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ABSTRACT

Introduction: The opening of the contact point can happen after orthodontic closure of the site of dental extraction and opened interproximal contacts are considered potential factors for periodontal diseases. **Objective:** To evaluate the condition of the alveolar bone crest of the interdental site between canines and upper premolars with or without contact points in individuals submitted to orthodontics associated with the extraction of the first premolars. **Material and Methods:** This cross-sectional observational study selected upper canines and premolars of individuals undergoing orthodontic treatment without extractions (12 hemiarches – control group), or with extraction of the upper first premolars and whose canines and second premolars had interproximal contact (11 hemiarches – group 1) or diastema (15 hemiarches – group 2). The height and the presence of lamina dura in the interproximal bone crest of the distal surfaces of canines and mesial surfaces of premolars were evaluated. **Results:** Groups 1 and 2 demonstrated the higher and smallest prevailing of the presence of lamina dura, respectively. The control group presented the bone crest positioned more crownly in relation to the others groups. Experimental groups did not present significant differences to the height of bone crest. **Conclusion:** The orthodontic allocation of teeth to extraction sites was associated with the significant reduction of the height of the marginal bone crest, regardless of the presence or absence of contact point between the teeth. The lack of contact point resulted in a minor prevalence of the continuity of the lamina dura of the alveolar bone crest in these regions.

Key-words: Periodontics; Orthodontic Space Closure; Tooth Extraction; Dental Occlusion.

RESUMO

Introdução: A abertura do ponto de contato pode ocorrer após o fechamento ortodôntico do sítio de extração dentária e os contatos interproximais abertos são considerados fatores potenciais para as doenças periodontais. **Objetivo:** Avaliar a condição da crista óssea alveolar do espaço interdentário entre caninos e pré-molares superiores com ou sem pontos de contato em indivíduos submetidos a tratamento ortodôntico associado à exodontia dos primeiros pré-molares. **Material e Métodos:** Este estudo transversal observacional selecionou caninos e pré-molares superiores de indivíduos submetidos a tratamento ortodôntico sem extrações (12 hemiarcos – grupo controle), ou com exodontia dos primeiros pré-molares superiores e cujos caninos e segundos pré-molares tiveram contato interproximal (11 hemiarcos – grupo 1) ou diastemas (15 hemiarcos – grupo 2). Foram avaliadas a altura e a presença da lâmina dura na crista óssea interproximal das superfícies distais dos caninos e mesiais dos pré-molares. **Resultados:** Os grupos 1 e 2 demonstraram a maior e a menor prevalência da presença de lâmina dura, respectivamente. O grupo controle apresentou a crista óssea posicionada mais coronalmente em relação aos demais grupos. Entre os grupos experimentais, não houve diferença significativa para a altura da crista óssea. **Conclusão:** Neste estudo preliminar, a movimentação ortodôntica dos dentes para os locais de exodontia foi associada à redução significativa da altura da crista óssea marginal, independentemente da presença ou ausência de ponto de contato entre os dentes. A falta de ponto de contato resultou em menor prevalência de continuidade da lâmina dura da crista óssea alveolar nessas regiões.

Palavras-chave: Periodontia; Fechamento de Espaço Ortodôntico; Extração Dentária; Oclusão Dentária.

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INTRODUCTION

Fixed contact point and well located in proximal surfaces are considered an essential characteristic for periodontal health, because they avoid the impact of food during mastication, considered one of the potential factors for the development of periodontal diseases.¹⁻⁴

In functional terms, proximal contact areas should be located at the joint of the upper and middle third of the proximal surface and should be sufficiently tight to avoid food impact. Otherwise there can be an increase in the formation of biofilm and dental calculus in the region, causing gum inflammation, cervical caries and loss of bone support.⁵ Opened interproximal contacts are considered potential factors for periodontal diseases, being reported less healthy gingival papillae in these proximal areas,⁴ mainly due food impaction and plaque retention.⁶

The morphology of the dental crown and the position of the teeth in the dental arch are characteristics that demonstrate mutual dependency for the formation of an ideal contact point, being the correct relationship among the teeth essential for the protection of the support tissue during the mastication process.⁵

