

# Control of oral hygiene in the orthodontic patient: comparison between public facility and private practice

Alessandra Impellizzeri DDS  
 Roberto Samà DDS  
 Roberto Di Giorgio MDS  
 Ersilia Barbato PhD  
 Gabriella Galluccio DDS

Department of Oral and Maxillofacial Sciences,  
 "Sapienza" University of Rome, Rome Italy

## Corresponding author:

Gabriella Galluccio  
 Director of Post-graduate Course in Functional Orthodontics,  
 Vice-President of the Course for Dental Degree  
 Department of Oral and Maxillofacial Sciences,  
 "Sapienza" University of Rome  
 Piazzale Aldo Moro 5  
 00185 Rome, Italy  
 E-mail: gabriella.galluccio@uniroma1.it

## Summary

**Aims.** To evaluate how the application of orthodontic appliances influences the level of collaboration in the oral hygiene of the patient and whether a difference exists between patients treated in public and private structures.

**Methods.** From April 2016 to December 2017, two hundred patients, 100 treated in the Orthodontics Department of "Sapienza" University of Rome and 100 treated in a private practice, have been evaluated for six months from the start of the treatment. All the 200 patients completed a questionnaire and an evaluation with OHI-S (Oral Health Index-Simplified) modified oral hygiene index, repeated every three months. All data have been statistically analyzed to evaluate the level of collaboration to oral hygiene and eventually present differences between public vs private structures. The differences in behavior in oral hygiene with reference to different orthodontic devices (fixed/removable) were also evaluated and the ability to maintain adequate oral hygiene with respect to the expected length of orthodontic treatment was assessed.

**Results.** A statistically significant difference was found between the initial level of plaque index at the T0 and T1 time, found at a lower level. The

maintenance of oral hygiene between public or private facilities, although the initial level was different, were eventually revealed to be not statistically different at the planned controls. There was indeed a difference between patients in treatment with fixed or removable appliances, showing a higher level of plaque deposition for the first group.

**Conclusions.** The appropriate prescription of an oral hygiene protocol in orthodontic patients and the periodical reiteration of the message are positively correlated with an improvement of oral hygiene conditions, in spite of the sort of health facility and mainly related to the ability of the dental professionals. The presence of a fixed appliance strengthened the need for a close control.

**Key words:** oral hygiene, orthodontic appliance, public health, compliance.

## Introduction

Orthodontics is a specialty of dentistry that deals with prevention, diagnosis and treatment of malposition of teeth and facial bones. The main objectives of orthodontic treatment are the correct alignment of the teeth, in order to improve the health prospects of the teeth and their supporting apparatus, efficient masticatory function, good facial appearance and stability of the occlusion.

For the treatment of malocclusions, the therapy requires fixed or removable devices, often used in association with each other or applied in sequence, according to the specific treatment objective.

Oral hygiene is the set of measures taken to ensure cleanliness of the oral cavity and thus prevent carious lesions and other diseases such as gingivitis and periodontitis (1-3).

For the realization of a correct hygiene during orthodontic treatment, the use of common aids, such as manual or electric toothbrush, is suggested and more specific devices such as brushes, interdental brushes, end tuft toothbrushes and "Super floss". All these devices help to reach the more common plaque deposition area, which is difficult to keep clean with the standard approach, such as below the orthodontic arches (1-6).

The task of dentist and hygienist is to teach the most suitable technique for performing correct oral hygiene, based on the characteristics of the patient's mouth and any dental problems (6).

Orthodontic appliances are selected according to the specific treatment objective and often, more than one appliance can be used, in particular, when problems of skeletal growth and dental misalignments are associated (1, 6, 7).

The term “removable appliance” means each device that the patients can apply and remove on their own. Usually, it is formed by an acrylic resin body, which retains in its structure both the elements which allow it to be anchored to the teeth properly, and the mechanical elements, such as screws, springs and arcs, which, once activated, are able to move the teeth (7). Mobile appliances need careful daily hygiene, because bacterial plaque is deposited when they are placed in the mouth and when they are stored in their containers. It is therefore especially important to instruct the patient to properly maintain the appliance, but the patient’s compliance is limited to the performance of normal daily oral hygiene maneuvers (4,8).

