UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

LOUISE RESTI CALIL

Long-term periodontal status of maxillary central incisors after orthodontic traction: CBCT and clinical findings

Condição periodontal em longo prazo de incisivos centrais superiores após o tracionamento ortodôntico: TCFC e achados clínicos

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FOLHA DE APROVAÇÃO

"Muitas vezes, as pessoas são egocêntricas, ilógicas e insensatas.
Perdoe-as assim mesmo!

Se você é gentil, podem acusá-lo de interesseiro.
Seja gentil assim mesmo!

Se você é um vencedor, terá alguns falsos amigos e alguns inimigos verdadeiros.
Vença assim mesmo!

Se você é bondoso e franco, poderão enganá-lo.
Seja bondoso e franco assim mesmo!

O que você levou anos para construir, alguém pode destruir de uma hora para a outra. ***Construa assim mesmo!***

Se você tem paz e é feliz, poderão sentir inveja.
Seja feliz assim mesmo!

O bem que você faz hoje, poderão esquecê-lo amanhã.
Faça o bem assim mesmo!

Dê ao mundo o melhor de você, mas isso pode nunca ser o bastante.
Dê o melhor de você assim mesmo!

Veja você que, no final das contas, é entre ***você e Deus.*** *Nunca foi entre você e os outros."*

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cumplicidade e bondade que procuro seguir sempre.

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cuidando sempre de mim.

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"Cada pessoa que passa em nossa vida passa sozinha e não nos deixa só
Porque deixa um pouco de si e leva um pouquinho de nós.
Essa é a mais bela responsabilidade da vida
E a prova de que as pessoas não se encontram por acaso."
Charles Chaplin

Abstract

ABSTRACT

Long-term periodontal status of maxillary central incisors after orthodontic traction: CBCT and clinical findings

Purpose: The aim of this study was to evaluate the buccal and lingual alveolar bone morphology and the periodontal clinical condition of impacted permanent maxillary central incisors at least 6 months after the orthodontic traction. **Methods:** This split mouth transversal study evaluated a sample of 11 patients a mean of 15.41 years after the orthodontic traction of unilateral impacted maxillary central incisor. The experimental group (TR) consisted of 11 impacted central incisors. The comparison group (NTR) consisted of 11 non-impacted contralateral teeth. High-resolution CBCT exams of central incisors were performed using Accuitomo (J. Morita, Kyoto, Japan). Cross section imagens passing through the center of maxillary central incisors were used to measure buccal and lingual alveolar bone level. Presence of fenestration, root dilacerations, root coverage, and position of the root apex were also assessed in the same images. Clinical parameters included the periodontal probing depth, attachment level, gingival bleeding index, plaque index, degree of gingival recession, amount of gingival mucosa and evaluation of interproximal papilla and black triangle. Digital model analysis included an assessment of clinical crown height and width. Intergroup comparisons were performed using paired t tests, McNemar and Wilcoxon tests ($p<0.05$). Pearson correlation coefficient was calculated to determine the relationship between the clinical and CBCT findings. **Results:** TR group showed a significantly thinner buccal bone plate thickness at the middle and apical root level compared to NTR group. A decreased buccal alveolar crest level was observed in TR group in comparison to NTR group. The TR group showed a greater frequency of buccal bone dehicences and root dilacerations than antimeres. Experimental group showed more gingival recession, a decreased amount of gingival mucosa and an increased clinical attachment level at the buccal aspect than the NTR group. Moderate inverse correlation was found between buccal bone plate thickness of central incisors and attachment level and moderate positive correlation was found between buccal alveolar crest height and attachment level **Conclusions:** The periodontal conditions of maxillary central incisors long-term after orthodontic traction are different compared to its antimere. A decreased thickness and height of buccal alveolar bone and gingival recessions were observed in central incisors 15 years after orthodontic traction.

Key-words: Tooth Impacted. Incisor. Tomography X-Ray Computed. Traction. Periodontium.

Resumo

RESUMO

Condição periodontal em longo prazo de incisivos centrais superiores após o tracionamento ortodôntico: TCFC e achados clínicos

Introdução: o objetivo deste estudo foi avaliar a morfologia óssea alveolar vestibular e lingual e a condição clínica periodontal de incisivos centrais superiores impactados há, pelo menos, 6 meses após o tracionamento ortodôntico. **Material e Métodos:** Este estudo transversal de boca dividida avaliou uma amostra de 11 pacientes com média de 15,41 anos após a mecânica de tração ortodôntica de incisivo central superior retido unilateral. O grupo experimental (TR) foi composto por 11 incisivos centrais retidos. O grupo controle (NTR) foi composto por 11 incisivos contralaterais irrompidos naturalmente. Exames de TCFC de alta resolução dos incisivos centrais foram realizados utilizando o Accuitomo (J. Morita, Kyoto, Japão). As imagens transversais que passaram pelo centro dos incisivos centrais superiores foram utilizadas para medir o nível ósseo alveolar vestibular e lingual. A presença de fenestração, dilaceração, recobrimento radicular e posição do ápice radicular também foram avaliados nas mesmas imagens. Os parâmetros clínicos incluíram profundidade de sondagem periodontal, nível de inserção clínico, índice de sangramento gengival, índice de placa, grau de recessão gengival, quantidade de mucosa queratinizada e avaliação da presença de triângulo negro na papila interproximal. A análise de modelo digital consistiu da avaliação da altura e largura da coroa clínica. As comparações intergrupos foram realizadas utilizando os testes de t pareado, McNemar e Wilcoxon ($p<0,05$). O coeficiente de correlação de Pearson foi calculado para determinar a relação entre os achados clínicos e TCFC. **Resultados:** o grupo TR apresentou uma espessura da tábua óssea vestibular significantemente mais fina em nível médio e apical da raiz, em comparação ao grupo NTR. Observou-se uma diminuição do nível da crista alveolar vestibular no grupo TR em comparação ao grupo NTR. O grupo TR mostrou uma maior frequência de deiscência óssea vestibular e dilaceração radicular quando comparado aos contralaterais. O grupo experimental revelou maior recessão gengival, diminuição da quantidade de mucosa gengival e maior do nível de inserção clínico na face vestibular, em comparação ao grupo NTR. Verificou-se uma correlação inversa entre a espessura da tábua óssea vestibular dos incisivos centrais e o nível de inserção clínico e uma positiva correlação entre a altura da crista alveolar vestibular e o nível de inserção, ambas moderadas. **Conclusões:** As condições periodontais dos incisivos centrais superiores em longo prazo após o tracionamento ortodôntico são diferentes em comparação aos contralaterais. Uma menor espessura e altura óssea alveolar vestibular, bem como presença de recessões gengivais foram observadas nos incisivos centrais 15 anos após o tracionamento ortodôntico.

Palavras-chave: Dente impactado. Incisivo. Tomografia Computadorizada por Raios X. Tração. Periodonto.

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1 INTRODUCTION

Impaction of maxillary permanent incisors has been found in the range of 0.2-1% of the population (KUROL, 2002). The early referral of patients in the mixed dentition is common due to concern of parents and general dentists regarding delayed eruption of the permanent maxillary central incisors (BECKER et al., 2002; KOLOKITHA; PAPADOPOULOU, 2008). Most of the retained teeth is discovered in a routine examination, initially suggested by the clinical absence related to the delay in relation to the expected eruption in dental age (LOCKS et al., 2000; TOVO et al., 2007; TANAKA et al., 2008). Impaction is twice as common in females, frequently in the maxillary than in the mandibular arch (ERICSON; KUROL, 1988) and can occur with any teeth. The most affected are the third molars, upper canines, second premolars, upper central incisors, second molars, lateral incisors and first premolars, in this order (AITASALO; LEHTINEN; OKSALA, 1972; THILANDER; MYRBERG, 1973; TOVO et al., 2007). Despite the impaction of maxillary central incisor is quite an infrequent finding in dental practice, its treatment is challenging (SHETTY et al., 2011). Early interception is required not only because of the potential to interfere with the occlusion of the surrounding teeth, but also because of its important to facial esthetic and psychosocial impact that entails (SILVA FILHO OG, 1997).

Although orthodontists focus on the issues of occlusion, mastication and phonation in defining the need for orthodontic treatment, patients seeking orthodontic treatment have esthetic needs (KLAGES et al., 2006). In adolescents and young adults, self-esteem seems to be very influenced by the psychosocial impacts of self-perception of dental esthetics (GOLDSTEIN, 1969; BADRAN, 2010). Correct smile imperfections, even in young children, can be remarkable in preventing bullying and improving quality of social interactions with other children, preserving the healthy psychological development (AL-BITAR et al., 2013). In addition, early treatment can promote root development to achieve a better morphology of the root apex, and can reduce the risk of loss of buccal bone (SUN et al., 2016). Therefore, in order to compose the harmony of smile due to the strong impact of clinical absence of permanent incisors on esthetics, it is wise to consider the conduct of immediate treatment (SILVA FILHO OG, 1997).

Although the tractions are a recognized way of treatment, few studies have assessed the prognosis of maxillary central incisors, as well as their changes in clinical periodontal parameters. To our knowledge, no previously published study has compared the implication in the long term more than a decade posttreatment of impacted central maxillary incisors. The aim of this split mouth transversal study was to evaluate the buccal and lingual alveolar bone morphology and the periodontal clinical condition of impacted permanent maxillary central incisors 15 years after the orthodontic traction.

2 Articles

2 ARTICLES

- **ARTICLE 1 - Long-term periodontal status of maxillary central incisors after orthodontic traction: CBCT and clinical findings**

- **ARTICLE 2 - Is there a consensus for CBCT use in Orthodontics?**

2.1 ARTICLE 1

Abstract

Long-term periodontal status of maxillary central incisors after orthodontic traction: CBCT and clinical findings

Purpose: The aim of this study was to evaluate the buccal and lingual alveolar bone morphology and the periodontal clinical condition of impacted permanent maxillary central incisors at least 6 months after the orthodontic traction. **Methods:** This split mouth transversal study evaluated a sample of 11 patients a mean of 15.41 years after the orthodontic traction of unilateral impacted maxillary central incisor. The experimental group (TR) consisted of 11 impacted central incisors. The comparison group (NTR) consisted of 11 non-impacted contralateral teeth. High-resolution CBCT exams of central incisors were performed using Accuitomo (J. Morita, Kyoto, Japan). Cross section imagens passing through the center of maxillary central incisors were used to measure buccal and lingual alveolar bone level. Presence of fenestration, root dilacerations, root coverage, and position of the root apex were also assessed in the same images. Clinical parameters included the periodontal probing depth, attachment level, gingival bleeding index, plaque index, degree of gingival recession, amount of gingival mucosa and evaluation of interproximal papilla and black triangle. Digital model analysis included an assessment of clinical crown height and width. Intergroup comparisons were performed using paired t tests, McNemar and Wilcoxon tests ($p<0.05$). Pearson correlation coefficient was calculated to determine the relationship between the clinical and CBCT findings. **Results:** TR group showed a significantly thinner buccal bone plate thickness at the middle and apical root level compared to NTR group. A decreased buccal alveolar crest level was observed in TR group in comparison to NTR group. The TR group showed a greater frequency of buccal bone dehicences and root dilacerations than antimeres. Experimental group showed more gingival recession, a decreased amount of gingival mucosa and an increased clinical attachment level at the buccal aspect than the NTR group. Moderate inverse correlation was found between buccal bone plate thickness of central incisors and attachment level and moderate positive correlation was found between buccal alveolar crest height and attachment level **Conclusions:** The periodontal conditions of maxillary central incisors long-term after orthodontic traction are different compared to its antimere. A decreased thickness and height of buccal alveolar bone and gingival recessions were observed in central incisors 15 years after orthodontic traction.