Teeth extraction in order to obtain the space for the correct alignment of the teeth are therapeutic strategies used on a daily basis in orthodontics, being the first premolars the ones highly indicated for extraction.^{7,8} This type of procedure is associated to the alterations in terms of architecture of the interdental bone in the site of the extraction resulting in the reduction of the height of the interproximal bone.^{7,9} The alterations in the alveolar bone caused by induced teeth moving by the orthodontic treatment are reasons for short to medium term worries, because they can increase the susceptibility of individuals to periodontal problems.^{10,11}

Once, due to the lack of final stability, the opening of the contact point can happen after orthodontic closure of the site of dental extraction, the present study aimed to evaluate the radiographic condition of the alveolar bone crest of the interdental site between canines and upper premolars with or without contact points in individuals submitted to orthodontics associated with the extraction of the first premolars.

MATERIAL AND METHODS

This study was approved by the Ethics Committee of Federal University of Juiz de Fora according to the norm 1.949.756, all of the individuals that took part in the study did it voluntarily.

In this cross-sectional observational study the individuals selected underwent orthodontic treatment, in which the treatment with fix edgewise ended between 2002 and 2017, the use of upper retention was suspended at least one year and the treatment of the upper arch

was done without teeth extraction or with the extraction of the first premolars. The individuals presented, in the pre-treatment the documentation that reported, full permanent dentition (except the second and third upper permanent molars) and canines and upper premolars totally erupted with absence of vertical bone loss or rotation higher than 10°.

The control group (CG) was formed by 12 interproximal regions between canines and first upper premolars of individuals treated without upper teeth extraction, but with the presence of contact points between these teeth. In individuals submitted to orthodontic treatment associated with extraction of the first upper premolars, 11 interproximal regions between canines and second upper premolars that presented contact points were allocated to group 1 (G1) and 15 regions that did not present contact point were allocated to group 2 (G2). The absence of contact was diagnosed through flossing without resistance using non waxed dental floss.¹²

The mean age of the individuals was 23.0, 29.2 and 29.5 years and the post-treatment mean time was 5.0, 2.2 and 6.3 years, in the control group, group 1 and group 2 respectively.

The teeth included in the three groups were submitted to interproximal digital radiographic exam with Kwik-Bite positioner. The center of the radiographic film (40x30mm) was positioned in the mesiodistal center of the first upper premolar in the control group and in the center of the second premolar in groups 1 and 2, being the center axis of the X-ray beam directed to the same point.

The radiographic images were evaluated by the Image J 1,46R (National Institutes of Health, USA) for the determination of the following variables:

- The height of the interproximal marginal bone crest: evaluated between the canine and first premolar (CG) or between the canine and second premolar (G1 e G2). Initially a perpendicular line was drawn to the bisector of the roots of the canine and premolar, in an equidistant way to the cement-enamel junction (CEJ) of the distal surface of the canine and mesial surface of the premolar (ECJ line). The height of the bone crest was determined by the vertical distance between the ECJ line and the most coronal point of the alveolar bone crest (figure 1). So, the bigger the distance more apically positioned was the alveolar bone crest.
- Presence of lamina dura in the alveolar bone crest: It was evaluated the continuity of lamina dura in the alveolar bone crest between the canine and the first premolar (CG) or between the canine and the second premolar (G1 and G2). The lamina dura was classified as present when its outline was fully visible.

