



# The impact of oral hygiene instruction on plaque control in orthodontic patients: a cross-sectional study

O impacto da instrução de higiene oral no controle da placa bacteriana em pacientes ortodônticos: um estudo transversal

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## ABSTRACT

**Objective:** Deficient dental plaque control is common in adolescents, mainly among those wearing orthodontic apparatus. This study aimed to compare plaque control and oral hygiene habits in adolescents with and without fixed orthodontic appliances. Additionally, it was investigated whether personalized oral hygiene instruction (OHI) could be a predictor for reducing dental plaque accumulation in orthodontic patients. **Material and Methods:** Sixty-nine patients, aged 12 to 20 years, were evaluated in a public organization which provides dental care. A questionnaire of oral hygiene habits was applied, and the number of natural teeth and number of teeth with visible biofilm were obtained during clinical examination. A comparative analysis of sociodemographic and clinical data was performed, splitting this population into two groups: those who used fixed orthodontic appliances (n=40) and those who did not (n=29). **Results:** There were no differences in oral hygiene habits among groups. The Poisson regression showed that adolescents with fixed appliances were 54% more likely to have dental plaque buildup compared to those who did not. Among individuals wearing orthodontic appliance, those who had not received personalized OHI before or during orthodontic treatment were 78% more likely to have a greater number of teeth with bacterial plaque compared to instructed ones. **Conclusion:** Especially among the adolescents wearing fixed orthodontic appliances, those who have not received personalized OHI were almost twice as likely to have a greater number of teeth with dental biofilm accumulation. Dentists and dental hygienists play a prominent role in motivating and improving the quality of individual oral hygiene.

## KEYWORDS

Oral hygiene; Dental plaque; Orthodontic appliances; Adolescent; Prevention and control.

## RESUMO

**Objetivo:** O controle deficiente da placa dental é comum em adolescentes, principalmente entre aqueles que usam aparelhos ortodônticos. Este estudo teve como objetivo comparar o controle da placa e os hábitos de higiene oral em adolescentes com e sem aparelhos ortodônticos fixos. Além disso, foi investigado se a instrução de higiene oral (IHO) personalizada poderia ser um preditor para reduzir o acúmulo de placa dental em pacientes ortodônticos. **Material e métodos:** Sessenta e nove pacientes, de 12 a 20 anos, foram avaliados em uma organização pública que presta atendimento odontológico. Foi aplicado um questionário sobre hábitos de higiene oral, e o número de dentes naturais e o número de dentes com biofilme visível foram obtidos durante o exame clínico. Foi realizada uma análise comparativa dos dados sociodemográficos e clínicos, dividindo essa população em dois grupos: aqueles que usavam aparelhos ortodônticos fixos (n = 40) e aqueles que não o usavam (n = 29). **Resultados:** Não houve

diferenças nos hábitos de higiene oral entre os grupos. A regressão de Poisson mostrou que os adolescentes que tinham aparelhos fixos apresentaram 54% mais chance de ter mais acúmulo de placa dental comparados aos que não tinham. Entre os indivíduos que usavam aparelhos ortodônticos, aqueles que não receberam IHO personalizada antes ou durante o tratamento ortodôntico apresentaram 78% mais chance de ter maior número de dentes com placa bacteriana em comparação com os que a receberam. **Conclusão:** Especialmente entre os adolescentes que usavam aparelhos ortodônticos fixos, aqueles que não receberam IHO personalizada tiveram quase duas vezes mais chances de ter um número maior de dentes com acúmulo de biofilme dental. Dentistas e higienistas dentais desempenham um papel proeminente na motivação e na melhoria da qualidade da higiene oral do indivíduo.

## PALAVRAS-CHAVE

Higiene oral, Biofilme bacteriano, Aparelhos Ortodônticos fixos, Adolescente, Prevenção.

## INTRODUCTION

The transition from childhood to adolescence is a period with multifactorial characteristics that influence behavior and care with oral hygiene [1]. The individual starts to interact and adapt to his/her own physical and psychological changes as a preparation for adult life, taking care of health, an activity previously performed by parents. It is also at this stage that oral hygiene tends to become precarious due to acquired habits and routines [2].

Poor dental plaque control is common in adolescents also due to difficulties that an orthodontic device creates when dental correction is needed. The roughness of the brackets, the connecting arches and the elastomeric rings bonded to enamel favor a rapid agglomeration of biofilm and growth of microorganisms. Hence, using fixed orthodontic appliances is considered a promising factor for accumulation and retention of bacterial plaque, also a risk factor for the development of white spot lesions [3-5].

A great challenge for dentists and dental hygienists goes beyond clinical procedures in the office, being directly linked to patient awareness of their responsibility in care and maintenance of oral health. Professional guidelines are crucial for excellent treatments and results, which value brushing and hygiene of all dental and interdental surfaces and oral mucosa, thus ensuring health of periodontium and entire oral cavity [6].