Key-words: Tooth Impacted. Incisor. Tomography X-Ray Computed. Traction. Periodontium.

INTRODUCTION

Failure of eruption of permanent maxillary incisors is a rare observation in dental practice[1] and this pathologic condition of the early mixed dentition phase occurs in the range of 0.2-1% of the population.[2] Most of the retained teeth is discovered in a routine examination, due the eruption delay.[3] The etiology of retained maxillary central incisors can be divided into 2 main groups: obstructive and traumatic causes.[4-7] The treatment options may include a broad range of options including passive observation, surgical exposure and traction, and tooth extraction followed by prosthesis or lateral incisor substitution.[5,8,9]

The traction option requires a combination of surgical exposure, attachment placement, and orthodontic movement,[5,6,10] which might cause damage to the supporting structures and to the teeth.[7,11-14] The presence of gingival recession together with an increased clinical crown height was often observed after incisor traction.[8] The surgical approach of maxillary incisors can be carried out by an open or a closed surgical technique.[11] Many studies have demonstrated that the closed eruption technique showed a better periodontal outcome[7,15-18] The most frequent periodontal outcome after incisor traction include gingival irregularity,[5,11,19,20] longer clinical crown,[8] decreased bone support[5,11,21,22] and loss of attachment[5] and derived from clinical and radiographic investigations.

Three previous studies used CBCT to evaluate maxillary central incisors after orthodontic traction Shi et al.[22] evaluated root and alveolar bone development in impacted immature maxillary central incisors by CBCT before and after closed-eruption treatment. The roots were in different stages of root development at the beginning of the treatment, and were compared with an immature contralateral maxillary central incisor already erupted but not necessarily reaching the occlusal plane. The results showed that impacted immature incisors grew to the same stage as did erupted contralateral incisors after treatment and both incisor types had some alveolar bone loss, and thin alveolar bone surrounded the roots. The pulp of impacted and contralateral incisors was still alive. Sun et al.[23] evaluated the timing of treatment for the labial inversely impacted maxillary central incisors, according to their dental age. All the patients were treated with a combination of surgery and orthodontic traction. Using the CBCT analysis taked immediately after treatment, the study suggested that the impacted teeth should be treated early in consideration of its particular location and morphology that early treatment may promote root development to achieve a better morphology of root apex and may reduce the risk of alveolar bone loss on the labial side. Recently, Hu et al.[24] presented an analysis the development and stability of roots and alveolar bone in orthodontically treated labial inversely impacted maxillary central incisors by CBCT images at the completion of treatment and the long-term follow-up. Both groups had similar growth in the follow-up period. The treated labial inversely impacted central incisors had continuous and similar growth as did the mature contralateral incisors in the follow-up period. The roots had an increase in length and a change in direction of the apex, with a relatively stable condition of the surrounding alveolar bone. Neither the labial inversely impacted maxillary central incisors nor the contralateral incisors had further alveolar bone loss.

There is a lack of evidence-based information about the long-term periodontal status of maxillary incisor after traction using CBCT. Additionally, no previous study performed a correlation between CBCT and clinical parameter long-term after incisor traction. Therefore, the aim of this study was to evaluate the buccal and lingual alveolar bone morphology and the periodontal clinical condition of impacted permanent maxillary central incisors at least 6 months after the orthodontic traction, correlating both parameters. The null hypothesis was that no periodontal differences are observed for maxillary central incisors after traction compared to its antimere.

MATERIALS AND METHODS

Study population

Approval was obtained from the Ethical Committee of Bauru Dental School, University of São Paulo (protocol number 1.567.356) and informed consent was obtained. Considering an alpha of 5%, to detect a minimum difference of 1mm in vertical alveolar bone loss, with our SD of 1.22mm and a sample size of 11 patients, the statistical test power was 84%. This was a split-mouth transversal study. Orthodontic records of approximately 1,340 patients in the mixed dentition treated at the Orthodontic department of Bauru Dental School, University of São Paulo, and at Profis (Society for the Social Promotion of Cleft Lip and Palate Patients) were evaluated before patient recruitment.

The inclusion criteria for enrollment were: 1. Presence of unilateral impacted maxillary central incisors with both obstructive or traumatic etiologies; 2. Impacted incisor successful tractioned at the mixed or permanent dentition; 3. Completion of orthodontic treatment occurring at least 06 months before recruitment. The exclusion criteria were: 1. Presence of craniofacial anomalies; 2. Periodontal disease.

Eighteen patients were found. One patient was died, three other refuse to participate and three were not found. The final sample included 11 patients (5 females, 6 males) with a mean age of 28.6 years (SD=9.32). The mean time elapsed from the removal of the full fixed appliance to the recruitment was 15.41 years (SD=9.48). Two groups were analyzed. The experimental group (TR) consisted of 11 impacted central incisors. The comparison group (NTR) consisted of 11 non-impacted contralateral teeth. Table I describe the initial position of impacted maxillary central incisors in the sample.

All of the patients were treated with the closed eruption technique. A flap was created to expose the surface of the crown of the impacted tooth, a button was attached with a 0.010-inch ligature wire on it. The flap was reclosed and sutured, leaving a tied ligature wire with a hook end protruding through the mucosa.

The duration of the orthodontic traction time, calculated as the time between the application of the power and the date of the bonding bracket of the impacted incisor in the dental arch, was 6.1 months. Different traction modalities were employed. Seven patients used removable appliances with spring coils; one patient received the orthodontic traction associated with the maxillary expansion, with the use of a spring coil incorporated in the Haas expander, and; three patients underwent the traditional orthodontic technique with fixed appliance. A light force was applied by an elastomeric chain. As the impacted tooth moved downward, the wire was cut shorter to maintain the elastomeric chain effective. The same procedure of elastic traction continued until the impacted tooth became exposed to the oral cavity. The attached button was then removed and a standard incisor bracket was bonded. The final alignment was completed with 4x2 or comprehensive fixed appliance.

CBCT analyses

High-resolution CBCT exams were performed using the 3D Accuitomo (J. Morita, Kyoto, Japan) with a FOV of 60x60mm and a voxel size of 0.080mm. During the exam, patients were positioned with the Frankfort plane parallel and the sagittal plane perpendicular to the floor. The DICOM files were imported into Nemoscan software (Nemotec, Madrid, Spain). Before analysis in both group, image position was standardized using multiplanar reconstruction by maintaining the long axis of the central incisor coincident with the vertical plane in the frontal and sagittal sections. In the axial section, a line passing through the center of both maxillary central incisor canals was maintained in the horizontal plane.

Buccal and lingual bone plate thickness (BBT and LBT) were measured on two axial sections passing between the cervical and middle thirds and between the middle and apical third root (Fig. 1).

Buccal and lingual alveolar crest height was measured on cross section passing through the center of the root canal of each central incisor. The distance between cementoenamel junction and alveolar bone crest was measured on the buccal and lingual aspects (Fig. 2).

Using the same cross section, the following parameters were also analyzed: presence or absence of buccal bone fenestration; subjective evaluation of the percentage of the root coverage (0%, 25%, 50%, 75% e 100%), at the buccal and lingual side; presence or absence of root dilacerations; and position of the root apex by dividing the alveolar ridge in three thirds in the horizontal plane. Incisor root apex position was assigned as centered (C), buccally (B) or lingually (L) displaced.

Clinical measurements

In both groups, the periodontal clinical examination was clinically performed using a periodontal probe of Williams (Hu-friedy, USA). Gingival recession (GR), probing depth (PD), clinical attachment level (CAL), gingival bleeding index (B), plaque index (P), amount of gingival mucosa (GM) and presence of interdental black triangles (BT) were recorded.[25]

All periodontal clinical measurements were performed at six sites of the tooth (mesial, center and distal, both at the buccal and lingual surfaces). The identification of the mucogingival junction was facilitated by staining with Schiller's IKI solution.[26]

For the evaluation of plaque index (P), all teeth were air-dried, examined with the green malachite solution at 2% and recorded for 6 above mentioned regions of each central incisor. The presence or absence of plaque was evaluated in a binomial pattern in which the visible plaque received grade 1 and the absence of plaque received degree “0”.

Presence of interdental black triangles (BT) on the mesial or distal aspects of each maxillary incisor was investigated.

Digital Models

Conventional dental models were obtained after clinical evaluation. The dental models were digitalized using the 3Shape R700 3D scanner (3Shape A/S, Copenhagen, Denmark). Using the software OrthoAnalyzerTM 3D (3Shape A/S, Copenhagen, Denmark), clinical tooth crown height and width of both central incisors were measured.[27]

Error study

Thirty percent of the sample was measured twice by the same examiner (LRC), with at least one month-interval. Random and systematic errors were calculated comparing the first and second measurement with Dahlberg's formula and paired t-test, respectively, at a significance level of 5%.

Statistical Analyses

Kolmogorov-Smirnov tests showed normal distribution of the variables.

Intergroup comparisons were performed using paired t test, McNemar test and Wilcoxon test. Pearson correlation coefficient was calculated to determine the relationship between the clinical and CBCT findings. Results were considered significant at $p<0.05$. The statistical analyses were performed with SPSS software (version 10.0; Statisoft, Tulsa, Okla).

RESULTS

The random error for the CBCT and digital dental model variables varied from 0.23 (lingual bone plate thickness, in the apical third) to 0.35mm (buccal alveolar crest height), and no significant systematic errors was found.

The TR group showed significantly thinner buccal bone plate in the middle and apical root levels (Table II). The experimental group also showed a decreased buccal alveolar crest height compared to its antimere (Table II). On the buccal aspect, the TR group showed a greater gingival recession, a decreased amount of gingival mucosa and an apically displaced attachment level compared to NTR group (Table II).

The experimental group showed an increase frequency of root dilacerations and smaller root coverage on the buccal aspect compared to NTR group (Table III). Black triangles were not found in both groups (Table III).

Moderate inverse correlation was found between buccal bone plate thickness of central incisors and attachment level (Table IV). Moderate positive correlation was found between buccal alveolar crest height and attachment level (Table IV). Weak significant correlations were not considered clinically relevant (Table IV).

DISCUSSION

This is the first study to analyze the periodontal status of impacted maxillary incisors more than one decade after treatment and also correlate CBCT and clinical findings. Most previous article on impacted maxillary incisors was clinical reports, clinical periodontal evaluations or bidimensional assessments. Only three recent studies evaluated treatment of maxillary impacted incisor by means of tridimensional images[22-24] and maximum posttreatment evaluation was two years [24].

Computed tomography is the only current imaging method that permits the visualization of buccal/labial and lingual bone plates.[28] With high image definition and high sensitivity CBCT images can reveal bone dehiscences and fenestrations.[29-32] Accuitomo system (J. Morita, Kyoto, Japan) can depicte small anatomical structures[33] due to high image definition. The good quality image of this system is related to the smaller voxel size and smaller field of view compared with other CBCT machines.[33] The CBCT high definition contributed to small study error observed in this study. The variability in the initial position of impacted incisors is a limitation of our study. Three previous CBCT studies collected a homogeneous sample with labial inverted impacted maxillary incisors. However, the long-term nature of our study restrict exclusion due initial incisor position.

