Periodontal health in patients under conventional and lingual orthodontic therapies

Saúde periodontal em pacientes sob tratamentos ortodônticos convencional e lingual

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Resumo

Objetivo: Alguns parâmetros clínicos de saúde periodontal foram avaliados comparativamente em pacientes que utilizavam braquetes convencionais e linguais. **Material e método:** Um examinador treinado registrou as frequências de placa bacteriana visível (PB) e sangramento à sondagem (SS), bem como dos índices *higiene oral simplificado* (IHO-S) e *gengival modificado* (IGM), em 83 pacientes de duas clínicas. Os efeitos dos tratamentos ortodônticos na saúde periodontal foram analisados por regressão logística (α=0,05). **Resultado:** No grupo convencional, a frequência de placa bacteriana foi significativamente mais elevada nas superfícies vestibulares dos dentes anteriores (OR = 12,5) e posteriores superiores (OR = 3,6), p < 0,01. O SS nos dentes posteriores também foi mais frequente neste grupo, p < 0,05. O grupo lingual apresentou frequência mais alta de placa bacteriana nas superfícies linguais dos dentes anteriores (OR = 4,3; p = 0,0034). O grupo convencional apresentou frequências significativamente elevadas de gengivite leve nas regiões vestibulares dos dentes anteriores (OR = 9,0) e posteriores superiores (OR = 16,7), p < 0,05, e de papilas anteriores (OR = 9,0 p = 0,0003). Por outro lado, o grupo lingual evidenciou gengivite leve mais frequentemente nas superfícies linguais dos dentes anteriores (OR = 54,5), p < 0,01. **Conclusão:** Com base nos resultados deste estudo, as condições clínicas de saúde periodontal podem ser consideradas razoáveis em pacientes que utilizavam braquetes convencionais e linguais.

Descritores: Braquetes ortodônticos; placa dentária; índice periodontal.

Abstract

Objective: Some clinical periodontal health parameters were assessed comparatively in patients using conventional and lingual brackets. **Material and method:** A trained examiner registered the frequencies of visible plaque (VP), bleeding on probing (BOP), as well as the simplified oral hygiene (OHI-S) and modified gingival (MGI) indices in 83 subjects from two clinics. The effects of orthodontic treatments on periodontal health were analyzed using logistic regression (α = 0.05). **Result:** In the conventional group, the frequency of visible plaque was significantly higher on the buccal surfaces of anterior (OR = 12.5) and maxillary posterior (OR = 3.6) teeth, p < 0.01. BOP in posterior teeth was also more frequent in this group, p < 0.05. The lingual group presented higher frequency of visible plaque on the lingual surfaces of anterior teeth (OR = 4.3; p = 0.0034). The conventional group had significantly higher frequencies of mild gingivitis in the buccal regions of anterior (OR = 9.0) and maxillary posterior (OR = 16.7) teeth, p < 0.05, and anterior papillae (OR = 9.0; p = 0.0003). On the other hand, the lingual group evidenced mild gingivitis more often in the lingual regions of anterior teeth (OR = 54.5), p < 0.01. **Conclusion:** Based on the results of this study, the clinical periodontal health conditions may be considered acceptable for patients using both conventional and lingual brackets.

Descriptors: Orthodontic brackets; dental plaque; periodontal index.

INTRODUCTION

Orthodontic treatment, when not well-monitored, may induce adverse periodontal effects[1,2]. There may be associated increases in the quantity, composition, metabolic activity and pathogenicity of the oral microbiota[3]. Following tooth-banding, an increase in pocket probing depth may be observed. A statistically significant increase of black-pigmented bacteroides has been found[3]. Longitudinal assessment of patients demonstrated that placement of fixed orthodontic appliances influenced clinical periodontal and microbial parameters, which were only partially normalized three months after bracket removal[2].

Although lingual therapy represents the most esthetic orthodontic treatment option[4,5] because brackets are not visible and the lips are not protruded[5], some discomfort[6], speech alteration[7] and difficulty in oral hygiene[8-10] have been reported. Evidence comparing clinical periodontal parameters associated with dental plaque accumulation in patients using lingual and conventional brackets is scarce. Moreover, few studies registered data on the periodontal status of patients using lingual brackets[11,12].