Regarding efficacy of behavior change techniques in young orthodontic patients, individually tailored oral hygiene instructions has been a key element in achieving and maintaining gingival health and must be considered to them, a population in which household plaque control is usually jeopardized [7]. This study aimed to compare plaque control and oral hygiene habits among adolescents with and without fixed

orthodontic appliances. Additionally, it was investigated whether personalized oral hygiene instruction is useful for more efficient plaque control in patients undergoing orthodontic treatment. The null hypotheses were, 1) there would be no significant differences between plaque control and oral hygiene habits among adolescents, irrespectively to the use of fixed orthodontic appliances; 2) personalized oral hygiene instruction would not influence plaque control in adolescents wearing braces.

## MATERIAL AND METHODS

### Study design and participants

This was a cross-sectional study involving a population of adolescents with and without dental braces, comparing their biofilm accumulation, oral hygiene habits at home and evaluating the impact of personalized oral hygiene instruction on dental biofilm control. Participants were adolescents referred to receive prophylaxis and oral hygiene instruction, prior to installation of fixed orthodontic appliances or during orthodontic treatment, in the Preventive Dentistry sector of a public institution providing dental care, belonging to the Brazilian Navy, in Rio de Janeiro, during the months of March and October of 2018 and 2019.

Records of all adolescents aged 12 to 20 years, regardless of gender, were evaluated. When presenting to the Preventive Dentistry sector, adolescents were invited to answer a questionnaire with six questions about oral hygiene habits and diet. The filling was carried out in a waiting room, while they waited to be called for care, together with their guardians.

This study was approved by a local ethic committee, under number 3,399,461, and is in accordance with ethical principles of the Declaration of Helsinki.

## Characteristics

Primary dental care, including basic periodontal therapy and oral hygiene instructions (OHI), are provided by dental hygienists in the Preventive Dentistry section.

OHI is performed individually, in a specific office for that, after oral prophylaxis, and takes about 20 to 30 minutes. Dental hygienists demonstrate brushing and interdental cleaning techniques, interactively, using audiovisual resources, applications and arch models with mounted orthodontic appliances. It comprises a moment of conversation, in which the patient feels free to ask questions and curiosities regarding oral health. Subsequently, patient performs brushing and interdental cleaning in models, similar to a hands-on, and receives an interdental brush (Edel White®) as a gift, in order to encourage its use.

## Data collection

A questionnaire of oral hygiene habits and diet contained the following questions and their alternatives: “1. How many times a day do you brush your teeth?” - one; two; three or more; “2. How long do you think you brush your teeth?” – up to 2 minutes; 2 minutes or more; “3. The bristles on your toothbrush are” – soft; medium; hard; “4. How often do you do interdental cleaning?” – rarely/hardly; 1 time a day; 2 or more times; “5. Do you use dental floss, interdental brush, interdental picks toothbrush, mouthwash” – yes or no for each item; and “6. Do you daily eat cookies, candy, or drink soda?” – yes or no to each item.

The question “How do you consider the health of your teeth and gums?” was added to data collection with an answer option – bad; average; good; very good; excellent. The aim was to assess participants’ self-perception of oral health [8]. Responses to this item were categorized as negative (poor and average) and positive (good, very good or excellent).

In case of doubts regarding questions, and understanding or lack of knowledge of a term, participants were instructed not to respond.

## Clinical and demographic data

Demographic data, such as sex (male; female) and age (in years), were collected at the beginning of clinical care by properly trained dental hygienists. In addition, it was verified in

medical records if any session of personalized oral hygiene instruction (OHI) had been carried out within two years before the consultation.

Oral clinical data such as number of natural teeth and number of teeth with visible biofilm were obtained during clinical examination, previously to oral prophylaxis. Tooth was considered to have visible dental plaque when, after drying tooth surface, mature biofilm was visualized on either face. Dental plaque frequency was obtained by dividing the number of teeth with biofilm by total number of teeth and multiplying by 100.

## Statistical analysis

A descriptive analysis was performed for demographic and clinical data, dividing participants into two groups: with fixed orthodontic appliances and without orthodontic appliance. Dichotomous variables were expressed as frequencies, and numerical variables as means/standard deviation. Statistical differences between groups were obtained using chi-square test for categorical variables, and Mann-Whitney test for continuous variables.

Poisson regression with robust covariance was used to test the association of fixed orthodontic appliance use and previous OHI with the number of teeth with visible plaque, aiming to estimate relative risk (RR) and confidence intervals (CI) of 95%. An adjusted analysis, involving only adolescents who used dental braces, was applied to verify whether lack of personalized OHI before or during orthodontic treatment would be a predictor of a greater number of teeth with plaque.