The fixed orthodontic appliance is made up of metal or ceramic attachments, and bands fixed to the teeth, that are connected and activated by further components: wires, elastic bands, springs and extra-oral traction, so as to move the teeth into a correct position. In this case, the devices cannot be removed except by the orthodontist (4, 8).

Fixed appliances reduce the physiological self-disruption mechanisms favoring plaque retention and accumulation; they also create objective difficulties in the execution of daily oral hygiene techniques; therefore, the patient in fixed orthodontic therapy requires a strong motivation and compliance in hygiene maneuvers (4, 8, 9).

Orthodontic treatment involves a long period of collaboration between patient, orthodontist and hygienist (10, 11).

The complete understanding of the oral hygiene problem, the manual skills of the duly educated patient and the appropriate use of tools and materials are indispensable, but not sufficient conditions for the daily practice of oral hygiene (12). The “motivation” is the decisive key, that is the complex of factors that instill in the patient “mental orientations tending to be concretized through actions and behaviors aimed and coherent” (2, 11).

All patients, although informed, trained and motivated by the dentist and/or hygienist, through appointments, sessions and oral hygiene instructions, tend to lose motivation relatively quickly, in a few days to a few months. This phenomenon requires great consistency in continuously providing the patient with the necessary reinforcements to maintain motivation over time (10).

Collaboration is essential for successful treatment in orthodontic patients. Failure to collaborate leads to an increase in working time for the patient, the parent and the orthodontist; moreover, in some cases, the treatment may be compromised, and it may be necessary to interrupt it prematurely, due to the risk of tissue damage, such as demineralization enamel and recurring gingival inflammation (11).

Richter et al. in 1998 reported that patient compliance could be achieved through a reward path regardless of the repetition of instructions, for example with the use of a report card for reporting the goals, taking care to transform them into tangible prizes (13).

The importance of maximizing collaboration in proper oral hygiene from orthodontic patients is indicated by the results of studies that have assessed changes in bacterial plaque composition in patients during orthodontic treatment (13).

Maret et al. carried out a study to highlight any differences in salivary microbial load among orthodontic patients and related controls. The Authors found an increase of *Streptococcus mutans* and *Lactobacillus* (14).

Several Authors evaluated the presence of the microbial load in the oral cavity (Streptococci, Staphylococci, Veillonelle, Lactobacilli and Mycetes) before, during and after orthodontic treatment. The prevalent conclusion is that the average bacterial population increases and that the anaerobes become prevalent on the remaining bacterial flora. Generally, the increase in these bacteria is related to higher incidence of caries. On the other hand, there is a decrease in the percentage of *Actinomyces* (13.3% decrease in the total flora), and smaller reduction in *Fusobacterium* and *Bacteroides* species (15).

Although there is no general agreement in the literature on the adhesion pattern of micro-organism during the orthodontic treatment, an *in vitro* study showed a lower adhesion for the combination sapphire brackets/coated wire, while metallic brackets and metallic wires showed the worst performance. The Authors concluded that the capacity of micro-organisms to adhere and grow is dependent on the materials of the orthodontic appliance (16).

Hagg et al., analyzed the prevalence of *Candida* and *Enterobacteria* in a group of adolescents in orthodontic treatment with fixed appliances. They conclude that the presence of these appliances alters the ecological balance in the oral cavity, due to the introduction of new stagnant areas of plaque and debris retention, with a direct effect on the plaque index but a contrary and transitory effect over the prevalence and density of *Candida* and the transmission of Coliforms (9).

The fixed appliances, therefore, interfere with the practice of oral hygiene and should be considered as parts of the surface of the teeth (17).

