ASSOCIATION BETWEEN POST-ORTHODONTIC TREATMENT GINGIVAL MARGIN ALTERATIONS AND SYMPHYSIS DIMENSIONS

Luciane Q. Closs[1], Leonardo F. Bortolini[1], Ary dos Santos-Pinto[2], Cassiano K. Rösing[3]

[1] *Lutheran University of Brazil (ULBRA), Brazil / Department of Orthodontics, Porto Alegre/, RS –Brazil*

[2] *Araraquara School of Dentistry, São Paulo State University (UNESP), Brazil*

[3] *Federal University of Rio Grande do Sul (UFRGS) Porto Alegre-Brazil*

ABSTRACT

Orthodontic therapy is known to be associated with the development of gingival recession. Several factors may be involved in the causal chain of this outcome, including anatomical and behavioral aspects. Among the anatomical aspects, the dimensions of the mandibular symphysis could play a predisposing role. This study evaluated the relationship between the mandibular symphysis dimensions prior to orthodontic therapy and the development of gingival recessions on the lower incisors and cuspids. Records from 189 orthodontically treated adolescents were evaluated, including radiographs, casts and intra-oral photographs. Symphysis dimensions were assessed by cephalograms. Gingival margin alterations were determined in photographs and cast models. Association between gingival margin alterations and symphysis dimensions was tested by chi-square (α=0.05). Occurrence of gingival recession increased after orthodontic therapy. No association was observed on average of symphysis dimensions and the occurrence of gingival recessions. It may be concluded that pretreatment symphysis dimensions may not be used as predictors of gingival recession after orthodontic therapy.

Key words: *Gingival Recession; Orthodontics; Adolescent*

ASSOCIAÇÃO ENTRE ALTERAÇÕES DA MARGEM GENGIVAL PÓS-TRATAMENTO ORTODÔNTICO E DIMENSÕES DA SÍNFISE

RESUMO

Sabe-se que o tratamento ortodôntico está associado com o desenvolvimento de recessão gengival. Vários fatores podem estar envolvidos na cadeia causal deste desfecho, incluindo aspectos anatômicos e comportamentais. Dentre os aspectos anatômicos, as dimensões da sínfise mandibular poderia ter um papel predisponente. O presente estudo avaliou a relação entre as dimensões da sínfise mandibular prévias ao tratamento ortodôntico e o desenvolvimento de recessões gengivais nos incisivos e caninos inferiores. Prontuários de 189 adolescentes tratados ortodonticamente foram avaliados, incluindo radiografias, modelos e fotografias intra-orais. Dimensões da sínfise foram determinadas em cefalogramas. Alterações da margem gengival foram observadas em fotografias e modelos. Associações entre alterações da margem gengival e dimensões da sínfise foram testadas por qui-quadrado (α=0.05). A ocorrência de recessão gengival aumentou após tratamento ortodôntico. Não foi observada associação entre as medidas médias de sínfise e a ocorrência de recessões gengivais. Pode-se concluir que as dimensões da sínfise pré-tratamento ortodôntico não podem ser usadas como preditores de recessão gengival pós-tratamento ortodôntico.

Palavras-chave: *Recessão gengival; Ortodontia; Adolescente*

INTRODUCTION

Gingival recession is a common undesirable side-effect that can occur during orthodontic treatment. Although some studies have shown the association between incisor proclination, bone dehiscences and the subsequent gingival recession,[1-6] it is a controversial subject with a number of studies that have not been able to find such association[7-10].

Årtun *et al*.,[11] and Furhrmann[12] concluded that small alveolar process and thin bone plates are anatomic risks for the development of gingival recession. Furthermore, Wennström *et al.*[8] and Engelking and Zachrisson[13] in studies with monkeys observed that as long as the tooth movement occurred exclusively within the alveolar bone, no apical shift of the gingival margin is likely to take place. Also, bone

repositioning can occur in a coronal direction once teeth that are in extreme labial position are moved to a more ideal position.

The possibility that recessions can be caused by tooth roots moving through the alveolar plate suggests the need to evaluate the thickness of the alveolar process in order to assess and reduce the risk of bone dehiscences and recessions.