Significance was established at 5%. All statistical analyzes were performed with commercially available software (Statistical Package for the Social Sciences, SPSS Inc., Chicago, USA, version 21.0).

## RESULTS

In total, 69 adolescents were assisted in the sector during the months of the study. None of participants reported being a smoker, alcoholic or diabetic, and all denied presence of comorbidities. None of teenagers was pregnant.

Results of the descriptive analysis of sample are shown in Table I. It was observed that adolescents who used fixed orthodontic

**Table I** - Clinical and demographic data of participants with and without fixed orthodontic appliance

Variable	Fixed orthodontic appliance		p
	No n=40	Yes n=29	
Demographic data			
Sex			
Male	22 (55.0)	22 (75.9)	0.07
Female	18 (45.0)	7 (24.1)	
Age (years)	17.3 ± 2.5	16.3 ± 2.2	0.66
Clinical data			
Previous OHI			
Yes	12 (30.0)	12 (41.4)	0.33
No	28 (70.0)	17 (58.6)	
Frequency of visible dental plaque	26.6 ± 24.2	41.3 ± 27.8	0.01*
Number of teeth	26.7 ± 5.7	28.0 ± 1.5	0.99
Questionnaire			
Self-perception of oral health			
Positive	32 (80.0)	21 (72.4)	0.46
Negative	8 (20.0)	8 (27.6)	
Habits of oral hygiene			
Frequency of brushing teeth			
Once a day	15 (37.5)	13 (44.8)	0.73
Twice a day	9 (22.5)	7 (24.2)	
Three or more	16 (40.0)	9 (31.0)	
Duration of brushing teeth			
Up to 2 minutes	28 (70.0)	16 (55.2)	0.21
2 minutes or more	12 (30.0)	13 (44.8)	
Toothbrush bristles			
Soft	10 (25.0)	8 (27.6)	0.81
Medium or hard	30 (75.0)	21 (72.4)	

Categorical data expressed as absolute numbers followed by percentages (%). Numerical data expressed as mean ± standard deviation. OHI: oral hygiene instruction. N: number. \*p value: significance level ≤ 0.05. Qui-square test for categorical variables. *Mann-Whitney* test for numerical variables.

appliances had a significantly higher frequency of visible bacterial plaque than those who did not use orthodontic appliance. For the number of natural teeth, age, self-perception of oral health, as well as oral hygiene habits and diet, no differences were found between the groups.

Poisson regression showed that adolescents using fixed orthodontic appliances had a 54% greater chance of having a greater number of teeth with biofilm accumulation. Among those, according the adjusted model, individuals who had not previously received personalized OHI were 78% more likely to have a greater number of teeth with visible bacterial plaque (Table II).

## DISCUSSION

Based on results of this study, it was observed that the use of fixed orthodontic appliances is associated with a greater accumulation of bacterial plaque in adolescents. Although these results refer to studied population, the association varies with application of personalized oral hygiene instruction.

Significantly higher frequency of visible plaque in adolescents with fixed orthodontic appliances compared to those without orthodontic appliance agrees with results found in a study with evidence-based recommendations. The study

**Table II** - Crude and adjusted Poisson regression on the association of fixed orthodontic appliance use and oral hygiene instruction with the number of teeth with visible dental plaque

	Total (n=69)		Adjusted for appliance use			
	RR (CI 95%)	p	Yes (n=29) RR (CI 95%)	p	No (n=40) RR (CI 95%)	p
Fixed orthodontic appliance			-		-	
Yes	1.54 (1.07 – 2.23)	0.02*	-		-	
No	1					
Previous oral hygiene instruction OHI						
Yes	1		1			
No	1.17 (0.79 – 1.75)	0.43	1.78 (1.14 – 2.79)	0.01*	0.82 (0.44 – 1.51)	0.52

RR: relative risk; CI: confidence interval. N: number. \*p value: significance level  $\leq 0.05$ .

showed a significant increase in opaque white spots and bacterial plaque in adolescents during orthodontic treatment, in addition to aggravation of existing lesions even before starting the treatment [3]. Changes in the oral microbiota, 3 months after placement of fixed orthodontic appliance, with an increase of *Prevotella intermedia* and *Actinobacillus actinomycetemcomitans* also showed that the duration of treatment can be a negative factor concerning patient's attitude about oral health [5], which corroborates with results of the present study. However, some authors did not find differences in frequency of bacterial plaque between those who used or did not use fixed orthodontic appliances [9,10]. These divergences can be explained by methodological differences, either by design, sample size, age of participants, time and frequency of brushing, or by methods of evaluation of bacterial plaque.