The level of collaboration offered is fundamental for the success of orthodontic treatment. While the patient is asked to use the appliance in the most correct way, it is also necessary to respect scheduled appointments and to maintain an adequate level of oral hygiene in order not to make the benefits of the entire treatment questionable. So, orthodontic treatment envisages a constant commitment on the part of the patient, the parents, the orthodontist and the hygienist, both as regards the maintenance of oral hygiene and the duration of treatment and the subsequent therapeutic results (13).

Beckwith et al. (18) have identified some of the primary factors that influence the duration of orthodontic treatment. In this study, parameters were collected from 140 cases completed consecutively, including data from patients being treated in 5 different private studies. Significant correlations were found for factors related to patient collaboration (number of missed appointments, number of rebonded brackets and bands, number of treatment steps, detection of poor oral hygiene) and only two related to the treatment modality (more than one treatment phase, prescription of extraoral traction use).

In a review of the factors concerning the duration of orthodontic treatment, Mavreas and Athanasiou conclude that extraction treatment lasts longer than the non-extraction therapy, while age does not seem to play an important role. Several conditions appear to be operator-sensitive; at least various factors including the compliance of the patients seem to play a role in prolonging the treatment (19).

The aim of the study was to evaluate how the application of orthodontic appliances influences the level of collaboration in the oral hygiene of the patient.

The present work also evaluated if the behavior in oral hygiene is different between patients treated in public and private structure, as the patient's cooperation is based on motivation, information and sense of appreciation and interest. This behavior is transmitted by dental health staff through a program of instructions that must be developed for each patient, according to their needs and the type of appliance applied.

The different structuring of the service in the public sector could be less followed by the individual path of the patient about the maintenance of oral hygiene and the maintenance of compliance, for reasons of organization of the structure, while greater personalization and monitoring could be envisaged in the prevention path in the private structure, especially with regard to the implementation of the protocols.

The present work also aimed to compare how different treatment methods can affect the patient's ability to maintain proper oral hygiene.

## **Materials and methods**

The study was conducted on a sample of 200 patients in orthodontics, 100 of whom were treated in the Orthodontics Unit of the Department of Dentistry and Maxillo Facial Sciences, "Sapienza" University of Rome – named group G1 – and 100 treated at a private practice – group G2. The observations took place between April 2015 and December 2017.

N. 57 males and n. 43 females of average age 15.2 formed the sample of the public hospital G1.

Of these 100 patients, 16 were in orthodontic therapy with removable devices, 84 in orthodontic therapy with a multiband fixed device, 24 of whom also had a fixed palatal expansion appliance.

The private practice sample, G2, was formed by 39

males and 61 females of average age 12.3. Of these 100 patients, 33 were treated with removable orthodontic devices, while 67 were in orthodontic therapy with fixed multiband equipment, 32 of whom also had a fixed palatal expander appliance.

All the 200 patients initially completed a questionnaire, which was repeated every three months over a total period of six months.

The questionnaire is a re-elaboration of a pre-existing folder concerning oral hygiene in pediatric dentistry, modified according to the aims of the present work.

In the first survey, data were collected regarding age, sex, type of orthodontic appliance, methods of oral hygiene, number of meals taken during the day and any reference to oral hygiene; plaque and bleeding indices were also detected. In the following two appointments with the patient, only the detection of the oral hygiene indexes was performed.

Oral hygiene instructions were given by the operators both to the sample examined in the public sphere and in the private sector, before orthodontic treatment.

19% of the patients treated in private practice and 5% of patients treated in the public facility had fluoroprophylaxis treatments during orthodontic treatment, due to previously detected caries susceptibility.

The index considered by this study was the OHI-S (Oral Health Index-Simplified) modified oral hygiene index, which is a reversible index used to measure the degree of oral hygiene.

This epidemiological index allowed the evaluation of the amount of soft residues present on the teeth, and regardless of whether they are plaque or alba matter, only the explorer was used, without using revealing solutions; this system was preferred to simplify the detection of indices by operators.

