Two-year evaluation of buccal bone dehiscences and fenestrations on mandibular incisors of patients after orthodontic treatment with piezocision and/or collagen matrix compared to a conventional orthodontic technique: a retrospective study

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ABSTRACT

Introduction : Different biomaterials have been used as a replacement for soft tissue augmentation, such as Mucograft®. For this reason, we consider the use of Mucograft® to thicken the gingiva concomitant with accelerated orthodontic treatment and, hypostatized that it could play a protective role for the periodontium during tooth movement.

Objective : The aim of this study was to compare the magnitude of buccal bone dehiscences and fenestrations, before treatment, at completion of treatment, and two years after retention, on mandibular incisors of patients who underwent conventional and accelerated orthodontic treatment with piezocision and/or Mucograft.

Materials and Methods: The study sample consisted of cone-beam computed tomography scans, taken before treatment (T0), at completion of treatment (T1) and two years after retention (T2) of 29 patients. The control group (G1) consisted of 9 patients who received conventional orthodontic treatment; the piezocision group (G2) consisted of 6 patients who received accelerated orthodontic treatment with piezocision; the piezocision and Mucograft® group (G3) consisted of 7 patients who underwent accelerated orthodontic treatment with piezocision and anteroinferior soft tissue graft (Geistlich Mucograft®); and the Mucograft® group (G4) consisted of 7 patients who underwent accelerated orthodontic treatment with anteroinferior soft tissue graft only (Geistlich Mucograft®). Buccal dehiscences and fenestrations were measured at baseline, at completion of treatment, and two years after retention. Also, absolute frequency, percentage, and transition degree of dehiscences and fenestrations in each time was evaluated for each incisor.

Results: Mandibular buccal Dh showed a statistically significant increase from T0 to T1, and a non-statistically significant decrease from T1 to T2 for all groups. In general, Fn showed non-statistically significant changes at all timepoints. The percentage of Dehiscences increased from T0-T1 especially for G1 and G2 and decrease from T1 to T2 in G2 and G4, in G1 it maintained, and in G3 it increased. The percentage of Fenestrations decreased from T0-T1 especially for G1 and G2, and decrease from T1 to T2 in G3, in G2 it maintained, and in G1 and G4 it increased.

Transition degree analysis showed that for teeth that had no dehiscences at T0, G3 and G4 has a better transition than did G1 and G2 at T1. For the incisors having dehiscences at T0, G3 and G4 had a worse transition degree at T1. For incisors without dehiscences at T1, most of it maintain without dehiscence at T2. G2 had a better transition degree than did G1, G3 and G4. For incisors with dehiscences at T1, most of it improved with a decrease of the dehiscences at T2, G1 followed by G4 had a better transition degree than did G2 and G3. For incisors without fenestrations at T0, most of it maintain without fenestration at T1. Incisors with fenestrations at T0, got cured at T1. G1 had a better transition degree than did G2, G3 and G4.

Conclusion: Dehiscences significantly increase at completion of orthodontic treatment; and decrease two years after retention for all groups. Mucograft may play a protective role in incisors that does not have dehiscence before treatment, while does not play this protective role when there is already a bone defect at baseline.

Key words: Accelerated orthodontics, Piezocision, Dehiscences, Fenestrations, Cone-beam computed tomography.

Introduction

The thickness of the anterior alveolus should be considered a limiting factor for orthodontic treatment since the structure and morphology of the alveolar process depends on the presence and position of teeth (1). This dependence can lead to the development of bone defects such as dehiscences (Dh) and fenestrations (Fn) (2). A dehiscence is described as a bone defect which expose the root surface when the crestal bone margin has been lost, whereas a fenestration is an isolated area in which the root is denuded of bone and the marginal bone stays intact exposing mainly the middle third of the root (3).

Dehiscences and fenestrations are common findings in different malocclusions (4), specifically, in lower incisors that have been considered the most susceptible teeth to develop these defects due to the decrease in the thickness of cortical bone in the mandible from the posterior to the anterior teeth (5–8). Recent studies have reported a high prevalence of alveolar bone defects before orthodontic treatments related to dental crowding and eccentric positions (5–9). Orthodontic forces and tooth movements could cause a reduction in bone height and thickness (1,2,5–8), therefore, it is important to evaluate individuals' bone morphology before any intervention (1).