Once the linear measures were made in pixels in

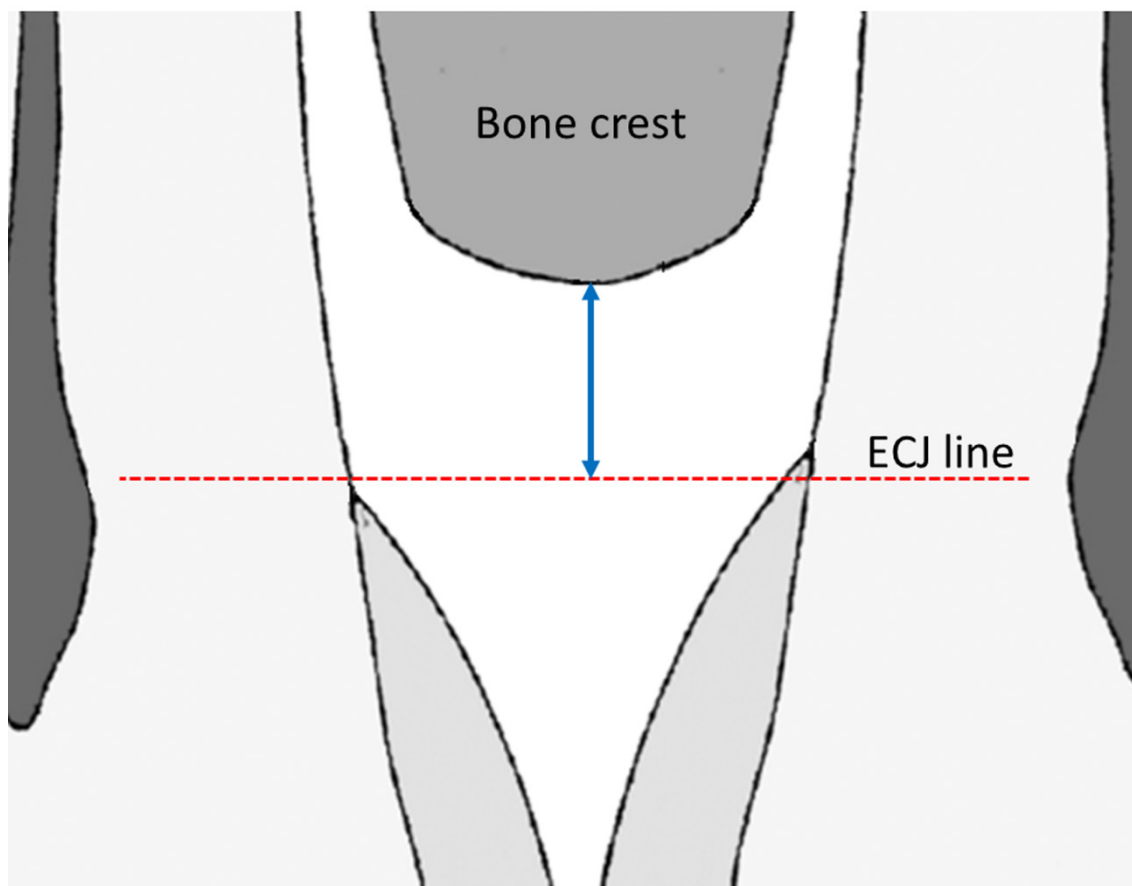


Figure 1: Determination of the height of the interproximal marginal bone crest.

the image programme J 1,46R (National Institutes of Health, USA), it was necessary the correction of these in millimeters. In order to do this, the first (CG) or the second (G1 and G2) premolars had their larger mesiodistal diameters measured in pixels in the radiographic image and in millimeters in plaster models with a digital caliper (Starret, Itu, Brazil). Having as a reference the measures in pixels and milimeters of the premolars, the linear measure in pixels of the height of the marginal bone crest was converted to millimeters using a calculation rule of three.

The individuals evaluated with the lack of contact point between canine and second upper premolar were asked about food impaction in the interproximal region.

To measure the mean error of the researcher responsible for the evaluations, a comparison was made of the values obtained of 10 radiographs in two different moments, with a 20 day interval, and the reproducibility of these measures was evaluated using the Intraclass Correlation Coefficient (ICC).

The values obtained for the height of the alveolar bone crest were compared between the pairs of groups (CG x G1, CG x G2 and G1 x G2) using the Mann-Whitney test. A significance level of $\alpha = 0.05$ was used and the data was processed by the SPSS Statistics 20.0.0 (SPSS, Chicago, IL, USA).

RESULTS

The values obtained for the error of the method showed excellent reproducibility for ICC (<0.850).

The average value of the height and the percentage of the presence of cortical bone in the marginal bone crest of the three groups evaluated are described on table 1.

Group 2 formed by the interproximal regions of canines and premolars allocated to the tooth extraction site without contact point, demonstrated the smallest prevailing situation of the presence of lamina dura of the alveolar bone crest (33.3%) and group 1 (with contact point in the interproximal region) showed the higher prevailing situation of lamina dura, 6.1% more than the control group.

The control group presented the bone crest positioned statistically more crownly in relation to group 1 ($p = 0.016$) and group 2 ($p = 0.004$). Groups 1 and 2 when compared did not present significant differences to the height of bone crest.