To perform this study, 8 maxillary teeth (1.6; 1.3; 1.2; 1.1; 2.1; 2.2; 2.3; 2.6) and 8 mandibular teeth (4.6; 4.3; 4.2; 4.1; 3.1; 3.2; 3.3; 3.6) were examined; the eventually present plaque was probed, by using an explorer, around the mesial, buccal and lingual/palatal distal surfaces of the examined teeth (for a total of 64 surfaces).

By summing up all the values of the surfaces positive to the presence of plaque and dividing by the total number of surfaces of the teeth considered, multiplying by one hundred, the percentage (%) of plaque present on the teeth was obtained.

All data were subjected to statistical analysis with SPSS software, to evaluate the correlations between the indexes collected and the arguments presented in the aim of the work:

- evaluation of the influence of orthodontic application on the level of collaboration to oral hygiene by the patient;
- evaluation of differences in behavior in oral hygiene between patients followed in public structure and patients followed in private practice;
- evaluation of differences in behavior in oral hygiene in the presence of different orthodontic devices (fixed/removable);
- assessment of the ability of patients to maintain

adequate oral hygiene with respect to the expected length of orthodontic treatment, assessed as short treatment (<1 year of therapy), or long treatment (>1 year of therapy).

The statistical evaluations carried out on the collected data were:

1. descriptive statistical analysis of the data;
2. double-tailed test T to evaluate the variation of the plaque index both in the presence of an orthodontic appliance and in relation to the different types of appliances (fixed and removable) and to compare the values of the plaque index in relation to the various care structures;
3. regression test and linear correlation to compare results on the progress of the plaque index with respect to the duration of orthodontic treatment.

## Results

Table 1 and Figure 1 showed the results of the T test for paired data referred to the plaque index in the presence of an orthodontic device at time T=0 and T=1. Through the measurement, we wanted to evaluate whether the presence of an orthodontic appliance produced a difference in behavior in oral hygiene of the patients of the whole sample examined both in the public and private structure.

Table 1. Plaque indexes at T0-T1.

Time	Group	Media	Dev Std	ESM
T0	200	0.4994	0.2749	0.0194
T1	200	0.4534	0.2512	0.0178
<b>Difference</b>		<b>0.0460</b>	<b>0.0237</b>	<b>0.0016</b>

95% Confidence Interval of diff. average: 0.03132 to 0.06068;

T = 6.181 with 199 degrees of freedom; P 0.000.

The average measured at time T0 was equal to: T0=0.4994 while at T1 it was equal to: T1=0.4534; this result, statistically significant since P is equal to: P=0.000, indicated how, even in the presence of an orthodontic device, if an appropriate oral hygiene protocol is applied, plaque indices can improve their level.

The ANOVA test for repeated measurements, performed at the time T0, T1, T2, showed that there were no statistically significant changes in the plaque index over 6 months; this is probably due to the improvement of the patient's compliance which, when properly stimulated, manages to maintain sufficient oral hygiene control over time (Tab. 2, Fig. 2).

The same result also comes from the T test for paired data, compared to the plaque index measurements made at the time T1 and at the time T2 in the two welfare structures: private and public (Tab. 3, Fig. 3). As can be inferred from the analysis of Table 3, there was no statistically significant modification (P=0.407) in the plaque index, which remained constant in the controls following the time T1.

The results of the plaque index measurements in relation to the different types of appliance: fixed or removable, carried out at time T=0 and T=1, on the patients followed both in the public and private structure, are reported in Tables 4, 5 and in Figure 4.

The analysis of these results confirmed a tendency for the plaque index to decrease in the presence of an orthodontic device in the first three months of the observation; in both cases, in fact, there were statistically significant data: P=0.002 and P=0.000, indicative of an effective improvement of the plaque index.

From the comparison of these tables, however, it appeared that the patients treated with removable devices presented better values of plaque index at detection performed at time T=1 compared to those who were subjected to a fixed therapy.