In our study, the TR group showed a greater frequency of root dilacerations than antimeres (Table III). These findings are explained by most of the 11 cases showing trauma as the main etiological factor of incisor impaction (Table I). Previous studies analyzing labial inverted impacted maxillary central incisor presents dilacerations found similar results[23,22] Although root dilacerations were present, most of the root apex were centralized in the alveolar ridge (Table III). Previous studies showed that when impacted central incisors with root dilacerations are treated early, root continue to develop and dilaceration severity decreases.[22, 23]

Previous studies showed that impacted maxillary incisors show reduced buccal bone cover after treatment. Hu et al. showed that the buccal bone loss is discontinued after treatment maintaining similar bone crest level two years after treatment. Previous authors has speculated if buccal alveolar crest could regenerate in the long-term[34] Our results showed that buccal bone loss could not recover 15 years after treatment. TR group showed both thinner buccal alveolar bone and greater buccal bone dehicences compared to spontaneously erupted contralateral incisors (Table II). On the other hand, lingual alveolar bone was similar in TR and NTR groups (Table II) in accordance to previous studies.[22-24] Buccal bone loss is a common complication of orthodontic traction as demonstrated in previous studies using high-resolution CBCT.[22,23]

A 2-mm distance from the cement-enamel junction to the alveolar crest is considered normal.[23,35,36] Many factors can explain the buccal bone loss observed after traction, such as the initial position of the impacted tooth.[37] The factors that predispose to the occurrence of bone dehiscences and fenestrations may include developmental anomalies, frenulum and bridles, orthodontic movements, periodontal and / or endodontic diseases, occlusal trauma, size, shape and positioning of teeth and the periodontal biotype.[44] Impacted maxillary incisors can show various angulations in the crown or root and the most complicated situation is dilaceration with the crown in an inverted orientation.[37,38] In our sample, most of the impacted central incisors showed a malposition before traction and therefore were more prone to buccal bone dehicences after traction (Table I). Surgical management of an impacted tooth is another important factor, considered the key to achieving desirable esthetic results.[17] During the exposure technique, there is a need to remove the surrounding bone minimally for bonding the button type attaching device, which can result in the loss of supporting tissues even using closed-eruption technique as in our and previous studies [14,18,22,23]. Traction direction is another important question during early treatment for impacted teeth. A well-controlled anchorage and sufficient torque for an ideal esthetic outcome are primary factors that contribute to successful treatment of impacted teeth.[39,40]

Insufficient buccal alveolar bone remaining in the long-term is a risk factor for development of gingival recessions.[41] These defects may be associated with the development of gingival recessions under certain conditions, such as orthodontic movement or plaque-induced inflammation due to decreased tooth bone support.[45] TR group showed more gingival recession at the buccal aspect than the NTR group (Table II). As consequence, the quantity of gingival mucosa was lower in TR group compared with its antimere (Table II). In the case of traction, gingival recession of the orthodontically tractioned tooth is often seen right after treatment[8,21] (Fig. 4). In this study, the mean of gingival recession in the buccal aspect found between the two groups was 0.45mm. A previous study found an increase in clinical attachment level, probing depth and recession 1 year after treatment and a stabilization after 5 years.[42] Compared to the immediate post-treatment, Farronato et al. found an increase of 0.21mm of gingival recession in incisors after the orthodontic traction by closed eruption technique. Despite all clinical measurements were as stable at the 5-year observation as a natural tooth, the possible explanation for the amount of recession in this study is that it can increase over time. The tooth position in the dental arch also are related to thin or absent buccal bone, predisposing patients to gingival recession. The presence of incipient bone loss of 1 mm lead to a 5-fold increased risk of developing gingival.[46] None of the 11 patients in this sample received a gingival graft.

On the buccal aspect, the TR group showed also an apically displaced attachment level compared to NTR group (Table II). The present result is in agreement to Vermette et al,[18] who showed decreased attached gingiva in the closed-eruption incisors group. The loss of attachment may be associated to the orthodontic procedures and it may be caused by injury during toothbrushing.[43] The attachment level was correlated with a thinner buccal bone plate and with an increased buccal alveolar crest high (Table IV). No previous studies had correlate CBCT and clinical finding in impacted maxillary incisors. However, buccal dehiscences were known as predisposing factor for loss of attachment.[44]

No differences in hygiene and gingival bleeding index were observed at between TR and NTR in the long-term (Table II). The probing depth in TR group also did not differ of NTR group. This findings agree with a previous study[18] and is probably explained by the development of a long connective attachment replacing the buccal bone loss.[45] No difference between groups was found for clinical crown height and width and no black triangles were found in both groups.

Although orthodontic traction using a closed-eruption technique is a clinical accepted method, slight negative esthetic and periodontal effects on the treated tooth should be anticipated. Posttreatment periodontal regeneration seems not be expected. Patients also should be informed of the possible need for additional periodontal procedures at the end of orthodontic treatment as gingival grafts. Further studies comparing the long-term smile esthetic assessment by professionals and laypersons, as well as esthetic patient self-report, should also be performed.

CONCLUSION

The null hypothesis was rejected. The periodontal condition of maxillary central incisors long-term after orthodontic traction was different compared to its antimere. A decreased thickness and height of buccal alveolar bone and gingival recessions were observed in central incisors 15 years after orthodontic traction.

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LEGENDS TO ILLUSTRATIONS

Fig 1. Buccal bone plate thickness (A): distance from the buccal root surface to the farthest alveolar bone surface, measured perpendicular to the long axis of the tooth at the middle and apical third of the root; Lingual bone plate thickness (B).

Fig 2. Buccal alveolar crest height (A): distance between the cementum-enamel junction and the alveolar bone crest, at the most coronal level of the alveolar bone, in the buccal aspect. Lingual alveolar crest height (B): distance between the cementum-enamel junction and the alveolar bone crest, at the most coronal level of the alveolar bone, in the lingual aspect.

Fig 3. Parasagittal sections of the eleven incisors of the sample: TR group (A) and NTR group (B).

Fig 4. Gingival recession observed after incisor traction. A- Case with left central incisor traction. B- Case with right central incisor traction.

FIGURES

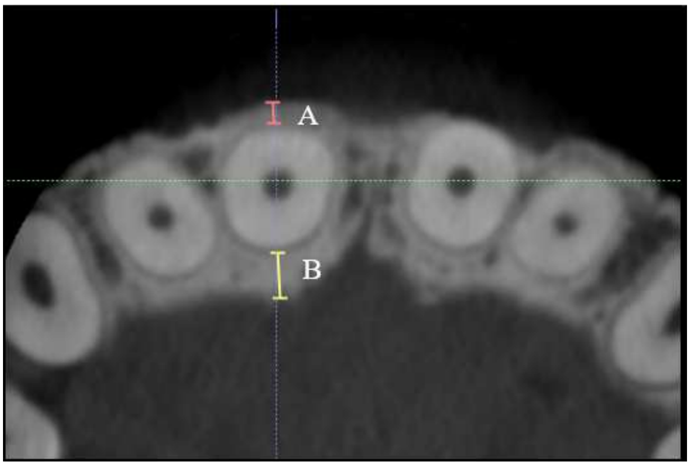

Fig 1.

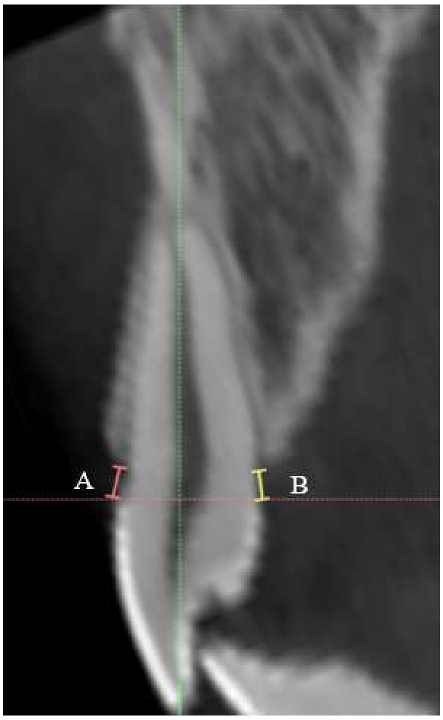

Fig 2.

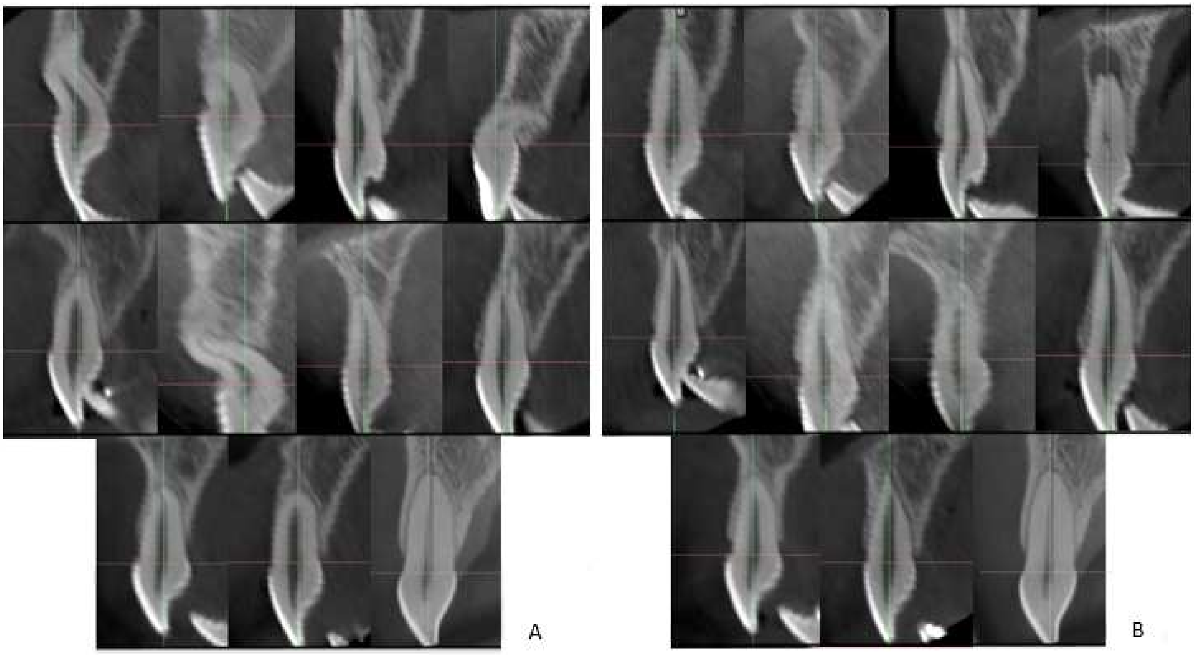

Fig 3.

Fig 4.