This comparative study analyzed some parameters that indicate changes in the periodontal health (visible plaque, simplified oral hygiene index, modified gingival index and bleeding on probing) in patients under conventional and lingual orthodontic treatments.

MATERIAL AND METHOD

Subjects

After approval by an Institutional Review Board (protocol n. 13580292), 83 patients of both genders were selected from two private clinics, one in São Paulo city, state of São Paulo (SP clinic); the other in Campo Grande city, state of Mato Grosso do Sul (MS clinic). Patients were included in the sample according to the following criteria: 1. good general health and no systemic diseases, investigated by a structured questionnaire; 2. no extensive caries lesions or severe alveolar bone loss; and, 3. no use of medicine that may alter oral physiology up to 4 months before the study, e.g. antibiotics and anti-epileptic drugs.

Patients undergoing lingual orthodontic treatment in both clinics were predominantly female (71.4% in SP and 77.3% in MS). The mean ages varied in SP (conventional: 19.6 years ± 8.9; lingual: 34 years ± 12.1) and MS (conventional: 28.8 years ± 14.2; lingual: 29.2 years ± 10.5).

The mean time (months) since beginning lingual orthodontic treatment was shorter (SP: 20.7 months ± 16.6; MS: 16.8 months ± 9.3) compared to conventional treatment (SP: 28.9 months ± 20.0; MS: 18.4 months ± 11.1), although this difference was not statistically significant[1] (SP: p = 0.1055; MS: p = 0.7814). It should be highlighted that the minimum time of two months was observed for a single patient under conventional treatment. The remaining individuals had been using fixed appliances for periods longer than 3 months.

The stainless steel brackets used in conventional therapy were designed for the MBT® (MBT system, 0.022" Slot, 3M Unitek,

Monrovia, CA, USA) and Roth® (Roth prescription, 3M Unitek , Monrovia, CA, USA) techniques; the stainless steel lingual brackets included the STB® (STB Lingual System, Ormco Corp., Glendora, CA, USA), Kurz® (Kurz appliance 7th generation, Ormco Corp., Glendora, CA, USA), ORJ® (ORJ Lingual bracket 0.018", Hangzhou, Zhejiang, China) and PSWb* (PSWb lingual bracket 0.018", Monoblock, Tecnident, São Carlos, SP, Brazil) systems. Orthodontic bands were cemented onto the maxillary and mandibular first molars in 100% of patients under conventional treatment in the SP clinic and in 90% of patients in the MS clinic. The percentages of patients undergoing lingual treatment who had cemented bands on the molars were 0% (SP clinic) and 20% (MS clinic).

The following exclusion criteria were defined: pregnancy, chronic smoking (only three individuals were smokers and used to smoke 2-4 cigarettes/day), use of esthetic (non-metallic) brackets and history of systemic diseases (e.g., *Diabetes Mellitus*). Considering that patients who reported the daily use of dental floss, regardless of the frequency, would be at lower risk for gingivitis[13], the structured questionnaire included questions related to the use of dental floss and its daily frequency. In the total sample, 25 patients did not use dental floss (30.1%), 7 used an interproximal toothbrush (8.5%) and 51 used dental floss 1-4 times/day (61.4%).

Clinical Evaluation

For training, after receiving practical instructions from an experienced periodontist, the examiner conducted clinical assessments twice in 15 orthodontic patients not included in the sample. The examiner registered the presence of visible plaque (VP), the simplified oral hygiene index (OHI-S), bleeding on probing (BOP) and the modified gingival index (MGI) using sterilized dental mirrors, dental probes and World Health Organization/WHO periodontal probes (Hu-Friedy®, Chicago, Il, USA).

The oral hygiene was clinically assessed using the OHI-S[14], which records the visible plaque and dental calculus on the buccal surfaces of the maxillary right first molar and central incisor, maxillary left first molar and mandibular left central incisor, and on the lingual surfaces of the mandibular right and left first molars. In this study, the examiner also analyzed the opposite free surfaces of the same teeth. The scores defining oral hygiene are: 0.0-1.2 (adequate), 1.3-3.0 (acceptable) and 3.1-6.0 (poor).