Different surgical techniques have been described to enhance orthodontic treatment acceleration considering the preservation of periodontal tissues: Inflicted corticotomies together with mineralized bone graft is known as periodontal accelerated osteogenic orthodontics (PAAO). In the other hand, piezocision, a less invasive technique, consist of combining gingival microincisions followed by minimal piezoelectric osseous cuts to the buccal cortex concomitant bone or soft-tissue graft with a tunnel approach to enhance periodontium if needed (10).

Until now, the available clinical studies have focused on evaluating the effectiveness of the surgical techniques on accelerating tooth movement finding contradictory results (11–16). Only few, have evaluated the influence of these techniques in terms of alveolar bone defects (12,17,18). Considering that gingival recession is always accompanied by alveolar bone dehiscence (2), it is determinant to evaluate how different orthodontic techniques can affect the development of these bone defects, since bone defects may not always generate gingival recessions (8). The critical factor that could be associated with gingival recession is the thickness of periodontal phenotype, hence, it is determinant to monitor and intervene the width of the attached gingiva (19).

Different biomaterials and techniques are being used as a replacement for soft tissue augmentation, including grafts, local flaps, allogenic derived matrices, xenogenic tissue matrices from animal origin and and synthetic materials, such as Mucograft®.(20,21) Tissue engineering of oral mucosa represents an interesting alternative to obtain sufficient

autologous tissue for reconstructing oral wounds using biodegradable scaffolds, and may improve vascularization and epithelialization, which are critical for successful outcomes.(20)The xenogeneic collagen matrices proposed for soft tissue augmentation are preferred as they have provided, in general, outstanding clinical outcomes, greater availability, low cost and ability to be harvested in large quantities. (22)
We consider the use of Mucograft® to thicken the gingiva concomitant with accelerated orthodontic treatment and, hypostatized, that it could play a protective role for the periodontium during tooth movement (23). Different studies have found Mucograft to be a suitable substitute for free gingival graft in procedures designed to increase keratinized tissue around teeth. It has remarkable benefits, such as acceptable keratinized tissue gain, less pain, less surgical chair time, and better aesthetics.(24–27)
The influence of this procedure in the bone response to orthodontic forces, as well as changes in the amount of angulation of the tooth displacement remains unknown. CBCT is a useful tool to generate craniofacial images with adequate resolution, allowing a precise evaluation of anatomical structures. Therefore, the aim of this study was to compare the magnitude of buccal bone dehiscences and fenestrations on mandibular incisors, using a novel AI-automated dental tool, before, after and a two year-post retention period of patients who underwent conventional and accelerated orthodontic treatment with piezocision and/or Mucograft.

Materials and Methods

Study design.

This retrospective study was approved by the Ethics Committee of University of CES (Ae-480). The data was gathered from a sample that was prospectively collected in a previous study (28) were the patients' allocation to the groups was done by a randomized draw.

Twenty-nine patients were aged between 18 and 40 years old, with Angle's class I and mild-class II or -III malocclusion, with moderate lower anterior crowding and healthy periodontium, who underwent orthodontic treatment with passive self-ligating bracket system (Damon SL; Ormco, Orange, Calif)). The control group ((G1), n=9; 31%) consisted of patients who received conventional orthodontic treatment; Group 2 ((G2), n=6; 20.7%) obtain piezocision; Group 3 ((G3), n=7; 24.1%) consisted of piezocision and anteroinferior soft tissue graft (Geistlich Mucograft®); and Group 4 ((G4), n=7; 24.1%) underwent only anteroinferior soft tissue graft (Geistlich Mucograft®).

Clinical treatment protocol.