Since the use of computerized tomography involves unnecessary exposure of the patient to radiation and additional expense, the lateral cephalogram became the simplest option to evaluate symphysis morphology. However, the precise measurement of the alveolar process is nearly impossible to achieve due to the superimposition of the anterior teeth and the bone structures.

Aki *et al.*[14], created a symphysis ratio based on lateral cephalograms, and found an association between the amount of mandibular anterior growth with short height and large depth of the symphysis. It may therefore be presumed that individuals with a higher anterior growth have a larger alveolar bone and may be the least susceptible to having bone fenestrations.

The purpose of this study was to answer the question: is symphysis morphology a predisposing factor to post-orthodontic treatment gingival recession in lower anterior teeth? The hypothesis underpinning the study is that recession could be facilitated by different anatomical characteristics of the symphysis.

MATERIALS AND METHODS

The sample consisted of records (pretreatment and post-treatment) of Caucasian adolescents that completed orthodontic therapy with fixed appliances at two private practices with experienced orthodontists. The Institutional Review Board of the Lutheran University of Brazil approved this study protocol. From a total of 209 records, 189 were selected (82 males and 107 females) with mean ages of 11.2 years (SD: 1.9 years) and 14.7 years (SD: 1.8 years) when the initial and end of treatment records were taken, respectively. The inclusion criteria were:

- Angle Class I or a Class II malocclusion, Angle Class III were excluded due to their tendency of incisor retroclination;
- With or without transverse and/or vertical discrepancy;
- Treated without extractions but allowed enamel stripping, since extraction requires a subsequent space closure that may result in tooth retroinclination that can generate unreliable data;
- Spacing or crowding not exceeding 4 mm. This limit was established because greater crowding may be treated with extraction or enamel stripping associated with proclination, while larger spaces require similar space closure of the cases treated with extractions;
- The lower permanent incisors were fully erupted to allow recession evaluation;
- Apparently good periodontal health, as gingivitis may produce edema that could mask existing recession;
- Final records (study models and intra-oral photographs) taken 28 days or more after removal of the appliances.

The average duration of the active treatment in the lower arch was 1.99 ± 0.89 years. All patients in the study received oral hygiene instruction and/or periodontal treatment based on their individual needs. Patients were excluded if they had a pre-existing systemic condition that could interfere in gingival or orthodontic outcomes, were taking medication associated with gingival changes, and if the pre- and/or post-treatment records could not be measured.

Main outcome

Dependent Variable

The dependent variable in this study is gingival recession on the lower incisors and canines, which were evaluated by means of visual inspection of the models and intra-oral photographs. Gingival recession was considered present when the cementoenamel junction was visible at the buccal gingival margin. The positions of the gingival margins relative to the maximum curvature of the labial surfaces of the lower canines and incisors were measured with a digital caliper (Digimatic®, Mitutoyo,UK) on pre- and post-treatment 3.54 x 5.12 inch intra-oral photographs (anterior and lateral views) and study models. The amount of the recession was measured to the nearest tenth of a millimeter.

To determine the errors of the method, gingival margin measurements were performed twice on 20 randomly selected photographs, with an interval of at least one week. Kappa statistics were used to evaluate intra-examiner agreement, and a Kappa value of 1.0 was obtained for the presence/absence of gingival recession.

Since the records used in this study included photographs, it was necessary to use a multiplication factor, as suggested by Djeu *et al.*[15], to reduce the unknown magnification present on the photographs as a measurement distortion. The enlargement correction for the photographs was achieved by comparing the crown length of the upper incisor, recorded in the same photograph, with the same tooth as recorded on the cast. The following equation was then used: actual recession is equal to photographic measurement of the recession multiplied by the actual cast crown length and divided by the photographic measured crown length.

Independent Variables

Lateral cephalograms were scanned and cephalometric landmarks were marked and digitized using Radioceph® program (Radiomemory, Belo Horizonte, Brazil) by an experienced examiner who was not informed of the objectives of the study.