Evaluation of periodontal health conditions included recording the MGI[15] based on examination of the maxillary right first molar and central incisor, maxillary left first molar, mandibular right first molar, and the left central incisor and first molar. Six sites were assessed on the gingiva: distal buccal papilla, buccal margin, mesial buccal papilla, distal lingual papilla, lingual margin and mesial lingual papilla. Each site was scored according to the following criteria: 0 (no inflammation), 0.1-1.0 (mild gingivitis), 1.1-2.0 (moderate gingivitis) and 2.1-3.0 (severe gingivitis).

To evaluate BOP[16], the WHO probe was gently inserted in the free gingival margins and papillae of one maxillary hemiarch and the opposite mandibular hemiarch. The decision to begin by the maxillary right or left hemiarch was randomized by selection of a number from 1 to 4 by the patient, thus avoiding confounding factors as tendency to unilateral oral hygiene[11,12].

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1   Mann-Whitney test, α = 0.05

Statistical Analyses

To analyze the effects of treatment type on the frequencies of VP, BOP, OHI-S and MGI, logistic regression models were adjusted (α = 0.05 and the standard power of 80%)[17,18]. The reference subgroup was conventional treatment. Patients were dichotomized as having adequate OHI-S/ acceptable OHI-S. Based on MGI data, this variable was also dichotomized as adequate/ mild gingivitis. The analyses were performed using the R software version 2.15.1 (The R Foundation for Statistical Computing, Wien, Austria).

RESULT

Patients under conventional treatment would have more chances of presenting dental plaque (in variable amounts, from the cervical to the incisal/ occlusal aspect) on the buccal surfaces of anterior teeth (OR = 1/0.08 = 12.5) and maxillary posterior teeth (OR = 1/0.28 = 3.6) than patients under lingual therapy (Table 1). The opposite was observed for the lingual surfaces of anterior teeth (OR = 4.32; p < 0.01). No effect of any covariable on the OHI-S was found.

Based on registered MGI data, all patients had scores varying from 0 (adequate) to 0.7 (mild gingivitis). In patients having some kind of alteration, the scores varied from 0.1-0.7 (this relatively high score was registered for only one patient). Therefore, the MGI had to be dichotomized as adequate/ mild gingivitis. As shown in Table 2, patients under conventional treatment would also have higher chances of presenting mild gingivitis on the buccal surfaces of anterior (OR = 1/0.11 = 9.0; p = 0.0064) and maxillary posterior (OR = 1/0.06 = 16.7; p = 0.0113) teeth. Furthermore, this group evidenced significantly higher frequency of mild gingivitis on the buccal surfaces of anterior interproximal papillae (Table 3). Conversely, patients using lingual brackets would have significantly higher chances of developing mild gingivitis on the lingual surfaces (OR = 54.47, p = 0.0002) and interproximal papillae (OR = 10.17; p = 0.0034) of the anterior teeth (Tables 2 and 3).

Patients under conventional treatment had significantly higher frequencies of BOP in the free surfaces of maxillary and mandibular posterior teeth (Table 4), resulting in corresponding greater chances of demonstrating BOP (OR = 1/0.29 = 3.4 and OR = 1/0.26 = 3.8, respectively). No statistically significant difference was found in the interproximal papillae.

Table 1. Multiple logistic regression for analyzing the effect of treatment type on the presence of dental plaque, registered on the buccal and lingual surfaces of anterior and posterior teeth

Model	Groups	Levels	Presence of Plaque				Logistic Regression Model		
			no		yes		OR	95% CI	p value
			N	(%)	N	(%)			
AT-Buccal	Treatment	Conventional	14	(35.0)	26	(65.0)	-		
		Lingual	37	(86.0)	6	(14.0)	0.08	(0.03-0.25)	<0.0001*
AT-Lingual	Treatment	Conventional	21	(52.5)	19	(47.5)	-		
		Lingual	9	(20.9)	34	(79.1)	4.32	(1.62-11.51)	0.0034*
MxPT-Buccal	Treatment	Conventional	17	(42.5)	23	(57.5)	-		
		Lingual	31	(72.1)	12	(27.9)	0.28	(0.11-0.71)	0.0072*

AT: Anterior Teeth (11 and 31); **MxPT:** Maxillary Posterior Teeth (16 and 26); **OR:** odds ratio; **95% CI:** 95 per cent confidence interval. *Significant at level of 1% (p value < 0.01).