The surgical procedure was performed under local anesthesia, by two calibrated periodontists with the following protocol: for the experimental G2 and G3, vertical and interradicular gingival incisions were done on the buccal surface of the mandibular arch from the right to the left first molar, starting 2-3 mm below the interdental papilla and with sufficient depth to the periosteum to allow the scalpel to reach the alveolar bone. Through the incisions, a piezoelectric scalpel (piezotome) penetrated the buccal cortex thickness (1-2mm) to perform the corticotomies. A total of 11 mandibular corticotomies per lower arch were done. After piezocision was performed, G3 received the tunneling graft between the incisors where the matrix was positioned and retain using absorbable 5.0 suture. For G4, no piezocision was executed, only vertical and interradicular gingival incisions were done from the right to the left lateral incisor, where the grafting took place and sutured. Patients were prescribed with antibiotics and non-steroidal anti-inflammatories, and it was indicated to use chlorhexidine-mouth wash twice a day. The control group was followed up every 4 weeks compared to the experimental groups observed every 2 weeks. Mandibular archwire sequence followed cooper-nickel-titanium 0.014, 0.018 and 0.018x0.025-in; TMA 0.017x0.025-in; and stainless steel 0.017x0.025-in, only changed when they were no longer active.

Imaging acquisition

CBCT were obtained before (T1), after (T2), and two years after completion of orthodontic treatment (T3). The CBCT scans were acquired using the Veraviewepocs 3D R100 (J Morita Corp, Tokyo, Japan) according to the following acquisition protocol: 90 kV; 3–5 mA; 0.16 mm^3 voxel size; scan time, 9.3 s; and field of view of 100 × 80 mm. Three CBCT scans were acquired from the subjects in this study. The acquisition protocol was adjusted following radiology ALADAIP (As Low As Diagnostically Acceptable being Indication-oriented and Patient- specific) principles to minimize the radiation dose to patient and surroundings to a level as low as reasonably achievable (29). During the CBCT acquisition, all patients were awoken with Camper's horizontal plane parallel to the ground and were not occluding. All images were stored in Digital Imaging and Communications in Medicine (DICOM) files.

Variables

This study analyzed treatment outcomes regarding the bone profile considering dehiscences and fenestrations, as well as buccolingual inclination of lower anterior lateral and central incisors. The description of landmarks and measurement variables are those obtained in the report by Sun et al. (4): (1) *Dehiscence:* An alveolar bone defect involving an alveolar margin 2mm or greater and concurrent with a v-shaped bone margin of the alveolar crest, and quantified as *Dh:* the distance between A (cementoenamel junction at the buccal side) and B (alveolar crest at the buccal side). (2) *Fenestration:* a circumscribed defect on the alveolar bone exposing the root, not involving the alveolar crest; and quantified as *Fn:* the distance between C (coronal border of a fenestration) and D (apical border of a fenestration). The critical point for dehiscence on the CBCT was set at 2mm and for fenestrations at 2.2 mm. (3) *Buccolingual inclination:* The difference of the buccolingual long axis angulation in each timepoint of central and lateral mandibular incisors.

Image processing

All CBCT imaging data from T0, T1 and T2 were automatically anonymized and converted into single NIfTI files, using the 'SlicerBatchAnonymize' extension from the Slicer software, version 5.2.2 (www. slicer. org). The CBCT image pre-processing protocol included T0 orientation and T1 registration from a previous study (28). Subsequently, T2 CBCTs were manually approximated to the T1 images using a voxel-based registration validated semi-automated tools (30–38). The AMASSS automated tool was utilized for the mandibular bone and root canals segmentation, which were later converted in VTK-3D models using the Model-maker extension. Dental reference landmarks were automatically assigned with the ALI-extension and manually refined. The buccal bone defects were then measured using the ruler tool and the measurements of the buccolingual inclination were made using the AQ3D3 extension.

Study error

To avoid potential sources of bias, the landmark placement was measured by two calibrated operators and repeated two times where the resulting mean values were used. Systematic errors were evaluated with the intraclass correlation coefficient (ICC) and the Bland–Altman test. The Jamovi software, version 2.3 was used for the analyses. The ICC values ranged from 0.85 to 0.99 indicating excellent intraexaminer repeatability of the landmarks for linear measurements. The Bland–Altman method was performed revealing strong agreement in the inter-examiner measurements. The estimated bias was small (-0.5°), indicating a positive agreement, while the 95% confidence interval for the bias ranged from -1.12 to -0.01mm and −1.12 to -0.03°, demonstrating a close level of agreement.