TABLES

Table I – Characteristics of impacted upper central incisors

Characteristics	N
Etiology	
Odontoma	1
Supernumerary teeth	2
Dental trauma	
Horizontal	2
Vertical	3
Vertical inverted	3

Table II – Intergroup comparisons for CBCT and clinical variables (paired t tests)

n=11 Variables	TR Group Mean	(SD)	NTR Group Mean	(SD)	p
Buccal bone plate thickness (middle)	0.10	(0.26)	0.67	(0.30)	0.000*
Buccal bone plate thickness (apical)	0.34	(0.34)	0.80	(0.22)	0.009*
Lingual bone plate thickness (middle)	1.23	(1.11)	1.07	(0.49)	0.549
Lingual bone plate thickness (apical)	2.48	(2.33)	3.23	(1.60)	0.216
Buccal alveolar crest height	4.78	(1.59)	2.42	(0.99)	0.000*
Lingual alveolar crest height	1.92	(1.12)	1.34	(0.51)	0.133
Dental crown height	10.57	(1.65)	9.94	(1.69)	0.114
Dental crown width	8.59	(0.58)	8.47	(0.41)	0.474
Height / width ratio	0.83	(0.12)	0.87	(0.13)	0.336
Gingival recession (buccal)	0.60	(0.51)	0.15	(0.31)	0.016*
Gingival recession (lingual)	0.09	(0.21)	0.00	(0.00)	0.193
Probing Depth (buccal)	2.24	(0.39)	1.96	(0.48)	0.158
Probing Depth (lingual)	2.27	(0.35)	2.18	(0.27)	0.518
Clinical attachment level (buccal)	2.66	(0.51)	2.00	(0.44)	0.022*
Clinical attachment level (lingual)	2.36	(0.48)	2.15	(0.27)	0.224
Gingival bleeding index (buccal)	0.45	(0.47)	0.45	(0.48)	1.000
Gingival bleeding index (lingual)	0.39	(0.46)	0.42	(0.49)	0.755
Plaque index	0.47	(0.50)	0.36	(0.50)	0.242
Quantity of gingival mucosa	5.27	(1.79)	6.18	(1.66)	0.033*

*Statistically significant

Table III- Intergroup comparison of qualitative analysis (McNemar test‡ and Wilcoxon test†)

Presence	TR Group	NTR Group	p
Presence of dilaceration	8 (72.7%)	0 (0%)	0.013*‡
Presence of fenestration	1 (9,1%)	0 (0%)	1.000 ‡
Buccal root coverage	50%	100%	0.007*†
Lingual root covegare	100%	100%	0.067
Presence of black triangles	0%	0%	
Position of the root apex			
• **Buccal**	8 (72.7%)	10 (90.9%)	0.083‡
• **Center**	2 (18.2%)	1 (9.1%)	
• **Lingual**	1 (9.1%)	0 (0%)	

*Statistically significant

Table IV- Correlation between the clinical and CBCT findings (Pearson correlation coefficient)

CBCT variables and clinical parameters	r	p
Buccal bone plate thickness (middle) vs probing Depth (buccal)	-0,114	0,613
Lingual bone plate thickness (middle) vs probing Depth (lingual)	-0,201	0,370
Buccal bone plate thickness (middle) vs clinical crown height	-0,477	0,025*
Buccal alveolar crest height vs clinical crown height	0,455	0,034*
Lingual alveolar crest height vs clinical crown height	-0,081	0,721
Buccal alveolar crest height vs probing Depth (buccal)	-0,018	0,936
Lingual alveolar crest height vs probing Depth (lingual)	0,251	0,260
Buccal bone plate thickness (middle) vs recession	-0,205	0,360
Buccal bone plate thickness (middle) vs amount of gingiva mucosa	0,357	0,102
Buccal bone plate thickness (middle) vs attachment level	-0,646	0,001*
Buccal alveolar crest height vs recession	0,141	0,532
Buccal alveolar crest height vs amount of gingival mucosa	-0,443	0,039*
Buccal alveolar crest height vs attachment level	0,597	0,003*

*Statistically significant

2.2 ARTICLE 2

special **article**

Is there a consensus for CBCT use in Orthodontics?

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This article aims to discuss current evidence and recommendations for cone-beam computed tomography (CBCT) in Orthodontics. In comparison to conventional radiograph, CBCT has higher radiation doses and, for this reason, is not a standard method of diagnosis in Orthodontics. Routine use of CBCT in substitution to conventional radiograph is considered an unaccepted practice. CBCT should be indicated with criteria only after clinical examination has been performed and when the benefits for diagnosis and treatment planning exceed the risks of a greater radiation dose. It should be requested only when there is a potential to provide new information not demonstrated by conventional scans, when it modifies treatment plan or favors treatment execution. The most frequent indication of CBCT in Orthodontics, with some evidence on its clinical efficacy, includes retained/impacted permanent teeth; severe craniofacial anomalies; severe facial discrepancies with indication of orthodontic-surgical treatment; and bone irregularities or malformation of TMJ accompanied by signs and symptoms. In exceptional cases of adult patients when critical tooth movement are planned in regions with deficient buccolingual thickness of the alveolar ridge, CBCT can be indicated provided that there is a perspective of changes in orthodontic treatment planning.

Keywords: Orthodontics. Cone-beam computed tomography. Recommendations.

O presente artigo visa discutir as evidências e recomendações atuais concernentes à indicação da tomografia computadorizada de feixe cônico (TCFC) em Ortodontia. Devido à dose de radiação mais elevada em relação às radiografias, a TCFC não é o método padrão de diagnóstico em Ortodontia. O seu uso rotineiro, em substituição à documentação convencional, é considerado uma prática inaceitável. A TCFC deve ser indicada com muito critério, e somente após uma análise clínica, quando os benefícios para o diagnóstico e tratamento superarem os riscos de uma dose mais elevada de radiação. Deve ser requisitada estritamente quando houver um potencial de prover novas informações não demonstradas em exames radiográficos convencionais, modificando o plano de tratamento ou facilitando a sua execução. As indicações mais frequentes em Ortodontia, que demonstram algum nível de evidência sobre sua eficácia clínica, podem ser resumidas em casos de dentes permanentes retidos; anomalias craniofaciais complexas; discrepâncias faciais severas com indicação de tratamento ortodôntico-cirúrgico; e malformações ou irregularidades ósseas na ATM acompanhadas de sinais e sintomas. Em casos excepcionais, em pacientes adultos em que se planeja movimentos dentários críticos em áreas com espessura óssea vestibulolingual deficiente, a TCFC pode ser indicada, desde que se vislumbre uma perspectiva de alteração no plano de tratamento ortodôntico.

Palavras-chave: Ortodontia. Tomografia Computadorizada de Feixe Cônico. Recomendações.

» The author reports no commercial, proprietary or financial interest in the products or companies described in this article.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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INTRODUCTION

We have currently been through modern times in Orthodontics. In a retrospective view of our science and art, we envisage a Classical era from the end of the XIX century until the 60s with the legacy of Edward Hartley Angle and his eminent pupils, including Charles Tweed, Broadbent and Brodie.[49,50] After the Classical era, a Contemporary era started in the 70s not only with the development of specific occlusal objectives and the Straigth-Wire appliance by Andrews, but also with the development of orthognatic surgery and facial analysis for orthodontic diagnosis.[51,52] When we look to the present, we see our time being highlighted by two major vanguard advents: tridimensional images and skeletal anchorage.

Cone-beam computed tomography (CBCT) together with digital dental models and 3D facial photographs personify the modernity of the present. Introduced in 1998,[39] CBCT is in its adolescence, but has contributed with over seven hundred international publications in Orthodontics, according to a search at Pubmed database. Evidence related to CBCT have provided important development in three levels: orthodontic diagnosis; orthodontic or orthodontic-surgical treatment planning; and knowledge of treatment outcomes. It is not difficult to fall in love for CBCT scans, once they allow three-dimensional visualization of the morphology of the face and cranium, and demonstrate one's anatomy in multiplanar sections with adequate resolution and sharpness.[21] CBCT presents high accuracy and precision, sensibility and specificity, as well as absence of image amplification.[6,7,9,11,17,27,28,33-36,38,41,43] Faced with these advantages, the following question recurrently arises: Can CBCT be indicated as a routine in Orthodontics?

As every light has its shadows, a method does not have advantages, only. CBCT has the drawback of having a higher radiation dose compared to conventional radiograph frequently requested in Orthodontics.[3,45] Effective radiation dose is the sum of the dose received by all irradiated tissues and organs, considering both tissue weight and the quality of ionizing radiation in terms of biological effects.[15] Effective radiation dose represents a stochastic risk to health, in other words, the probability of carcinogenesis and genetic effects on irradiated tissues.[15] During X-ray examination, millions of photons pass through patient's cells and can cause damage to DNA molecules due to ionization.[15] The majority of changes caused to genetic material is reversible and immediately repaired.[15] However, DNA may be rarely, yet permanently altered, thereby establishing a genetic mutation.[15] Fortunately, effective dose and risks related to dental radiation are very small compared to the natural risks of carcinogenesis.[15,16] Nevertheless, some limited evidence on the increase of radiation-related tumor in the brain and thyroid glands requires caution and rationality before indicating X-ray examination in Dentistry, including conventional radiographs.[15] This concern is amplified in children, as they present tissues with higher radiosensitivity, greater number of cell divisions and a longer lifetime spam for carcinogenesis development.[16]

The effective radiation dose of CBCT depends on the scanner, the field of view (FOV) and on the acquisition protocol, particularly considering resolution or voxel dimension.[3] For a detailed analysis of CBCT effective dose, we recommend consulting Table 5 of the manuscript issued by the American Academy of Oral and Maxilofacial Radiology, published in 2013 with the goal of discussing CBCT recommendations in Orthodontics.[3] The aforementioned table also compares the effective radiation dose of extraoral radiographs and multi-slice computed tomography. These data are summarized in Table 1.

By weighing the advantages and risks of CBCT and based on specialized and updated literature, this article aims to discuss CBCT use in Orthodontics. The main goal of this paper is to guide the orthodontist towards a discerning use of CBCT in daily practice.

EXAMINATION	Effective dose (mSv)
CBCT of face and cranium (FOV > 15 cm)	52 to 1073
CBCT of face (FOV 10 - 15 cm)	61 to 603
CBCT of the jaws (FOV < 10 cm)	18 to 333
Multi-slice CT	426 to 1160
Panoramic radiograph	6 to 50
Cephalogram	2 to 10

Table 1 – Effective radiation dose (EICRP 2007) expressed in microSieverts (mSv) and produced by cone-beam computed tomography at different resolutions and fields of view (FOV) in comparison with multi-slice CT and conventional radiograph. Data adapted from the American Academy of Oral and Maxillofacial Radiology (2013).[3] Great variation in radiation dose according to each type of scan occurs due to differences caused by the scanner and the acquisition protocol.

THE CONTROVERSY

In November, 2010, a publication in "The New York Times" reported the abuse of dental professionals in indicating CBCT to children and adolescents.[8] The article had great impact in the United States and encouraged the American Association of Orthodontics and the American Academy of Oral and Maxillofacial Radiology to prepare guidelines for CBCT use in Orthodontics.[3] During the 3-year interval between these two publications, much controversy was seen on this subject.

In 2011, 83% of postgraduate programs in Orthodontics in the US and Canada reported to use CBCT.[46] The majority (82%) of them recommended CBCT only in selected cases, including impacted teeth (100% of programs), craniofacial anomalies (100% of programs) and TMJ (67%) or upper airway assessment (28%). Only 18% of programs reported replacing conventional radiograph by CBCT. Most of them, however, routinely used conventional radiograph for control during orthodontic treatment.

CBCT recommendation in Orthodontics raised so much controversy that the American Journal of Orthodontics and Dentofacial Orthopedics published a Point-Counterpoint session on the subject in 2012.[23,29] On one side, in defense of routine use of CBCT for comprehensive orthodontic treatment, was Dr. Brent Larson, director of the Orthodontic division of the University of Minnesota, United States.[29] On the other side, against the idea of routine use of CBCT for comprehensive orthodontic treatment, was Dr. Demetrius Halazonetis from the University of Athens, Greece.[23] The aforementioned publication also portraits the dichotomy between United States and Europe concerning the conservative approach of CBCT use.