In order to assess the dimensions of the symphysis, its height and width (depth) were measured as described by Aki *et al.*[14] A ratio was created by dividing height by depth:

Height was measured by a vertical line tangent to point B, from point B to a line tangent to the inferior limit of the symphysis.

The symphysis larger depth was considered to be the distance from the projection of the most anterior point to the most posterior point of the symphysis on the horizontal plane.

Other attempts to evaluate the symphysis smaller depth were made: in the lower incisor, a 15-millimeter measurement from the tooth edge towards the root apex was used to create a cephalometric landmark Sli (symphysis lower incisor). Over this point, a plane was established parallel to the mandibular plane that cuts the symphysis at SyA (Symphysis Anterior) and SyP (Symphysis Posterior) and a measurement across SyA-SyP was used to determine a depth closer to the gingival margin and to the bone crest.

The inclination of the lower incisors was obtained through IMPA (Incisor Mandibular Plane Angle - lower incisor to mandibular plane). Initial and final measurements were evaluated and divided into three groups: patients with teeth that were proclined, patients with teeth that were retroclined and patients without alteration in the labio-lingual position of the lower incisors.

Statistical Analysis

Absolute and relative frequencies of gingival margin alterations as well as measurements from the symphysis and indexes were obtained. Chi square analysis was utilized to verify the association between recession and tooth inclination. The data collected was submitted to one-way ANOVA and Student's t test, depending on the number of groups, at 5% level of significance.

RESULTS

After treatment, 91.6 % of the evaluated teeth remained without recession, 6.3 % developed recession, in 1% there was coronal migration masking a previous recession and 1.1 % of the pre-existing recessions remained the same after treatment ($p<0.001$). The chi square analysis revealed no significant association ($p=0.277$) between the alteration of tooth inclination and the presence of new gingival recessions (Table 1).

Although it was observed that at the end of treatment patients with greater symphysis heights and therefore higher ratio values were more frequently associated with recessions; these associations were not statistically significant (Table 2).

Ratio values changed upon comparing the initial and final means, as observed in Table 3. This table also shows that different ratio values and their association to the gingival margin position at the beginning and at the end of the treatment.

No statistically significant difference was observed between the mean ratio values (at the beginning and the end of the treatment) that could be related to gender (Table 4).

Table 1: Occurrence of gingival recession in relation to the experimental times (before and after orthodontic treatment) – Site/tooth level analysis.

Before	After				Total	
	Absent		Present			
	N	%	*N*	%	*N*	%
Absent	1074	91.6	74	6.3	1148	97.9
Present	12	1.0	13	1.1	25	2.1
Total	1086	92.6	87	7.4	1173	100.0

Statistically significant differences observed comparing before and after treatment (Mc Nemar test; $p<0.001$)

Table 2: Association of the gingival margin position and the values for symphysis height and depth before and after orthodontic treatment.

	Gingival Margin Position						P
	Coronal Migration		Unaltered		Recession		
	Mean	*Standard Deviation*	*Mean*	*Standard Deviation*	*Mean*	*Standard Deviation*	
Initial Height	20.12 mm	2.20 mm	19.83 mm	2.50 mm	19.67 mm	2.28 mm	0.842
Initial Depth	15.11mm	1.96 mm	14.37 mm	1.76 mm	14.53 mm	1.84 mm	0.419
Final Height	22.13 mm	2.51 mm	22.56 mm	2.74 mm	23.53 mm	2.88 mm	0.073
Final Depth	15.32 mm	1.86 mm	15.12 mm	1.93 mm	15.35 mm	2.23 mm	0.767

p= minimum level of significance from one-way ANOVA

Table 3: Association of the gingival margin position and the average ratios at the beginning and end of the treatment.

	Classification						P
	Coronal Migration		Unaltered		Recession		
	Mean	*Standard Deviation*	*Mean*	*Standard Deviation*	*Mean*	*Standard Deviation*	
Initial Index	1.34	0.17	1.38	0.22	1.34	0.23	0.496
Final Index	1.46	0.19	1.50	0.23	1.55	0.23	0.265

p= minimum level of significance from ANOVA

Table 4: Symphysis ratio prior to orthodontic therapy (Initial Index) and after treatment (Final Index), by gender.