Statistical approach

All statistical analyses were performed with the Statistical Package for the Social Sciences (version 16.0; SPSS, Chicago, IL). d0 and d1 of all groups were compared by Student's t tests, so were f0 and f1 of all groups. Mixed model t tests were performed to compare d1 − d0 and f1 − f0 of both control and treatment groups. Chi-square test and Wilcoxon rank sum test were performed to compare the transition degree of both control and treatment groups. Intra-operator reliability was assessed by calculating the intra-class correlation coefficient

(ICC) between measurements collected at both times. The significance level was set at a 2-tailed P value of 0.05.

The data were stored in Microsoft Excel and exported to the Jamovi software, version 2.3, in which the analyses were performed adopting 95% confidence intervals. The normality of the outcomes was evaluated with the Shapiro-Wilk test. The parametric data was analysed with Student's *t*-test, while the non-parametric data with the Mann-Whitney *U* test. To adjust the *P*-values for multiple testing, the Bonferroni correction was applied by multiplying each *P*-value by the total number of variables (*P* x n). All the data were expressed as the mean and standard deviation.

Statistical analysis

Statistical analyses were conducted using SPSS Statistics for Mac (version 23.0; SPSS, Chicago, Ill). One observer was calibrated by a radiologist, who repeated measurements for 10 randomly selected CBCT scans 3 times with a 1-week interval in between. Intraoperator and inter-operator reliability were assessed using the intra-class correlation coefficient (ICC) estimates and their 95% confident intervals (CI) using an absolute agreement, 2-way mixed-effects model.
The Kolmogorov-Smirnov and Shapiro-Wilk tests revealed that the variables of the study did not have a normal distribution. Therefore, non-parametric tests were used. The Wilcoxon test was used to compare intragroup measurement changes from T0 to T1 (T1-T0), T1 to T2 (T2-T2), and T0 to T2 (T2-T0). Kruskal Wallis test was used to compare the differences between the four groups at baseline (T0) and the T0-T1, (T1-T0), T1 to T2 (T2-T2), T0 to T2 (T2-T0) changes between the four groups.

There is also an Absolute Frequency and Percentage of Dehiscences (Dh>2mm) and Fenestrations (Fn>2.2mm) Before (T0) after treatment (T1) and two years after retention (T2) table that shows the count of dehiscences and fenestrations in all the three times for the four groups.

Based on Sun’s study in 2019 (4). a table of transition degree was made for dehiscences and fenestrations that shows by codes (1 to 18) how these defects changed at different timepoints. Codes 1 (maintain) and 2 (worsen) represents the change from T0 to T1 when at baseline there was no dehiscence or fenestration, codes 3 (maintain) and 4 (worsen) represents the change from T0 to T2 when at baseline there was no dehiscence or fenestration. Codes 5 (cure), 6 (improve), 7 (maintain) and 8 (worsen) represents the change from T0 to T1 when there was dehiscence or fenestration at baseline. Codes 9 (cure), 10 (improve), 11 (maintain) and 12 (worsen) represents the change from T0 to T2 when there was dehiscence or fenestration at baseline. Codes 13 (maintain) and 14 (worsen) represents the change from T1 to T2 when there was no dehiscence or fenestrations at the end of treatment. Finally, codes 15 (cure), 16 (improve), 17 (maintain) and 18 (worsen) represents the change from T1 to T2 when there was dehiscence or fenestrations at the end of treatment.

Results All the variables had excellent ICC for intra-operator repeatability (ICC=0.978 with 95% CI=0.951-0.994;), and good to excellent interoperator reliability ((ICC=0.973 with 95% CI=0.940-0.992).

Table I shows the study variables at T0. No statistically significant differences were found in age, treatment time, little irregularity index (LII), Interproximal reduction (IPR), cephalometric measurements, and bone defects between groups before treatment, except for Dh left central incisor ($P = 0.041$).