Defense was based on arguments such as increased geometrical accuracy and reliability of measurements on CBCT images; high sensitivity for localization of impacted teeth and identification of related root resorption; easiness in quantifying discrepancies in cases of facial asymmetry; sharp visualization of TMJ, upper airway and tooth buccal and lingual bone plates; significant frequency (10%) of incidental findings; ease in mini-implant and customized fixed appliance planning; confidence provided by CBCT to therapeutic choices; the possibility to simulate and demonstrate the therapy of choice to patients; and last but not least, the evidence that CBCT radiation dose is minimal in comparison to the sum of radiation doses of panoramic radiograph, cephalometric radiograph and the full set of periapical radiographs.[29]

Opposing to the general use of CBCT in Orthodontics, it was mentioned that criteria for patients selection should be based on the ratio risk-benefit of CBCT; and that there was not enough evidence supporting CBCT efficacy for diagnosis, treatment planning or treatment outcomes in Corrective Orthodontics.[23] We invite readers to advance in the arguments raised by Dr. Halazonetis[23] by carefully examining the following topics of this article.

WEIGHING RISKS AND BENEFITS

There seems to be an antithesis between what the orthodontist desires and what the orthodontist can do with regard to CBCT. The conflict starts in clinicians' attraction to visualize the virtual anatomical replica of the patient at high resolution; however, the risk related to increased radiation dose is rationalized. The Golden Law of Ethics says that we should do to others only what we would like to do to ourselves. Therefore, before requesting a CBCT scan, the orthodontist should weigh the risks and benefits. CBCT scans should only be requested in cases in which the potential benefits of diagnosis and treatment planning, treatment execution or treatment outcomes outweigh the potential risks of an increased radiation dose (Fig 1).

The benefit for orthodontic diagnosis can be analyzed by the capacity of CBCT scans to change orthodontic treatment planning. Another benefit of CBCT would be to favor treatment execution, as observed in cases in need of orthognatic surgery or implants in which the surgeon performs a 3D simulation with the goal of performing the surgery *in vivo* with more precision. Finally, a long-term benefit would be to have better or more efficient treatment outcomes compared to treatment outcomes reached without CBCT images. Evidence in these three levels of benefits guide the recommendations for CBCT use in Dentistry, as recently published by committees in North America and Europe[3,15] and which we are about to discuss in the next topic of this article.

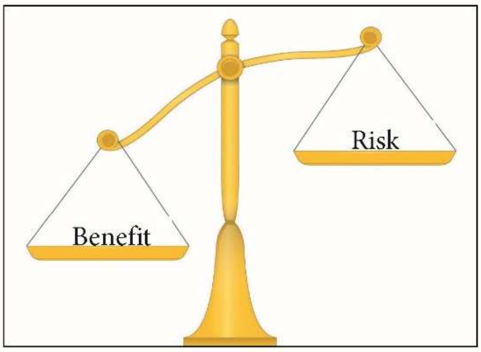

Figure 1 - Cone-beam computed tomography should only be requested in cases in which the potential benefits of diagnosis and treatment planning, treatment execution or treatment outcomes outweigh the potential risks of an increased radiation dose.

Principle 1	CBCT should not be used routinely for all patients
Principle 2	CBCT examinations must not be carried out unless a history and clinical examination have been performed
Principle 3	CBCT examinations must be justified for each patient
Principle 4	CBCT field of view (FOV) should be restricted as much as possible
Principle 5	The lowest achievable resolution should be used without jeopardizing evaluation of the area of interest

Table 2 - Basic principles to be followed in daily clinical practice before requesting cone-beam computed tomography.

BASIC PRINCIPLES FOR CBCT RECOMMENDATION

According to the American Academy of Oral and Maxillofacial Radiology, there is neither convincing evidence for radiation-induced carcinogenesis at the level of dental exposure, nor absence of evidence of such effect. Because Orthodontics is a field of health, we prudently assume there is a risk, given that there is no safe limit for ionizing radiation.[3] Each exposure has a cumulative effect on the risk of carcinogenesis.[3] In this perspective, the basic principles recommended by European and North-American guidelines aim to avoid or minimize unnecessary exposure for diagnosis purposes.

The orthodontist should follow some basic principles regarding indication of cone-beam computed tomography, as described bellow and summarized in Table 2:

1. Indiscriminate, routine use of CBCT for all orthodontic patients is considered an unacceptable practice.[15]

2. CBCT examination must not be carried out unless a history and clinical examination have been performed.[3,15]

3. CBCT examinations must be justified for each patient. CBCT scans should only be requested when there is a potential for CBCT images to provide new information not provided by conventional radiograph.[15] Clinical justification should be based on the risk-benefit ratio of radiation exposure.[44] This principle opens up space for discussion and controversy, once the benefits of CBCT are not clear for all possible orthodontic indications. There is lack of evidence on the benefits for diagnosis, treatment planning, treatment execution or treatment outcomes in the orthodontic literature.

4. CBCT field of view (FOV) should be restricted as much as possible.[15] The field of view is the vertical volume covered by the exam. It is cylindrical, varies in height and can be adjusted before the exam. Thus, CBCT can be requested with a small (maxilla or mandible), medium (maxilla and mandible) or large (face and cranium) field of view, as illustrated in Figure 2. The greater the field of view, the greater the radiation dose. Therefore, the exam should include only the areas of interest for diagnosis so as to minimize radiation dose and follow the ALARA principle (As Low As Reasonably Achievable).

5. To use the lowest achievable resolution possible without jeopardizing evaluation of the area of interest.[3,15] CBCT image resolution is influenced, among other factors, by voxel dimension. The voxel is the smallest unit of a tomographic image. The word "voxel" is the combination of the words "volume" and "pixel". Voxels are cubic-shaped and have equal and submillimetric dimensions in height, width and depth (Fig 3). Voxel size may vary from 0.1 to 0.4 mm, and the smaller the voxel dimension, the better the spatial resolution, but the greater the radiation dose.[34] CBCT scans with high resolution (0.1 mm or 0.2 mm voxel size) should only be requested when in need of visualization of small details and delicate structures, such as mild root resorption, bone dehiscence and tooth fracture. When the purpose of the exam does not involve a high level of detail, voxel sizes of 0.3 mm and 0.4 mm should be preferred.

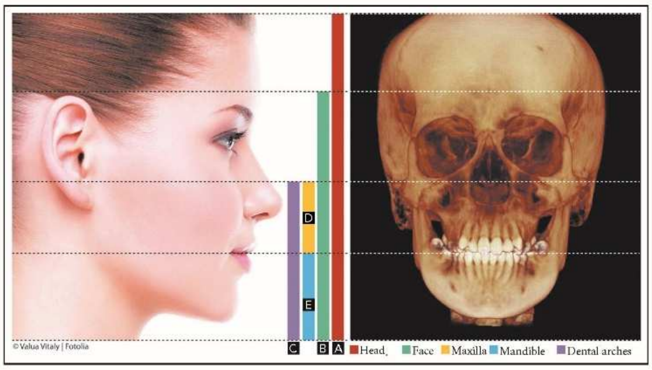

Figure 2 - Cone-beam computed tomography field of view. It is cylindrical and determined according to its vertical extent. A) Field of view of the face and cranium, B) Field of view of the face, C) Field of view of the jaws. D) Field of view of the maxilla, E) Field of view of the mandible.

CLINICAL RECOMMENDATION IN ORTHODONTICS

Based on principles 1 and 3 of the previous topic, the orthodontist should critically assess the risk-benefit ratio of CBCT exam before requesting it. In general, the decision regarding the use of CBCT depends on the severity of malocclusion[3]. The more severe the malocclusion, the more probability of needing the examination (Fig 4). On the other hand, the milder the malocclusion, the less likelihood of needing a CBCT scan. Malocclusion severity is understood as the presence of vertical and sagittal skeletal discrepancies, facial asymmetry, craniofacial malformation and tooth eruptive disorders. There is no rationale in indicating CBCT for patients with Class I malocclusion and anterior crowding, for example. In these cases, CT scans would not have the potential to change diagnosis, prognosis and treatment planning. In contrast, a patient with severe skeletal discrepancy or craniofacial anomalies in need of surgical-orthodontic treatment could have a more accurate diagnosis and prognosis, a more specific treatment planning as well as easy treatment execution with a qualitative increase in treatment outcomes. Additionally, the decision on requiring a CBCT scan is age-dependent.[3] The younger the patient, the more critical should the professional be for indicating a CBCT exam, particularly due to the biological effects of exposure to radiation.[3]

CBCT recommendation in Dentistry is based on a general evaluation of the benefits in counterpoint to risks.[44] However, how can the benefits of CBCT be evaluated? Benefits can be understood as the method efficacy. Imaging examinations present six levels of efficacy:[15,23] technical efficacy related to the quality of images; diagnosis efficacy understood as the low frequency of false-negative and false-positive diagnosis or accuracy and reproducibility of quantitative analyses; diagnostic thinking efficacy related to the capacity of the method to change a pre-established diagnosis; therapeutic accuracy representing the potential of the exam to change treatment planning; orthodontic finishing efficacy tak-

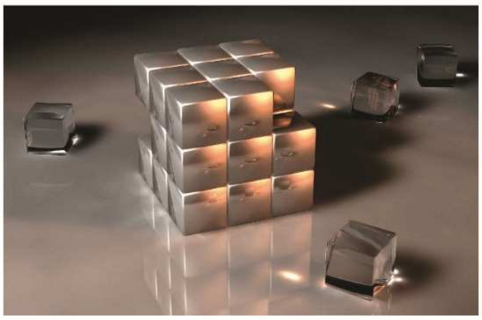

Figure 3 - The voxel is cubic-shaped and is the smallest unit of a tomographic image. In CBCT, voxels have equal and submillimetric dimensions in height, width and depth.

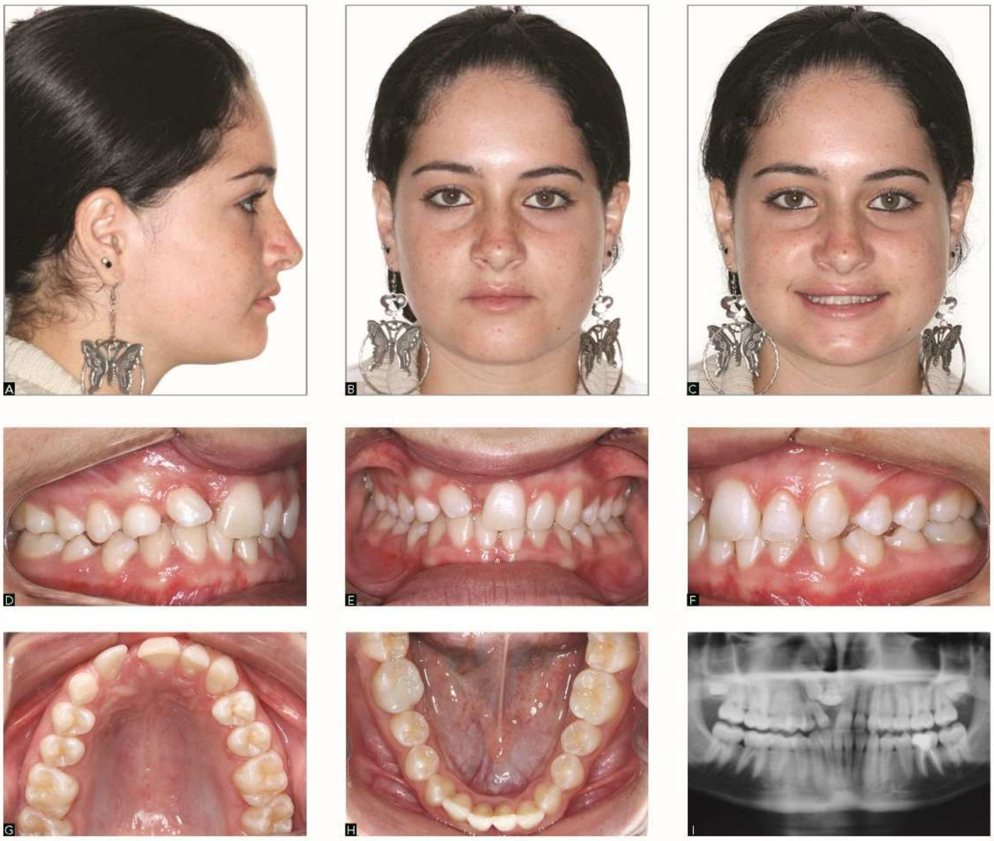

Figure 4 - A-H) Severe case of a 15-year-old patient with central incisor and maxillary canine retention on the left side (# 11 and 13). **I, J, L)** Conventional radiograph included in patient's orthodontic records confirms #11 and 13 retention.