Personalized OHI was shown to be a predictor of lower plaque accumulation in orthodontic patients. Corroborating with this finding, a recent study has shown that adolescents who individually received trained oral prophylaxis had a lower number of teeth with dental plaque and exhibited better plaque control [11]. This person-centered-approach may provide better results compared to commonly used information-giving approach to behavioral change in dental practice, which presents little effect on sustainable gain of dental knowledge [12]. Thirty to 60% of information necessary for care of oral cavity, provided by professionals, is lost by patient within 1 hour, and 50% of patients who receive these instructions simply decide not to put these recommendations into practice [13]. The results of the present study are also in agreement with another one that reported improvement in full mouth bleeding scores in a group of participants

who received the 'Touch-to-Teach' method of oral hygiene instruction, especially regarding the use of the interdental brush. Using dental floss or interdental brushes in addition to toothbrushing may reduce gingivitis or plaque, or both, more than toothbrushing alone [14]. With an emphasis on cleaning interdental surface and using fluoride toothpaste, this simple method reduced incidence of gingivitis, periodontal disease, and caries in adolescents who received instruction before placement of fixed orthodontic appliances [15]. Patients were more able to keep oral environment free of bacterial plaque, with a lower rate of visible plaque and better quality of oral health, after having received two sessions of oral hygiene instruction in a period of one year [15].

Despite evident short-term effect [16] and difficulty in maintaining successful oral hygiene in long term [17], individual hands-on guidance by dental hygienists seems to be a key approach, especially for adolescents. Compared to traditional approaches, visually attractive materials may be more appropriate to motivate and communicate with patients.

About the role of dental hygienists, OHI and patient motivation, often provided by them, are essential attributes to establishing good oral health in patients. A study reported that, in a context without dental hygienists, OHI and patient motivation appeared non-compliant with current international guidelines. The authors stated that, although dental professionals were concerned with preventive dentistry, they reported barriers including lack of time, remuneration and patient compliance [18].

The present study did not find differences between groups of adolescents related to sex and



self-perception of oral health, which differs from a cross-sectional study conducted in the Brazilian Unified Health System, which reported that women have better oral hygiene habits [19]. Moreover, lower education level and income have been associated with greater oral health problems [19], as well as with self-perception of oral hygiene [20]. A survey on self-perception of oral health, symptoms and oral hygiene behavior, with students aged 18 to 19 years, also pointed out that women have better results in periodontal clinical parameters [21].

Most adolescents reported brushing their teeth in up to 2 minutes, and two or more times a day, differing from professional consensus that establishes brushing time for 2 minutes as beneficial [22-24]. A large part of population does not use the minimum time necessary for a quality and efficient brushing, due to low efficiency in mechanical brushing, use of inadequate brush and time used to carry out brushing process [25]. As for frequency, brushing with fluoride toothpaste twice a day for two minutes has been recommended as an oral hygiene routine [22].

Some limitations must be considered when interpreting our results. One of them is that convenience sample selected in this study was obtained from patients who sought orthodontic treatment in a public organization providing dental care. Thus, the sample may not represent general population, as all participants had access to dental service support. Another limitation might be measurement bias linked to self-report condition to answer questionnaire on oral hygiene habits and diet.

Although there is some scientific literature on the effects of orthodontic devices on the oral health of adolescents, showing their greater predisposition to periodontal diseases and caries, this study has focused on the impact of personalized oral hygiene instruction as a predictor for lower dental plaque accumulation in this population. Beyond this, a questionnaire about diet and hygiene habits, including self-perception of oral health, was applied. To the best of our knowledge, this was the first study conducted specifically to reach these goal.

Further studies to address the more adequate manner to improve adolescents' empowerment, motivation, and compliance linked to oral hygiene would cooperate to tackle needs on prevention of caries and gingivitis in this population, especially among those wearing orthodontic brackets.

## CONCLUSION

This study demonstrated that oral hygiene habits were similar among adolescents, irrespectively to the use of fixed orthodontic appliances. However, its use was associated with a greater accumulation of bacterial plaque. Additionally, among who used the appliance, those that did not receive personalized OHI were almost twice as likely to have a greater number of teeth with biofilm accumulation. The difficulty that adolescents with orthodontic appliances face in maintaining good oral hygiene justifies the crucial role that the multi-professional team, formed by dentists and dental hygienists, have in maintaining motivation and improving quality of individual oral hygiene.

## Author's Contributions

DPC: Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing. MFM: Conceptualization, methodology, investigation, resources, data curation, writing. LGCF: Conceptualization, methodology, resources, data curation, writing. MMS: Resources, data curation, writing – review & editing, visualization. JCC: Resources, data curation, writing – review & editing, visualization.

## Conflict of Interest

The authors declare that they have no competing interests. The authors have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of: Research Ethics Committee of Hospital Naval Marcílio Dias, Rio de Janeiro, Brazil. The approval code for this study is: 3,399,461

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Date submitted: 2022 June 21

Accept submission: 2022 Oct 24