	Sex				P
	Male		Female		
	Mean	*Standard Deviation*	*Mean*	*Standard Deviation*	
Initial Index	1.35	0.20	1.38	0.24	0.287
Final Index	1.52	0.25	1.51	0.22	0.834

p= minimum level of significance from T Test

DISCUSSION

Even though the amount, size and shape of the symphysis are expected to be important in achieving adequate proclination of the lower incisors, in this study, different symphysis dimensions were not related to higher degrees of gingival margin recession development. The balance between esthetics, health and stability has been the subject of a great number of studies[2, 3, 14].

Considering only relative numbers, 6.3% of new recessions evaluated on the post treatment lie within the expected range of new recessions described in the literature, from 3% of development or aggravation of preexisting ones[16] to 10% and improved in 5% of those previously existing[5].

Since the sample was taken from adolescent records, differential growth of the symphysis can be expected, and as a consequence, the ratios could change over the treatment, as observed on Table 2. Although there was no statistically significant difference between the symphysis ratio in the three groups (coronal migration of the gingival margin, unaltered and recession) it was possible to observe that each group had different symphysis depth/height ratios. Another consequence of this ratio was described by Aki et al.[14] as having a correlation with the direction of mandibular growth. Individuals with mandibles with an anterior growth direction were associated with a small height, large depth and a small ratio. As

a result, individuals with small ratios are expected to have not only more anterior bone and better facial esthetics when teeth are proclined, but also more space to solve dental crowding.

Conversely, when an increase in facial height occurs, it is apparently related to the occurrence of an increase in alveolar height and a decrease in thickness of the alveolar bone[17]. Årtun et al., [9] showed similar results relating alveolar process to facial proportions. Furthermore, the results suggested that the risk of gingival recession was higher in patients with thin alveolar processes.

Since this was a restrospective study conducted on growing patients who sought treatment at two private practices, there was no control group. Considering the multi-causality associated to periodontal diseases in general, from plaque control to genetics, aging, changes in the oral microbiota associated with fixed appliances, among others, it is virtually impossible to isolate all the variables and to obtain a perfect untreated control group of similar age, with all the records needed. In another study using a similar age group representative of the same city, it was observed that among 14- to 29-year-olds, the mandibular central and lateral incisors showed the highest prevalence of gingival recession with 32.8% and 24.5 % of these teeth affected, respectively[18].

It should also be considered that plaque control plays an important role, especially taking into consideration that plaque can be shifted into a subgingival position resulting in infrabony cell infiltrate, and infrabony pockets[19]. This loss of attachment might appear clinically as recessions. In this study, plaque control was checked once a month on average, but it may not reflect the quality of everyday oral hygiene.

There is also evidence in dogs and monkeys that bone fenestrations caused by tipping the teeth against the facial cortical plate may not necessarily be accompanied by loss of connective tissue attachment[7,8]. Orthodontic therapy may result in recession of the gingival margin and loss of connective tissue attachment in areas with gingivitis and in situations where teeth were moved through the alveolar process[8]. Some previous studies concluded that the degree of proclination of mandibular central incisors during fixed appliance therapy was not correlated to gingival recession[15,20] and that the gingival marginal thickness was more important than proclination in causing recession[6].

The results of this study are also in agreement with previous studies, where more recessions were found after orthodontic therapy, although without statistically significant differences[5]. It is also acknowledged that if biomechanical and periodontal conditions are controlled, the risk of periodontal damage secondary to protrusion of incisors is low[21]. We believe that in order to identify those patients with higher chance of gingival recession at least the quality of plaque control and thickness of the gingival margin should also be evaluated. It may be concluded that different symphysis dimensions alone are not related to greater susceptibility to developing gingival margin recession, according to this study. The evaluation of symphysis height and depth seems to be one of the several factors that may explain and contribute to bone dehiscence and gingival margin alteration.

CORRESPONDENCE
Dr.Luciane Q. Closs
Rua G.Couto de Magalhães 1070 apto. 801
Porto Alegre – RS CEP: 90540-130 - Brazil
ckrosing@hotmail.com

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