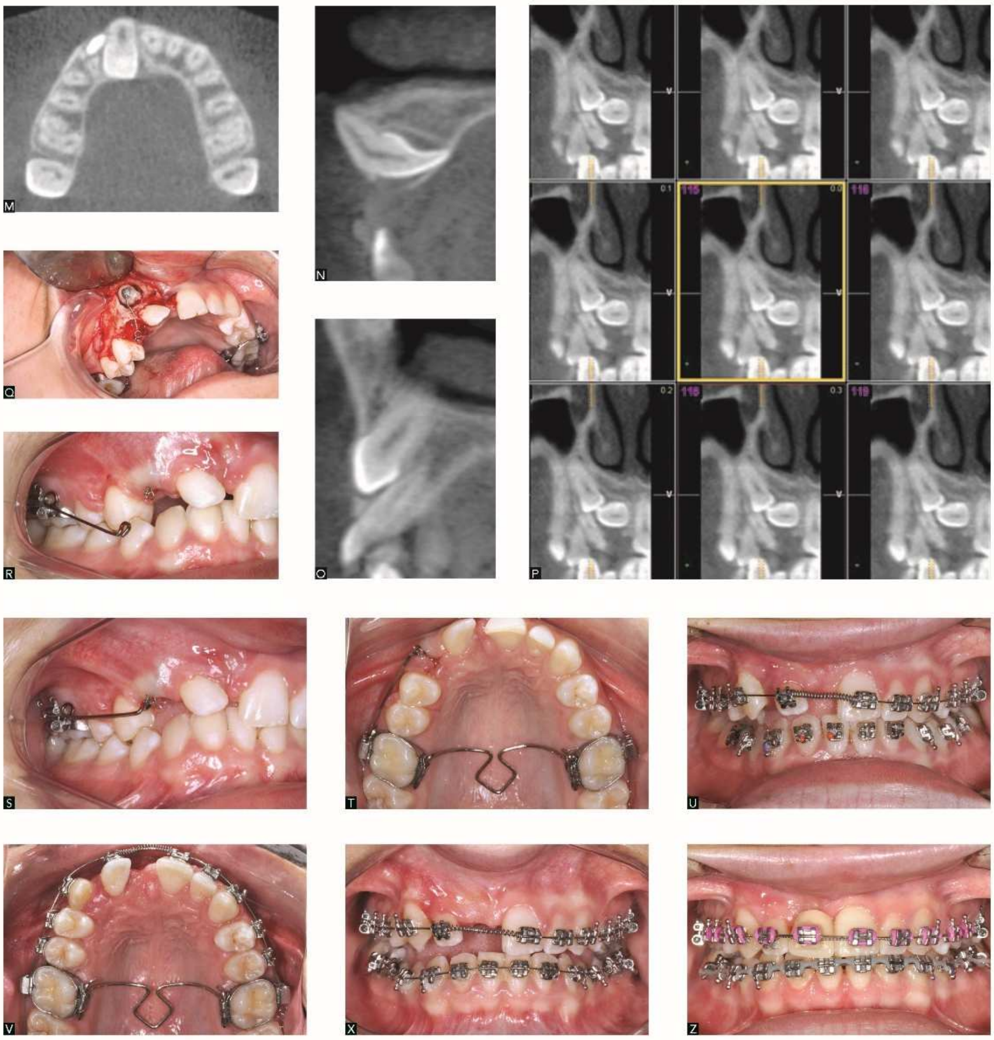

Figure 4 (continuation) - M) Axial CBCT scan revealing proximity between retained teeth and the tipped lateral incisor root. **N, O)** Cross-sectional slices revealing canine buccaly positioned, as well as central incisor atypically positioned with the incisal surface posteriorly faced, and the presence of root dilaceration. **P, Q)** Treatment began by tractioning #13 by means of occlusal and buccal force applied to preserve #12 root. **R, S)** Regaining space in the region of right central incisor for further traction carried out by applying occlusal and buccal force aimed at repositioning the incisal edge at the center of the alveolar ridge. **T a Z)** After an unsuccessful attempt to traction #11, extraction and anterior rehabilitation were recommended. (Treatment performed by Dr. Marilia Yatabe and Dr. Marcos Ioshida, postgraduate students at FOB-USP).

ing into account the qualitative gain of treatment results; and, finally, the societal efficacy.[23]

In Orthodontics, there is few evidence on the CBCT potential to change the quality of treatment outcomes and no evidence of CBCT social benefits.[23] Current evidence of efficacy for the other four levels have guided the North-American and European recommendations for CBCT use. In other words, evidence of efficacy guided the eligibility criteria of cases that justify the use of CBCT.

The North-American guidelines for CBCT use in Orthodontics were published in 2013 with the coordination of the American Academy of Oral and Maxillofacial Radiology (AAOMR) and have remained in force for 5 years.[3] Table 3 shows the orthodontic indications of CBCT according to the American guidelines.[3]

The European evidenced-based guidelines, known as SedentexCT Project, were issued in 2012[15] and were more conservative regarding the use of CBCT in Orthodontics. Table 4 summarizes the conclusion of these guidelines with regard to orthodontic cases. The difference between North-American and European recommendations may be explained by the distinct criteria used. The North-American guidelines were based on the most frequent use of CBCT revealed in the literature. Conversely, the SedentexCT guidelines were strictly based on the presence of high levels of evidence on CBCT efficacy.

Dental structural anomalies
Anomalies in dental position
Compromised dentoalveolar boundaries
Facial asymmetry
Sagittal skeletal discrepancies
Vertical skeletal discrepancies
Transverse skeletal discrepancies
TMJ signs and symptoms
Malformation and craniofacial anomalies
Localization of proper mini-implant placement sites
Airway assessment
Expansion procedures assessment

Table 3 - CBCT recommendations for orthodontic purposes, according to the American Academy of Oral and Maxillofacial Radiology (AAOMR).[3]

Localization of impacted teeth and identification of associated root resorption*
» CBCT should only be used when Multi-slice CT is necessary, in which case CBCT is preferred due to lower radiation dose; or
» CBCT should only be used when the question for which imaging is required cannot be answered adequately by lower dose conventional (traditional) radiograph;
Clef lip/palate*
» CBCT should only be used when Helicoidal CT is necessary, in which case CBCT is preferred due to lower radiation dose;
Mini-implants: Proper mini-implant placement site*
» CBCT are rarely necessary, except for cases with critical space left for mini-implant placement;
Severe cases of skeletal discrepancies
» CBCT of the face might be used to develop orthosurgical treatment planning;
» Preference is given to patients older than 16 years of age;
Pre-surgical assessment of impacted teeth
» CBCT should only be used when the question for which imaging is required cannot be answered adequately by lower dose conventional (traditional) radiography;
Orthognathic surgery planning
» CBCT of the face might be used to develop orthosurgical treatment planning;
TMJ assessment
» CBCT should only be used when Helicoidal CT is necessary, in which case CBCT is preferred due to lower radiation dose.

Table 4 - CBCT recommendations in Orthodontics according to the European SedentexCT (2012) guidelines.[15]
*field of view should be as restricted as possible.

DISCUSSING AND DRAWING CONCLUSIONS TOWARDS CLINICAL RECOMMENDATIONS

In the diagnosis of impacted teeth, CT scans are advantageous for providing the exact tridimensional location of the crown and the root(s) of unerupted teeth and their relationship with neighboring teeth. CBCT scans might also reveal the presence of associated root resorption in neighboring teeth, even when resorption lacunae are bucally or lingually located.[1] CT scans are more sensitive in comparison to conventional radiograph when diagnosing resorption of impacted teeth.[1] Conventional radiograph, including the periapical one, is limited in terms of overlapping of bucally or lingually impacted teeth images and neighboring teeth roots. For this reason, periapical radiograph might lead to false-negative results, even in the presence of deep root resorption reaching the root canal.[14]

Identifying root resorption in teeth neighboring impacted canines might alter treatment planning in a significant number of cases.[24,26] There is evidence highlighting that CT scans might alter treatment planning in approximately 30% of cases.[24] For instance, in a case with previously planned extraction of maxillary premolars, identifying the presence of root resorption in lateral incisors might lead to extraction of anterior teeth instead of posterior. Furthermore, CT scans might lead to better planning of traction force direction.[24] Surgical exposure and bonding for traction of impacted teeth might also benefit from accurate positional diagnosis provided by CT scans.[24]

The aforementioned benefits yielded by CBCT for impacted teeth allow orthodontists to be more confident in diagnosing and performing treatment plan.[24] Lastly, it has been recently proved that CBCT renders treatment of complexly positioned impacted canines easier, thereby reducing treatment time.[2]

Cases in which diagnosis of impacted teeth is made in initial conventional orthodontic records, CBCT might be requested as a compliment. Should that be the case, CBCT scan protocols should include a partial field of view comprising the maxilla or the mandible, only.[15] A reduced field of view minimizes exposure to radiation. Doubts involving cases of impacted teeth are usually solved by serial axial and cross-sectional slices of volumetric 3D reconstruction. Importantly, axial slices are the most appropriate CBCT scans used for diagnosis of root resorption associated with impacted teeth. Cross-sectional slices sometimes fail to show the entire cervico-apical portion of the roots, especially due to mesiodistal tooth angulation. Additionally, they might give a false impression of inexistent root resorption.

The literature does not highlight studies validating CBCT as a diagnosis tool of ankylosis of impacted teeth, perhaps due to difficulties in finding methods to investigate the theme. Cases in which the periodontal ligament cannot be identified by CBCT slices do not necessarily involve ankylosis. The periodontal ligament is on average 0.2-mm thick. For this reason, high resolution scans are required for its identification. Unlike ankylosis, root fracture is easily diagnosed by CBCT scans.[15] Cases of permanent impacted teeth are benefited from CBCT when conventional radiograph does not provide enough information for diagnosis, prognosis, treatment plan, surgical intervention and orthodontic therapy (Fig 5).

As for CBCT use in cases of cleft lip/palate, although some studies have assessed alveolar bone graft outcomes by means of computed tomography,[40] there is no evidence proving that this assessment method influences orthosurgical treatment protocol in daily practice. Empirically, the benefits of CBCT use are acknowledged for diagnosis and surgical treatment of more severe craniofacial anomalies with malformation of the midface, mandible or TMJ, particularly involving facial asymmetry. In these cases, CBCT is beneficial for allowing identification of the exact location of morphological errors, three-dimensionally quantifying the error and providing therapeutic planning that includes osteogenic distraction or craniofacial surgery.