Table II shows the changes from T0 to T1 for Dh and Fn. In general, mandibular buccal Dh significantly increased from T0 to T1 for all groups ($P < 0.05$), except for the left lateral incisor in Group 1 ($P = 0.066$). When comparing the changes from T0 to T1 for Dh between the four groups, no statistically significant differences were found (P > 0.05).
Mandibular buccal Fn showed no change or a non-statistically significant decrease from T0 to T1 for all groups. When comparing the changes from T0 to T1 for Fn between groups, no statistically significant differences were found (P > 0.05).

Table III shows the changes from T1 to T2 for Dh and Fn. In general, mandibular buccal Dh showed a non-statistically significant decrease from T1 to T2 for all groups (P > 0.05), except for the left lateral incisor in Group 4, which showed an insignificant increase from T1 to T2 (0.34 ± 1.09mm; P=0.753). When comparing the changes from T1 to T2 for Dh between the four groups, no statistically significant differences were found ($P > 0.05$). Mandibular buccal Fn showed no change or non-statistically significant decrease or increase from T0 to T1 for all groups (P > 0.05). When comparing the changes from T0 to T1 for Fn between groups, no statistically significant differences were found (P > 0.05).

Table IV shows the comparison of baseline (T0) Vs after two years of retention (T2) of Dh and Fn. In general, mandibular buccal Dh significantly increased from T0 to T2 for all groups ($P > 0.05$), except for the right lateral incisor in Group 2 (P=0.116), left central incisor (P=0.091) and right lateral incisor in Group 4 (P=0.499). When comparing the changes from T0 to T2 for Dh between the four groups, no statistically significant differences were found (P > 0.05). Mandibular buccal Fn showed no change or non-statistically significant decrease or increase from T0 to T2 for all groups ($P > 0.05$). When comparing the changes from T0 to T2 for Fn between groups, no statistically significant differences were found ($P > 0.05$).

Table V shows the absolute frequency and percentage of dehiscences and fenestrations in mandibular lower incisors at baseline (T0), at completion of treatment (T1) and two years after retention (T2). At baseline the presence of dehiscences in mandibular incisors were 44.44% for G1, 16.67% for G2, 50% for G3, and 64.29% for G4. The presence of fenestrations at baseline were 19.44% for G1, 17% for G2, 4% for G3, and G4. At the end of treatment, the presence of dehiscences in mandibular incisors increase for all groups, this increase was less for G3 (29%) and G4 (25%) compared to G1 (41.67%) and G2 (58%). At the end of treatment, the presence of fenestrations in mandibular incisors decrease for all groups (G1 -19.44%; G2 -13%; G4 -4%) except for G3 (0%). Two years after retention, the presence of dehiscences in mandibular incisors maintain without changes for G1 (0%), decrease for G2 (-13%) and G4 (-4%); and increase for G3 (4%). For fenestrations increase in G1(2.78%) and G4 (4%), decrease for G3 (-4%) and maintain without changes for G2 (0%).

Table VII shows the transition degree for dehiscences and fenestrations from T0 to T1, T1 to T2 and the comparison between the four groups. For incisors without dehiscences before treatment ($Dh0 \leq 2mm$), most of it got worsen after completion of treatment ($Dh1 > 2mm$). G4 followed by G3 had a better transition degree than did G1 and G2. For incisors with dehiscences at baseline ($Dh0 > 2mm$), most of it got worsen with an increase of the dehiscences after completion of treatment ($Dh0 > 2mm$). G2 followed by G1 had a better transition degree than did G3 and G4. Most of the incisor in G4 showed a worse transition degree than the other groups.
For incisors without fenestrations before treatment ($Fn0 \leq 2.2mm$), most of it maintain without fenestration after completion of treatment ($Fn1 \leq 2.2mm$). For incisors with fenestrations at baseline ($Fn0 > 2.2mm$), most of it got cured after completion of treatment ($Fn1 \leq 2.2mm$). G1 had a better transition degree than did G2, G3 and G4.