Table 2. Multiple logistic regression for analyzing the effect of treatment type on the Modified Gingival Index (dichotomized as adequate and mild gingivitis), registered on the buccal and lingual surfaces of anterior and posterior teeth

Model	Groups	Levels	Modified Gingival Index (Teeth)				Logistic Regression Model		
			Adequate		Mild Gingivitis		OR	95% CI	p value
			N	(%)	N	(%)			
AT-Buccal	Treatment	Conventional	28	(70.0)	12	(30.0)	-		
		Lingual	41	(95.3)	2	(4.7)	0.11	(0.02-0.54)	0.0064*
AT-Lingual	Treatment	Conventional	39	(97.5)	1	(2.5)	-		
		Lingual	18	(41.9)	25	(58.1)	54.47	(6.83-434.78)	0.0002*
MxPT-Buccal	Treatment	Conventional	30	(75.0)	10	(25.0)	-		
		Lingual	42	(97.7)	1	(2.3)	0.06	(0.01-0.53)	0.0113*

AT: Anterior Teeth (11 and 31); **MxPT:** Maxillary Posterior Teeth (16 and 26); **OR:** odds ratio; **95% CI:** 95 per cent confidence interval. *Significant at level of 5% (p value < 0.05).

Table 3. Multiple logistic regression for analyzing the effect of treatment type on the Modified Gingival Index (dichotomized as adequate and mild gingivitis), registered on the buccal and lingual interproximal papillae of anterior and posterior teeth

Model	Groups	Levels	Modified Gingival Index (Papillae)				Logistic Regression Model		
			Adequate		Mild Gingivitis		OR	95% CI	p value
			N	(%)	N	(%)			
AT-Buccal	Treatment	Conventional	21	(52.5)	19	(47.5)			
		Lingual	39	(90.7)	4	(9.3)	0.11	(0.03-0.38)	0.0003*
AT-Lingual	Treatment	Conventional	38	(95.0)	2	(5.0)	-		
		Lingual	28	(65.1)	15	(34.9)	10.17	(2.15-48.14)	0.0034*

AT: Anterior Teeth (11 and 31); **OR:** odds ratio; **95% CI:** 95 per cent confidence interval. *Significant at level of 1% (p value < 0.01).

Table 4. Multiple logistic regression for analyzing the effect of treatment type on the presence of bleeding on probing, registered on the buccal or lingual surfaces of anterior and posterior teeth

Model	Groups	Levels	Bleeding on Probing (Teeth)				Logistic Regression Model		
			no		yes		OR	95% CI	p value
			N	(%)	N	(%)			
MxPosterior	Treatment	Conventional	24	(60.0)	16	(40.0)	-		
		Lingual	36	(83.7)	7	(16.3)	0.29	(0.10-0.81)	0.0184*
MdPosterior	Treatment	Conventional	23	(57.5)	17	(42.5)	-		
		Lingual	36	(83.7)	7	(16.3)	0.26	(0.09-0.73)	0.0106*

MxPosterior: Maxillary Posterior Teeth; **MdPosterior:** Mandibular Posterior Teeth; **OR:** odds ratio; **95% CI:** 95 per cent confidence interval. *Significant at level of 5% (p value < 0.05).

DISCUSSION

The chances of VP (Table 1) and mild gingivitis (Tables 2 and 3) occurring on the buccal surfaces of anterior and maxillary posterior teeth, as well as BOP occurring on maxillary and mandibular posterior teeth (Table 4) would be significantly greater for patients under conventional treatment. Nevertheless, the lingual etching of brackets does not prevent the adverse effect of dental plaque formation during orthodontic treatment[1,11]. The higher frequencies of dental plaque and mild gingivitis on the lingual surfaces of anterior teeth (Tables 1, 2 and 3) may be related to the limitation of mechanical self-cleaning imposed by the lingual brackets. Moreover, the design of some lingual brackets, with hooks on the cervical region, may favor plaque accumulation[1]. Oral hygiene was significantly impaired in patients using pre-adjusted lingual brackets in comparison to those using customized lingual brackets[19]. In this study, all patients used pre-adjusted brackets.