Cone-beam computed tomography is indicated for orthodontic cases that require analysis of TMJ bone components accompanied by signs and symptoms.[3,44] CBCT programs reconstruct TMJ sequential slices, both in latero-lateral and anterior-posterior axes, and provide clear imaging of articular fossa and condyles. Morphological analysis of CT scans might reveal the presence of erosions, ankylosis, hyperplasia/hypoplasia of the condyle or degenerative arthritis.[5,25] In comparison to panoramic radiograph and linear tomography, however, CBCT proves more accurate in diagnosing erosion of the condyle.[25] Conventional radiograph is quite limited in reproducing TMJ morphology due to imaging overlap.[25] Nevertheless, TMJ imaging is not necessary for the diagnosis of temporomandibular disorders.[42] Furthermore, CBCT proves a good method to assess TMJ after orthognathic surgery, particularly when there is considerable potential for resorption of the condyle.[10] Based on such evidence, CBCT use is appropriate for diagnosis and development of treatment planning of TMJ skeletal irregularities accompanied by signs and symptoms.

Orthognathic surgery and its outcomes might benefit from CBCT scans at the time of diagnosis.[12] Additionally, CBCT is recommended in cases of severe facial skeletal discrepancies that require orthosurgical treatment.[3,15]

However, would CBCT be useful to assess one's airway? CBCT proves advantageous to assess upper

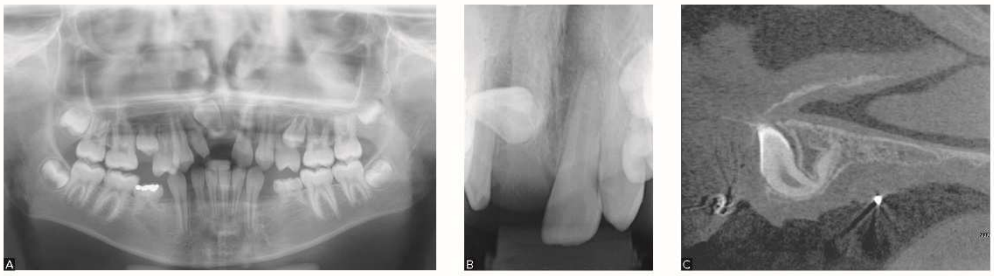

Figure 5 - Retention of right maxillary central incisor caused by trauma during childhood. **A, B)** Conventional radiograph. **C)** CT scans revealed dilaceration associated with root suffocation, both of which were not identified by conventional radiograph. The unfavorable root condition enlightened treatment prognosis and influenced orthodontic planning.

airways in terms of sagittal and transverse linear measurements as well as calculation of airway total area and volume.[30] However, the method has its limitations. CBCT airway imaging might vary according to patient's swallowing movement and position during the exam.[30] Whenever the patient swallows, the soft palate is lifted, which causes the nasopharynx to distort. Furthermore, some CBCT scanners require the patient to be in supine position, while others require the patient to remain sited or standing. Different scanners register different images of upper airways due to soft palate mobility.[13] Moreover, static analysis of patient's airways is another limitation posed by CBCT which differs from videofluoroscopy, as the latter allows a dynamic pharyngeal analysis. Additionally, the ideal method used to diagnose obstructive sleep apnea syndrome is polysomnography instead of CBCT. Previous studies found significant correlation between profile cephalogram and CBCT used to analyze patient's airways area and volume.[48] Nasopharyngeal sagittal linear measurement is strongly correlated to volume of upper airways.[30] Thus, despite building a 2D representation of a 3D structure such as patient's airways, profile cephalogram remains as a reliable method used to assess pharyngeal obstruction. To date, there seems to be no evidence stating that CBCT 3D imaging of one's airways affects orthodontic diagnosis and treatment. Therefore, there is no point in requesting CBCT scans with a view to tridimensionally assessing upper airways for orthodontic purposes.

Finally, it seems to be important to discuss the indication of CT scans to assess alveolar bone limits for tooth movement. One of the advantages of computed tomography used for orthodontic purposes is related to its ability of providing images of the alveolar bone which bucally and lingually surrounds the teeth. The only imaging diagnosis methods available to assess and measure buccal and lingual bone plates are multi-slice computed tomography and cone-beam computed tomography. Before computed tomography, patient's buccal and lingual bone plates could not be assessed by conventional radiograph due to imaging overlap and gingival covering. In the 90s, multi-slice computed tomography was validated to assess buccal and lingual alveolar bone.[20] Bone plates thinner than 0.2 mm were not always shown by multi-slice TC scans.[20] Additionally, cadaver studies revealed that buccal and lingual horizontal bone defects were assessed by multi-slice TC scans, but could not be identified by periapical radiograph.[19] Moreover, an experimental study in which bone dehiscence was artificially caused in cadaver jaws concluded that CT scans were the only imaging diagnosis method capable of quantitatively assessing alveolar ridge as well as buccal/lingual bone plates buccolingual thickness.[18]

After cone-beam computed tomography was introduced,[39] new studies were conducted to validate the method with a view to assessing buccolingual alveolar bone. Misch, Yi and Sarment[35] measured buccal bone defects and found a mean difference of 0.4 mm (SD = 1.2) between direct measurements performed on dry skulls and CBCT scans taken by an iCAT scanner. Mol and Balasundaram[36] evaluated accuracy of buccal/lingual bone plate measurements performed in cross-sectional CBCT slices acquired by NewTom QR-DVT-9000. They found a mean difference of -0.23 mm between real measurements and CBCT, thereby revealing that CBCT tends to underestimate real bone loss. The mean absolute difference between anatomic measurements and CBCT scans was 1.27 mm (SD = 1.43). Lower incisors had the lowest accuracy. The magnitude of the error was attributed to the use of primitive CBCT scanners which are no longer available. The devices produced unclear, low-contrast images.

Lund, Gröndahl and Gröndahl[33] used cross-sectional CBCT slices of a dry scull scanned by Accuitomo scanner (Morita, Kyoto, Japan) to measure buccal/lingual bone plates. The mean error for the distance between the cementoenamel junction and the bone crest was -0.04 mm (SD = 0.54), with variation between -1.5 mm and +1.9 mm.

Leung et al[31] assessed accuracy of natural bone dehiscence measurements and CBCT sensitivity of identifying them. The authors used 13 dry skull scans acquired by CB MercuRay (Hitachi, Medical Systems American, Ohio, USA). Their study presented some negative morphological aspects, as bone dehiscence was assessed in 3D reconstruction instead of CBCT orthogonal slices. Furthermore, they measured the distance from cuspid tips to the alveolar bone crest instead of the distance between the cementoenamel junction and the bone crest. The authors found a mean difference of -0.2 mm (SD = 1.0) and an absolute difference of 0.6 mm (SD = 0.8 mm) between real and digital measurements. They concluded that 3D reconstructions present low sensitivity (0.4), but high specificity (0.95) in identifying bone dehiscence.

Despite submillimetric accuracy revealed by CBCT, some principles must be followed when assessing buccal/lingual bone plates.[37] Imaging spatial resolution is the minimal distance required to distinguish two contiguous anatomical structures.[37] The smaller the anatomical structures, the higher the spatial resolution required.[37] Spatial resolution is not equivalent to voxel size (the smallest tomographic image), since calculation of mean partial volume, noise and artifacts negatively influence imaging clearness.[37] Mean partial volume occurs when a voxel includes two structures of different densities, for instance, the periodontal ligament and the alveolar bone. Density attributed to the voxel will be equivalent to the mean density of both tissues,[44] which hinders clear visualization of the limits of each structure in computed tomography.

Images acquired by iCAT scanner with voxel size of 0.2 mm have a mean spatial resolution of 0.4 mm, whereas images with voxel size of 0.3 and 0.4 mm have a spatial resolution of 0.7 mm.[4] Bone plates thinner than the imaging spatial resolution might not be revealed by CBCT, thereby reaching a false-positive diagnosis of bone dehiscence or achieving quantitative assessments that underestimate the level of bone crest.[47] Thus, care should be taken while drawing conclusions based on dimensions smaller than the

Eruptive disorders: impacted teeth
Severe craniofacial anomalies
Severe facial discrepancies potentially subjected to orthosurgical treatment
Bone irregularities or malformation of TMJ
Deficient buccolingual thickness of the alveolar ridge In exceptional cases of adult patients potentially subject to critical tooth movement in areas of deficient bone, CBCT is indicated provided that there is a perspective of changes in treatment planning

Table 5 - Cone-beam computed tomography **might be** indicated in the aforementioned orthodontic cases, whenever potential benefits of diagnosis, treatment planning and treatment execution outweigh potential risks

imaging spatial resolution.[37] In Orthodontics, voxel sizes of 0.4 mm and 0.3 mm are the most used.[47] However, investigations aiming to assess periodontal structures before and/or after orthodontic treatment should use the smallest voxel possible.[37] The smallest voxel in iCAT scanner is 0.2 mm; whereas Accuitomo and PreXon scanners produce images with higher spatial resolution, as their smallest voxel is 0.1 mm[32] Images with reduced voxel size are more accurate in terms of thickness and height of buccal/lingual bone plates.[47]

Therefore, CBCT scans are useful to assess the presence of bone dehiscence. However, CBCT scans have been restricted to investigations that guide the clinician towards the alveolar limits in cases of critical movement such as buccolingual tooth movement.[22] In Orthodontics, CBCT should be indicated to assess deficiencies of buccolingual thickness in the alveolar ridge of adult patients subjected to critical tooth movement in which case absence of buccolingual bone would affect orthodontic treatment. In these cases, the best option would be to use high resolution (reduced voxels) and a limited field of view (FOV) (Table 5).

IMPORTANT RECOMMENDATIONS: EDUCATION AND TRAINING

According to SedentexCT guidelines,[15] the prescriber, the clinics where the exam is taken and the medical physics expert share the responsibility over a radiographic exam. All professionals involved with CBCT, including the prescriber, should receive theoretical and practical training that includes the technical procedure of image acquisition, radiation dose, radiation protection and tomographic reading.[15] That is, the prescriber should know when and for what purpose he will request it. Furthermore, he should know how to exam and fully interpret it.

FINAL CONSIDERATIONS

Cone-beam computed tomography is not a standard diagnosis method in Orthodontics. CBCT should be indicated with criteria, when the potential benefits for diagnosis and treatment planning outweigh the potential risks of an increased radiation dose. The recommendations discussed in this article originate from current evidence and therefore are time-dependent. In the future, new evidence as well as technological evolution and innovation of CBCT scanners could change the current indications of CBCT in Orthodontics.

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3 Discussion

3 DISCUSSION

For the maxillary central incisors, the traction option is often undertaken because of the important role that tooth plays in esthetics (KAJIYAMA; KAI, 2000), and the resolution of the problem requires a combination of surgical exposure, attachment placement, and orthodontic movement (PROFFIT; FIELDS JR, 1993). These phases must also be considered when assessing periodontal challenges associated with orthodontic eruption (FRANK; LONG, 2002). In mechanical traction, subsequent periodontal and esthetic problems may follow (LUNDBERG; WENNSTRÖM, 1988; CRAWFORD, 1997). The presence of gingival recession together with a long clinical crown of the orthodontically erupted tooth is often seen (KAJIYAMA; KAI, 2000). The different methods of exposure have been shown to affect the quality of the periodontal and esthetic outcome of the treated case to a greater or lesser extent, and the manner in which the exposure is executed may also have an influence (CHAUSHU et al., 2009). Another factor is the direction to which we wanted the tooth to be moved, a thorough knowledge of biomechanics is required to achieve the desired result with the lowest harm to other structures (KUMAR; NAGAR; TANDON, 2017).