In Table 6 and Figure 5, the results of the plaque index value at time T1 in the fixed therapy patients were compared with those in mobile therapy and elaborated with the T test for paired data. It was possible to no-

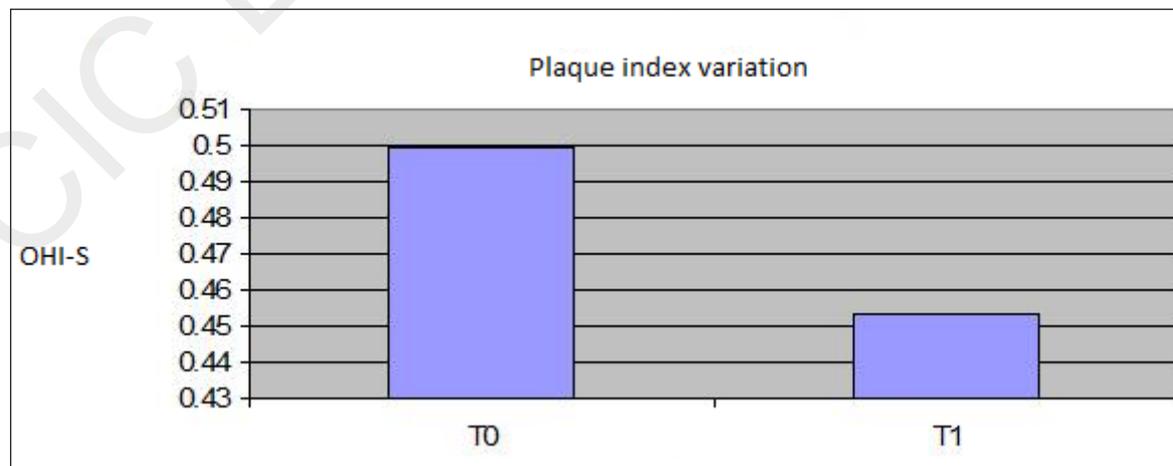


Figure 1. Variation of plaque indices.

Table 2. ANOVA for repeated measures.

Time	Group	Media	Dev Std	ESM
T0	200	0.4994	0.2749	0.0194
T1	200	0.4534	0.2512	0.0178
T2	200	0.4675	0.3338	0.0236

Variation source	SS	GL	Estimated variance (MS)
Between subjects	557.9536	199	
Within subjects	1051.8080		
Treatments	3.8786	2	1.9393
Residue	1047.9294	398	2.6330
Total	1609.7616	600	
MStreat	1.939		