For incisors without dehiscences after completion of treatment ($Dh1 \leq 2mm$), most of it maintain without dehiscence after two years of retention ($Dh2 \leq 2mm$). G2 had a better transition degree than did G1, G3 and G4. For incisors with dehiscences after completion of treatment ($Dh1 > 2mm$), most of it improved with a decrease of the dehiscences after two years of retention ($2 > Dh2 > Dh1$). G1 followed by G4 had a better transition degree than did G2 and G3.

Discussion

This is the first study that has sought to find the relationship between orthodontics, cortectomies and collagen matrix, as Mucograft in order to determine the role that this matrix plays as a protective factor during accelerated orthodontic treatment, in the anterior mandibular region that has found to be the most susceptible.

It has been found that when the incisors did not have dehiscences at baseline, G4, had a better transition degree than the other groups. However, those incisors with dehiscence at baseline in group 3 and 4 had the worst transition degree compared to the other groups. We can hypothesize that Mucograft can play a protective role for the periodontal phenotype when incisors had an intact alveolar bone before orthodontic treatment, on the contrary, when incisors have dehiscence at baseline, Mucograft did not have a protective role and maybe an osseous graft should be used to improve the condition of the alveolar bone previous orthodontic treatment This is proposed by Sun et al 2019, in their study they evaluated the changes of alveolar dehiscence and fenestration after augmented corticotomy assisted orthodontic treatment on cone-beam computed tomography (CBCT) compared with traditional presurgical orthodontics. They used a bovine inorganic bone over the anterior region and place collagen membrane over the bone graft material, finding for skeletal class III patients, that augmented corticotomy assisted orthodontic treatment is a promising method to improve the alveolar bone dehiscence and fenestration of lower anterior teeth (4).

We can also compare this study with Zigui Ma's and collaborators randomized control clinical trial that compared patients with orthodontic camouflage for dental Class II or decompensation for skeletal Class III malocclusions with bone defects on the buccal aspects of the anterior mandible region divided into the periosteum coverage group or traditional technique group for Periodontally accelerated osteogenic orthodontics (PAOO), showing that in contrast to our study, even with the bone defects at the beginning, both, periosteum-covered and bioresorbable membrane-covered PAOO regenerative procedures are effective in creating favorable alveolar conditions for orthodontic treatment and significant bone augmentation was achieved in each group from T0 to T2. Furthermore, the vertical alveolar bone augmentation in the experimental group increased significantly than that in the traditional surgery.(39) Similarly, Ziling Chen and collaborators found that the PAOO technique is beneficial to periodontal conditions and may represent a safe and efficient treatment for orthodontic patients with bone dehiscence and fenestration.

On the other hand, the systematic review of Ching Wei Wang showed Within the limited studies included that periodontal phenotype modification therapy PhMT-b via particulate bone grafting together with corticotomy-assisted orthodontic therapy CAOT may provide clinical benefits such as modifying periodontal phenotype, maintaining or enhancing facial bone thickness, accelerating tooth movement, expanding the scope of safe tooth movement for patients undergoing orthodontic tooth movement. (40)

This study found statistically significant increase of Dh from baseline (T0) to completion of treatment (T1) for all groups, while Fn showed no change or a non-statistically significant decrease. These findings were also reported by different authors that showed a worsening of periodontal status after orthodontic therapy (5,46). Wilcko et al (47). in a previous study of series of cases, showed that 2.5 months after debracketing there is the appearance of almost a complete lack of mineralized bone over both the labial and the lingual root surfaces of the treated teeth, but the osseous organic matrix is intact. Kyung-Min Lee et al. (48) also showed in a study with 25 patients how presurgical orthodontic for prognathic patients could cause alveolar bone to lose around lower incisors and finally, Fabian Jager at al. and Liangyan Sun et al. showed also a reduction on alveolar bone thickness and a worsening in dehiscences and fenestrations but in less degree than our study (1,4). On the other hand, these results conflict with Charavet et al. (12), who evaluated the effect of piezocision in the periodontium compared with a control group and found no significant increases in dehiscence or fenestration in either group.