Computed tomography is the only current imaging method that permits the visualization of buccal/labial and lingual bone plates (SCARFE; FARMAN, 2008), not showing image superposition by conventional radiographs (GARIB et al., 2006). As a good image definition and high sensitivity and, both cone beam and spiral CT images can reveal bone dehiscences and fenestrations (FUHRMANN; BÜCKER; DIEDRICH, 1995; LOUBELE et al., 2008; LEUNG et al., 2010; GARIB et al., 2014). Accuitomo system (J. Morita, Kyoto, Japan) shows to be superior to other CBCT systems for depicting small anatomical structures (LIANG et al., 2010). The good quality image of this system is related to the smaller voxel size and smaller field of view compared with other CBCT machines (LIANG et al., 2010).

This split mouth transversal study showed that the periodontal conditions of maxillary central incisors long-term after orthodontic traction are different compared to its antimere. The orthodontic traction mechanics suffered greater bone and periodontal damage when compared to the spontaneously erupted controlateral incisors. A decreased thickness and height of buccal alveolar bone and gingival recessions were observed in central incisors 15 years after orthodontic traction.

4 Final Considerations

4 FINAL CONSIDERATIONS

The orthodontist should take measures to avoid periodontal destruction. Knowing the biological limits of tooth movement and the adaptations of the teeth traction over time allows the professional to choose orthodontic mechanics in which the benefits to the patient overcome the damages that may occur. Although orthodontic traction is an accepted and known method, negative aesthetic and periodontal effects on the treated tooth should be anticipated. Patients also should be informed of the possible need for additional periodontal procedures at the end of orthodontic treatment, to improve the aesthetics and periodontal health of the treated teeth.

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Appendixes

APPENDIX A – Declaration of exclusive use of the article 1 in thesis

Declaration of exclusive use of the articles in thesis

We hereby declare that we are aware of the article “Long-term periodontal status of maxillary central incisors after orthodontic traction: CBCT and clinical findings” will be included in the Thesis of the student Louise Resti Calil and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.

Bauru, January 18th, of 2018.

Louise Resti Calil

Daniela Gamba Garib

Guilherme Janson

APPENDIX B – Declaration of exclusive use of the article 2 in thesis

Declaration of exclusive use of the articles in thesis

We hereby declare that we are aware of the article “Is there a consensus for CBCT use in Orthodontics?” will be included in the Thesis of the student Louise Resti Calil and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.

Bauru, January 18^{th}, of 2018.

Louise Resti Calil

Daniela Gamba Garib

Guilherme Janson

APPENDIX C

LIST OF CLINICAL PARAMETERS

1. **Clinical attachment level (CAL):** Measure of the cement enamel junction at the base of the gingival sulcus/periodontal pocket. The probing attachment level was calculated as the sum of the probing depth and recession.

2. **Gingival Recession (GR):** The marginal tissue recess corresponds to the displacement of the apical gingival margin to the cementum-enamel junction, with root surface exposure. Measurements of recessions was taken at the center of the buccal and lingual surface with the aid of the aforementioned probe.

3. **Probing depth (PD):** Measurement of the gingival margin at the base of the gingival sulcus or periodontal pocket.

4. **Quantity of gingival mucosa (GM):** Distance ranging from free gingival margin to mucogingival junction, also measured in millimeters.

Annex

FACULDADE DE ODONTOLOGIA DE BAURU-USP

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: AVALIAÇÃO LONGITUDINAL DO PERIODONTO DE INCISIVOS CENTRAIS SUPERIORES TRACIONADOS ORTODONTICAMENTE

Pesquisador: LOUISE RESTI CALIL

Área Temática:

Versão: 2

CAAE: 55678816.8.0000.5417

Instituição Proponente: Universidade de Sao Paulo

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.710.788

Apresentação do Projeto:

Idem ao parecer consubstanciado nº 1.567.356, de 30-05-2016.

Objetivo da Pesquisa:

Idem ao parecer consubstanciado nº 1.567.356, de 30-05-2016.

Avaliação dos Riscos e Benefícios:

Idem ao parecer consubstanciado nº 1.567.356, de 30-05-2016.

Comentários e Considerações sobre a Pesquisa:

Idem ao parecer consubstanciado nº 1.567.356, de 30-05-2016.

Considerações sobre os Termos de apresentação obrigatória:

Verificar considerações no item "Conclusões ou Pendências e Lista de Inadequações"

Conclusões ou Pendências e Lista de Inadequações:

Trata-se de um retorno para análise das pendências, em parecer anterior; quais sejam:

1) Termo de assentimento e TCLE: Falta descrever sobre o procedimento de exame clínico, principal. É descrito sobre a moldagem para esclarecer ao participante, porém nada foi reportado sobre as

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avaliações
principais relacionados aos exames periodontais, tempo, desconforto, sangramento etc..
- PENDÊNCIA ATENDIDA.

2) Providenciar termo de aquiescência da Profis.
- PENDÊNCIA ATENDIDA.

Diante do exposto acima, sou de parecer favorável à aprovação da pesquisa.

Considerações Finais a critério do CEP:

Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 17.08.2016, 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_PROJETO_661584.pdf	27/06/2016 10:06:10		Aceito
Outros	termoaquiescencia_PROFIS.pdf	27/06/2016 10:03:16	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLEpais_modificado.pdf	27/06/2016 10:00:05	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de	TCLE_modificado.pdf	27/06/2016 09:58:18	LOUISE RESTI CALIL	Aceito

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Continuação do Parecer: 1.710.790

Ausência	TCLE_modificado.pdf	27/06/2016 09:58:18	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	Assentimento_modificado.pdf	27/06/2016 09:57:17	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLEpais.pdf	27/04/2016 16:21:42	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	Assentimento.pdf	27/04/2016 16:16:09	LOUISE RESTI CALIL	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	27/04/2016 16:00:38	LOUISE RESTI CALIL	Aceito
Outros	termo.pdf	08/04/2016 12:53:29	LOUISE RESTI CALIL	Aceito
Outros	carta.pdf	08/04/2016 12:51:22	LOUISE RESTI CALIL	Aceito
Projeto Detalhado / Brochura Investigador	projeto.pdf	08/04/2016 12:49:40	LOUISE RESTI CALIL	Aceito
Declaração de Instituição e Infraestrutura	infraestrutura.pdf	08/04/2016 12:47:46	LOUISE RESTI CALIL	Aceito
Folha de Rosto	folhaderosto.pdf	08/04/2016 12:46:26	LOUISE RESTI CALIL	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BAURU, 30 de Agosto de 2016

Assinado por:
Izabel Regina Fischer Rubira Bullen
(Coordenador)

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Universidade de São Paulo
Faculdade de Odontologia de Bauru

Departamento de Odontopediatria, Ortodontia e Saúde Coletiva

Termo de Consentimento Livre e Esclarecido

Você está sendo convidado a participar como voluntário da pesquisa:

"Avaliação do periodonto de incisivos centrais superiores tracionados ortodonticamente", cujos objetivos destinam-se a avaliar a saúde do osso e da gengiva do dente da frente que recebeu a mecânica de tracionamento ortodôntico, comparando com seu dente vizinho que nasceu de forma natural.

Para tanto, será realizado inicialmente um exame clínico, o que significa que iremos verificar os aspectos e a qualidade de sua gengiva. Este procedimento é feito com um instrumento específico (sonda periodontal), onde esta sonda será colocada delicadamente abaixo de sua gengiva para que seja medida e classificada se ela (gengiva) e outras estruturas ao redor do seu dente encontram-se em padrões de normalidade (saudável) ou alteradas (doente/inflamada). Avaliaremos 5 características em sua gengiva, ou seja, 5 exames serão realizados nela. Em alguns desses exames, a sonda medirá 6 regiões diferentes de cada um dos seus dois dentes (do dente tracionado e do dente vizinho). Estas 6 medidas serão realizadas 3 vezes, no mesmo instante, para que possamos realizar uma média desses valores. Com duração aproximada de 30 minutos, esta examinação pode gerar certo desconforto e/ou sangramento gengival. Sangramento na gengiva é sinal de que ela não está saudável como deveria, ou seja, encontra-se inflamada (gengivite), podendo até mesmo estar em um estágio mais avançado e perigoso do problema (periodontite). Todos esses dados serão colhidos e registrados em uma ficha clínica para serem avaliados em conjunto com as demais informações a serem apanhadas, conforme explicaremos logo abaixo. Você receberá orientações necessárias e, se decidir parar, o procedimento será imediatamente interrompido.

Rubrica do Responsável da Pesquisa :

Além do exame clínico, um procedimento de moldagem, o qual resultará na obtenção de modelo de gesso, que será utilizado para avaliar os aspectos da coroa do seu dente e da sua gengiva. As moldagens são procedimentos rápidos, com duração aproximada de 5 a 10 minutos, e fazem parte da rotina odontológica. O procedimento de moldagem pode apresentar leve desconforto, que pode ocorrer devido à sensação de ânsia. Você receberá orientações específicas para não sentir náuseas durante a moldagem e, se mesmo assim acontecer, a profissional saberá como aliviar seu desconforto imediatamente, inclusive interrompendo o procedimento, se necessário.

A coloração do dente da frente tracionado será comparada visualmente ao dente vizinho, contrapondo-se através de um guia de cores que determina com exatidão a tonalidade de seu dente natural.

Serão realizadas também algumas fotografias intrabucais (frente e lateral do sorriso) e extrabucais (frente e lateral da face), para complementar a avaliação acima descrita. Sobre estas fotografias, as mesmas serão utilizadas neste trabalho respeitando a sua privacidade.

Por fim, caso necessário, um exame de tomografia computadorizada da região em questão será solicitado para complementar o exame clínico, dando assim condições para o profissional unir as informações e estabelecer um correto diagnóstico da situação dos dentes avaliados. Diante da presença defeito ósseo ou ausência de cobertura óssea que expõe a superfície radicular do dente, você será avisado de que deverá realizar uma cirurgia de enxerto gengival para corrigir o volume da gengiva e a exposição da raiz, sendo encaminhado para este procedimento na clínica desta faculdade (se houver vaga) ou orientado a procurar tratamento em uma clínica particular.

A pesquisa apresenta certo risco, sendo mínimo o nível de desconforto. Porém, a exposição à dose de radiação recebida pela tomografia justifica o benefício que este exame lhe trará, pois as informações que serão obtidas detectará os problemas e proporcionará um tratamento efetivo dos defeitos detectados.

Rubrica do Participante da Pesquisa :

Todos os voluntários serão submetidos aos mesmos procedimentos. A consulta será realizada por uma cirurgiã-dentista com formação em Ortodontia que irá orientá-la sobre cuidados gerais com a saúde bucal, com o benefício de direcioná-lo quanto à necessidade de qualquer tipo de tratamento odontológico que se faça indispensável e, estarão à disposição para eventuais

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questionamentos. Não será oferecida remuneração, auxílio para alimentação ou transporte até o local no dia do atendimento. É garantida 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.

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 **pesquisadora** envolvida com o referido projeto é **Louise Resti Calil** e com ela você poderá manter contato via **e-mail** (louise.rc@hotmail.com) ou **telefone** (14) 98112-1518.

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.

Pelo presente instrumento que atende às exigências legais, o(a) 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.9º do Código de Ética Odontológica).

Por fim, como pesquisadora responsável pela pesquisa, DECLARO o cumprimento do disposto na Resolução CNS nº 466 de 2012, contidos nos itens IV.3 e IV.5.a e, na íntegra com a resolução CNS nº 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 nº 466 de 2012, itens IV.3.f e IV.5.d.

Bauru, ____ de ______________ de _______.

Assinatura do Participante da Pesquisa

Louise Resti Calil
Pesquisadora responsável
(louise.rc@hotmail.com / (14) 98112-1518)

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 nº 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.

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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.
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