All individuals evaluated with the lack of contact point between canine and second upper premolar reported food impact in the interproximal region.

DISCUSSION

Table 1: Height and percentage of the presence of cortical outline of the marginal bone crest.

Groups	N	Height of marginal bone crest		Presence of lamina dura
		Mean (mm)	Standard deviation	
Control group (CG)	12	1.20	0.080	66.6%
Group 1 – with contact point (G1)	11	1.88	0.217	72.7%
Group 2 – without contact point (G2)	15	1.81	0.150	33.3%

Table 2: Comparison of the height of the bone crest between the groups.

Groups	p-value*
CG x G1	0.016
CG x G2	0.004
G1 x G2	0.775

*Mann-Whitney test. CG: control group. G1: group 1 (with contact point). G2: group 2 (without contact point).

The indication for teeth extraction as an auxiliary way to orthodontic treatment for individuals with lack of space for the correct dental alignment is a common practice in orthodontics and the allocation of teeth for extraction sites can alone lead to the reduction of interproximal bone height.^{7-9,13} In this study, the interproximal regions of the teeth allocated to the extraction sites that maintained the contact point (group 1) demonstrated a significant reduction of the alveolar bone crest. However the integrity of the lamina dura of the alveolar bone crest prevailed more when compared to teeth that were treated orthodontically without extraction. Zachrisson and Alnaes,¹⁴ Zachrisson and Artun and Osterberg also described significant bone loss in teeth that were moved to extraction sites, however their samples were composed by individuals treated with fully banded orthodontic appliance and compared with individuals not treated and limiting the comparisons with the present study, since orthodontic bands were linked to gingival inflammation, gingival bleeding and increased probing depth.¹⁵⁻¹⁷ Lombardo et al¹⁸ identified through cone beam computed tomography exams significant reductions on the height of alveolar bone crest only on the dental surfaces towards the extraction sites, when compared to the proximal homologous surfaces in the cases that were treated without extraction.

Once the loss of stability and consequently the opening of the contact point can happen after orthodontic treatment associated to the closure of spaces obtained through tooth extraction,¹⁹ two control groups were used in the present study: a positive control, formed by teeth allocated to the extraction sites and

with contact points (group 1), and a negative control, in which the extraction and the open contact point were absent (control group).

The lack of contact point generates a chewing disfunction due to the abnormal relation between teeth/periodontal tissue and food during chewing, resulting into an impact and local food retention.^{5,6,12,20,21} The repetitive food impact in the interdental site without contact point was linked to the alterations on the alveolar bone crest and clinical manifestations such as retaining plates and modifying periodontal disease for compromising the adherence between the teeth and connective tissue.^{1,4,22,23} On the other hand, Koral, Howell e Jeffcoat reported that there is no evident association among vertical bone loss and lack of contact point when compared with contralateral interproximal regions with contact points.²⁴ As a whole, it seems that the absence of contact point should not be considered a cause factor for periodontal problems, but as a facilitator of installing ethiological agents associated to these problems.^{15,25}

In this study, comparison between the interproximal sites that distinguish only by the presence or absence of contact point (groups 1 and 2), demonstrated that the height of the alveolar bone crest was not significantly altered by the absence of interproximal contact (0.07mm of difference between the groups), but the integrity of the cortical outline on the alveolar bone crest was of 2.2 times more prevalent when the contact point was present, probably related to the food impaction in the proximal contact loss sites.¹² Bimstein e Garcia-Godoy also reported discontinuity of the lamina dura on the interproximal alveolar bone crest in sites with open contact points,²⁵ however associated to vertical alveolar bone loss in the region.

Despite the fact that the discontinuity of the lamina dura of the marginal bone crest has been associated to the absence of contact point in interproximal spaces,²⁵ Greenstein et al²⁶ demonstrated that there was no correlation of this characteristic with the positive score for clinical periodontal parameters such as gum inflammation, bleeding index, probing depth and attachment loss.

CONCLUSION

In this preliminary study, the orthodontic alloca-

tion of teeth to extraction sites was associated to the significant reduction of the height of the marginal bone crest, regardless of the presence or absence of contact point between the teeth. The lack of contact point resulted into a minor prevalence of the continuity of the lamina dura of the alveolar bone crest in these regions.

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