This study also found no statistically significant difference from T0 to T1 for Dh and Fn when comparing the four groups. In contrast Raj et al. (18) compared the effect of traditional orthodontics and piezocision-assisted orthodontics on the resultant alveolar bone level and found a statistically significantly greater gain in the experimental side ($P < .05$) of the alveolar bone level in the buccal and mesial surface after a canine retraction. However, this last study evaluated the bone defects only after six months of treatment, while this study evaluated this effect at the end of orthodontic treatment.

Comparing the changes from T1 to T2, this study showed a non-statistically significant decrease of Dh for all groups, showing that although bone does not return to its initial state two years after retention, it recovers. To our knowledge, this is the first study to evaluate after two years retention the behavior of dehiscences and fenestrations after conventional and piezocision-assisted orthodontic treatment in humans. There are some studies in animals that evaluated the changes long term in alveolar bone defects, such as Tomasso Vercelloti et al. (49) who found that 56 days after the surgical procedure performed with piezoelectric knife, it resulted in more favorable osseous repair and a minimal gain in bone level. In addition, Dibart et al. (50) found in Sprague-Dawley rats that the alveolar bone significantly diminished after performing a bone piezocision and continue until day 28, but then it recovers its initial topographic characteristics after 56 days. To date, only a series of cases report have been published by Wilcko et al. (51) where they evaluated the topographic characteristics of the bone in the long term after performing an accelerated orthodontic treatment with surgery, showing that at 2 years retention, the alveolar housing over both the labial and the lingual root surfaces has reappeared in both adolescent and adult patient.

Like most studies, ours had some limitations. We used secondary sample CBCT scans of orthodontic patients, without considering the presence and magnitude of bone defects in the inclusion criteria before starting the treatment. Also, our sample size is small, therefore the results most be evaluated with caution. However, this is the first study to evaluate and describe the defects in the mandibular incisors, two years after retention of accelerated orthodontic treatment. Previous studies had shown that CBCT scans provides high-resolution 3D images and are effective in detecting naturally occurring dehiscences and fenestrations at a relatively lower dose and cost (3,41,42). Nevertheless, the use of CBCT scans in dentistry and in orthodontic diagnosis remains controversial. Some authors have justified the use of CBCT scans only in those cases where conventional radiography fails to provide a correct diagnosis information of a pathology (43). When evaluating alveolar bone defects such as dehiscences and fenestrations, traditional x-rays do not provide a complete information of bone anatomy, making impossible to determine a correct diagnose of this type alveolar bone loss, and to illustrate the evolution over time or after orthodontic treatment. For this reason, CBCT scans has been considered as a good imaging modality choice, because it provides high resolution imaging and diagnostic reliability with a positive risk–benefit balance (42,44,45), acceptable sensitivity, and specificity according to previous studies, and it has easy accessibility and has no need of an invasive procedure such as a flap elevation for a direct detecting of alveolar bone dehiscences and fenestrations (42,44). The CBCT scans in this study, allowed the quantitative and qualitative evaluation of dehiscences and fenestrations in patients, without the need of an invasive procedure for a direct assessment in the following times of observation. Although the radiation exposure for conventional radiographs is lower than for the CBCT scans, its resolution does not provide the precise reproduction of the periodontium anatomical details (45).

Future studies are recommended to evaluate the effect of bone graft with the use of Mucograft, when there is already a defect like dehiscence. As seen in Brugnami’s study, Corticotomy with bone grafting seems to be an effective method in minimizing the risk of marginal bone resorption and fenestration when a tooth is inclined or moved toward the cortical plane (54). and also in Chin Wei Wang`s study that concluded that corticotomy with particulate bone grafting may provide clinical benefits of augmenting periodontal phenotype, accelerating tooth movement, expanding the scope of incisor movement and enhancing post orthodontic stability of the mandibular anterior teeth (40).

Conclusions

Dehiscences significantly increase at completion of orthodontic treatment; and decrease two years after retention for all groups, showing that bone level can improve in the retention period, regardless of the intervention to which they were subjected.

Mucograft may play a protective role in incisors that does not have dehiscence before treatment, while does not play this protective role when there is already a bone defect at baseline. That is why is important to evaluate the periodontal status before starting a surgical accelerated orthodontic treatment.

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