principal

CPF: 39386021803	Nome: Felicia Miranda
Telefone: (14) 3231-1173	E-mail: felicia.miranda@usp.br

Instituição Proponente

CNPJ: 63.025.530/0029-05	Nome da Instituição: Universidade de Sao Paulo

É um estudo internacional? Não

■ **Assistentes**

CPF	Nome
368.046.548-38	Camila da Silveira Massaro

■ **Equipe de Pesquisa**

CPF	Nome
36804654838	Camila da Silveira Massaro
18092278873	DANIELA GAMBA GARIB CARREIRA

ANNEX B – Informed consent.

Universidade de São Paulo
Faculdade de Odontologia de Bauru

Departamento de Odontopediatria, Ortodontia e Saúde Coletiva

Disciplina de Ortodontia

Termo de Consentimento Livre e Esclarecido

Você está sendo convidado a participar como voluntário da pesquisa:

"Avaliação da maturação da oclusão normal e da oclusão tratada após 40 anos de acompanhamento", cujos objetivos e justificativas são comparar as alterações maturacionais da oclusão normal natural e oclusão tratada com aparelho ortodôntico em um período de 40 anos por meio de modelos dentários e fotografias.

Para tanto, será necessário realizar um procedimento de moldagem, o qual resultará na obtenção de modelos de estudos que serão utilizados para avaliar aspectos do amadurecimento da oclusão.Além disso, serão realizadas fotografias intrabucais (frente e lateral do sorriso) e extrabucais (frente e lateral da face),para complementar a avaliação acima descrita e será solicitado que você responda um breve questionário em relação à satisfação com seu sorriso de maneira geral.Todos os voluntários serão submetidos aos mesmos procedimentos, independente do grupo ao qual pertencerá (com ou sem tratamento ortodôntico prévio). Os modelos e fotografias obtidos serão comparados com sua documentação ortodôntica da década de 70 arquivada no Departamento da Disciplina de Ortodontia da Faculdade de Odontologia de Bauru, USP.

Sobre os procedimentos, o questionário é de resolução simples e terá uma duração aproximada de cinco minutos. Fotografias e moldagens são procedimentos rápidos efazem parte da rotina odontológica. O procedimento de moldagem apresenta como risco o desconforto, que pode ocorrer devido a sensação de ânsia. Você receberá orientações específicas para não sentir ânsia durante a moldagem e se mesmo assim acontecer, as profissionais saberão como aliviar seu desconforto imediatamente, inclusive interrompendo o procedimento se necessário. Em relação as fotografias, as mesmas serão utilizadas neste trabalho respeitando a sua privacidade. É importante que você saiba que sua privacidade será respeitada, ou seja, seu nome ou qualquer outro dado que possa, de qualquer forma, identificá-lo, será mantido em sigilo.

A consulta será realizada por duas cirurgiãs-dentistas com formação em Ortodontia que irão orientá-lo (a) sobre cuidados gerais com a saúde bucal, com o benefício de orientá-los quanto a necessidade de qualquer tipo de tratamento odontológico que se faça necessário e, estarão à disposição para eventuais questionamentos. Não será oferecida remuneração, auxílio para alimentação ou transporte até o local no dia do atendimento. É garantido a indenização em casos de danos que ocorram decorrentes dos procedimentos empregados nesta pesquisa. Você poderá deixar de participar da pesquisa a qualquer momento sem sofrer prejuízos, retirando, então, seu consentimento, sem precisar justificar

As **pesquisadoras** envolvidas com o referido projeto são*Felicia Miranda* e *Camila da Silveira Massaro* e com elas você poderá manter contato via**e-mail**: felicia.miranda@usp.br (Drª Felicia) / camilamassaro@usp.br (Drª Camila) ou **telefone**: (14) 98173 1239 (Drª Felicia) / (14) 99715 6465 (Drª Camila).

É assegurado o esclarecimento de dúvidas durante toda pesquisa, bem como será garantido o livre acesso a todas as informações e esclarecimentos adicionais sobre o estudo.

Por estarmos de acordo com o presente termo o firmamos em duas vias igualmente válidas (uma via para o participante da pesquisa e outra para o pesquisador) que serão rubricadas em todas as suas páginas e assinadas ao seu término, conforme o disposto pela Resolução CNS nº 466 de 2012, itens IV.3.f e IV.5.d.

RUBRICA (paciente):

RUBRICA (pesquisadoras):

Pagina 1 de 2

ANNEX B – Informed consent.

Universidade de São Paulo
Faculdade de Odontologia de Bauru

DepartamentoOdontopediatria, Ortodontia e Saúde Coletiva

Disciplina de Ortodontia

Pelo presente instrumento que atende às exigências legais, o Sr. (a) ____, portador da cédula de identidade ____________________, após leitura minuciosa das informações constantes neste TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO, devidamente explicada pelos profissionais em seus mínimos detalhes, ciente dos serviços e procedimentos aos quais será submetido, não restando quaisquer dúvidas a respeito do lido e explicado, DECLARA e FIRMA seu CONSENTIMENTO LIVRE E ESCLARECIDO concordando em participar da pesquisa proposta. Fica claro que o participante da pesquisa, pode a qualquer momento retirar seu CONSENTIMENTO LIVRE E ESCLARECIDO e deixar de participar desta pesquisa e ciente de que todas as informações prestadas tornar-se-ão confidenciais e guardadas por força de sigilo profissional (Art 9° do Código de Ética Odontológica).

Por fim, como pesquisador(a) responsável pela pesquisa, DECLARO o cumprimento do disposto na Resolução CNS n° 466 de 2012, contidos nos itens IV.3 e IV.5.a e, na íntegra com a resolução CNS n° 466 de dezembro de 2012.

Por estarmos de acordo com o presente termo o firmamos em duas vias igualmente válidas (uma via para o participante da pesquisa e outra para o pesquisador) que serão rubricadas em todas as suas páginas e assinadas ao seu término, conforme o disposto pela Resolução CNS n° 466 de 2012, itens IV.3.f e IV.5.d.

Bauru, ____ de _____________ de _______ .

____
Assinatura do Sujeito da Pesquisa

____
Felicia Miranda
Pesquisadora responsável
(felicia.miranda@usp.br / (14) 98173 1239)

____
Camila da Silveira Massaro
Pesquisadora responsável
(camilamassaro@usp.br / (14) 99715 6465)

O Comitê de Ética em Pesquisa – CEP, organizado e criado pela **FOB-USP**, em 29/06/98 (**Portaria GD/0698/FOB**), previsto no item VII da Resolução n° 466/12 do Conselho Nacional de Saúde do Ministério da Saúde (publicada no DOU de 13/06/2013), é um Colegiado interdisciplinar e independente, de relevância pública, de caráter consultivo, deliberativo e educativo, criado para defender os interesses dos participantes da pesquisa em sua integridade e dignidade e para contribuir no desenvolvimento da pesquisa dentro de padrões éticos.

Qualquer denúncia e/ou reclamação sobre sua participação na pesquisa poderá ser reportada a este CEP:

Horário e local de funcionamento:
Comitê de Ética em Pesquisa
Faculdade de Odontologia de Bauru-USP - Prédio da Pós-Graduação (bloco E - pavimento superior), de segunda à sexta-feira, no horário das **13h30 às 17 horas**, em dias úteis.
Alameda Dr. Octávio Pinheiro Brisolla, 9-75
Vila Universitária – Bauru – SP – CEP 17012-901
Telefone/FAX(14)3235-8356
e-mail: cep@fob.usp.br

RUBRICA (paciente):

RUBRICA (pesquisadoras):

Pagina 2 de 2