Placement of biomaterials and orthodontic appliances influences *in situ* dental plaque formation[1,20]. However, the initial thickness of biofilm is smaller on the lingual surfaces[20], presumably due to the action of the tongue and salivary flow promoting a self-cleaning mechanism. Although oral hygiene is even more important for lingual therapy, since plaque accumulation and gingivitis are not detected by the patient[4], the lingual brackets would supposedly not necessarily induce microbial and periodontal alterations at the same level as that of conventional treatment[21].

The present study was conducted in two clinics located in different Brazilian states and with patients who used distinct types of brackets. No clinically significant effect was observed for the origin. Based on anamnestic data, 70% of the total sample reported daily hygiene of the proximal surfaces, which is important to prevent not only periodontal disease but also caries lesions. Despite the possible influence of different types of lingual brackets, adequate oral hygiene instructions and monitoring seem to be the clinical key measures for preventing gingival inflammation in orthodontic patients.

Clinical periodontal parameters were evaluated in 83 orthodontic patients, most of whom had been using orthodontic appliances for more than 3 months. The maximum increase in periodontal and microbial parameters was registered at 3 months of orthodontic treatment[22,23]. Nevertheless, bacteria forming dental plaque, associated with orthodontic treatment, may be quantified at one and five weeks after bonding[24]. Concerning lingual therapy, a significant increase in the dental plaque index was observed after one month of treatment[9] and gingivitis was diagnosed in 7 out of every 10 patients after 3 months of treatment[10]. Greater dental plaque formation is expected after placement of orthodontic appliances, in both conventional[23,24] and lingual treatments[11,12], which in turn

is associated with an increase in probing depth and BOP[11,12,25]. Increasing dental plaque formation and BOP in patients under lingual therapy were registered between 4 weeks[11] and 3 months[12] after beginning orthodontic treatment.

Patients under conventional therapy exhibited higher frequencies of dental plaque and mild gingivitis on the buccal surfaces of maxillary posterior teeth (Tables 1 and 2). These findings may be related to the presence of orthodontic bands inserted into the first molars[3,20,26]. Seating these accessories may compromise the health of the surrounding periodontal tissues and may be associated with the occurrence of periodontopathogenic bacteria[3]. Orthodontic bands may also be associated with the significantly higher frequency of BOP in maxillary and mandibular posterior teeth (Table 4).

Dental plaque levels in orthodontic patients would be 2 to 3 times higher than are observed in adults without fixed appliances[27]. The findings of this study are in agreement with those of previous investigations[11,12,22-24], since it clearly demonstrates that patients under both conventional and lingual treatment are prone to VP accumulation and the development of mild gingivitis. As a result of microbiological changes after bracket etching, increased metabolic activity and pathogenicity of the oral microflora may be reported[11]. This can be confirmed by specific microbial analyses. Nevertheless, the unique laboratory microbial parameter is not a direct measure of gingival disease. Host salivary features and immunological defenses should be taken into account. That is why clinical evaluation is mandatory in every study of periodontal health. Gingivitis may be completely treated in one week by adequate tooth brushing and use of dental floss. Even BOP may be solved without intervention, if there is no bone loss. Hence, if monitoring and motivation for maintaining proper oral hygiene are frequently carried out, controlled levels of VP and mild gingivitis will not have important clinical repercussions on periodontal health.

CONCLUSION

Orthodontic brackets fixed on any tooth surface contribute to dental plaque retention. Significantly higher frequencies of dental plaque and mild gingivitis were recorded on the buccal surfaces of patients under conventional therapy, as well as on the anterior lingual surfaces of patients under lingual therapy. Patients under conventional therapy also presented significantly higher frequency of bleeding on probing in posterior teeth. Despite the findings of this study, it may be concluded that clinical periodontal health conditions were acceptable for both types of treatment.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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