F = ..... = ..... = 0.737 P = 0.479

MSres 2.633

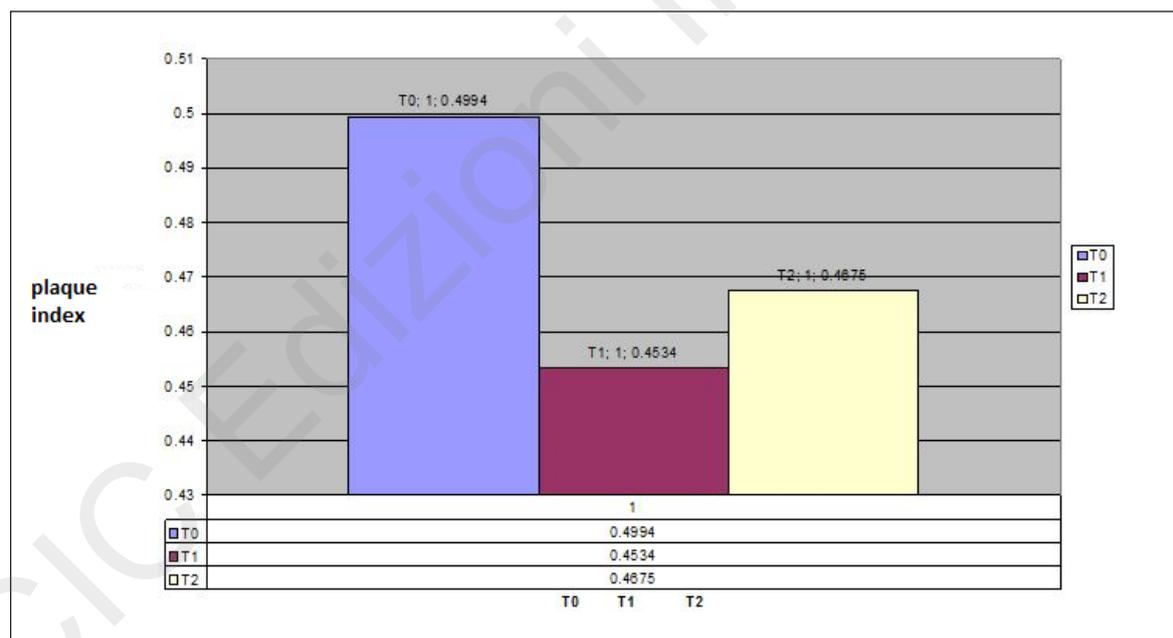


Figure 2. Variation of plaque indices at time T0-T1-T2.

tice a statistically significant difference in plaque index in the two different types of appliances for P=0.040. From the analysis of this result, therefore, it emerged that the presence of fixed appliances determined the need for greater collaboration in oral hygiene, compared to the presence of mobile devices. We then compared the plaque index values in patients under orthodontic treatment followed in the public structure, to those in the private structure. Al-

though the absolute values showed a difference between the two types of facilities, the values obtained through the elaboration, presented in Table 7 and Figure 6, showed statistically insignificant results (P=0.573). Finally, the results reported in Table 8 showed that the expected duration of orthodontic treatment, as communicated to the patients before the acceptance of the therapy, did not determine a statistically signifi-

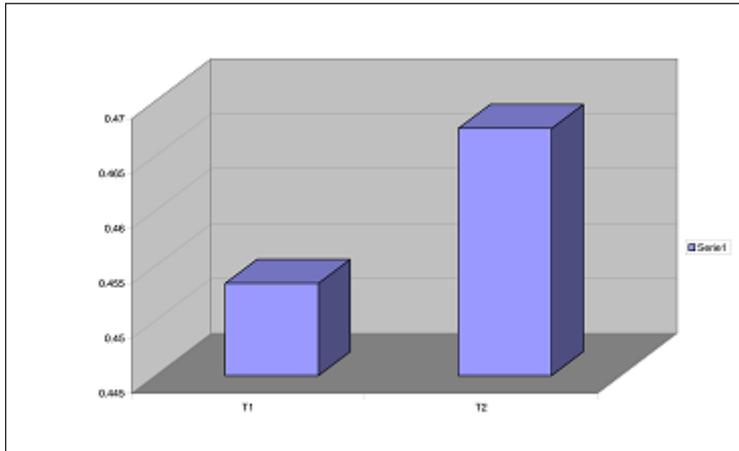


Figure 3. Variation of plaque indices at T1 and T2 (public structure + private structure).

Table 3. Change of the T1 and T2 time plaque index (public structure) (private structure).

Time	Group	Media	Dev Std	ESM
T1	200	0.4534	0.2512	0.0178
T2	200	0.4675	0.3338	0.0236
<b>Difference</b>		<b>-0.0140</b>	<b>0.2391</b>	<b>0.0169</b>

95% Confidence Interval of diff. average: 0.04739 to 0.01929;  
 T = -0.831 with 199 degrees of freedom; P= 0.407.

Table 4. Plaque indices in mobile devices (public structure + private structure).

Time	Group	Media	Dev Std	ESM
T0	45	0.4374	0.2584	0.0385
T1	45	0.3856	0.2400	0.0358
<b>Difference</b>		<b>0.0518</b>	<b>0.0184</b>	<b>0.0027</b>

95% Confidence Interval of diff. average: 0.01964 to 0.08396;  
 T = 3.246 with 44 degrees of freedom; P= 0.002.

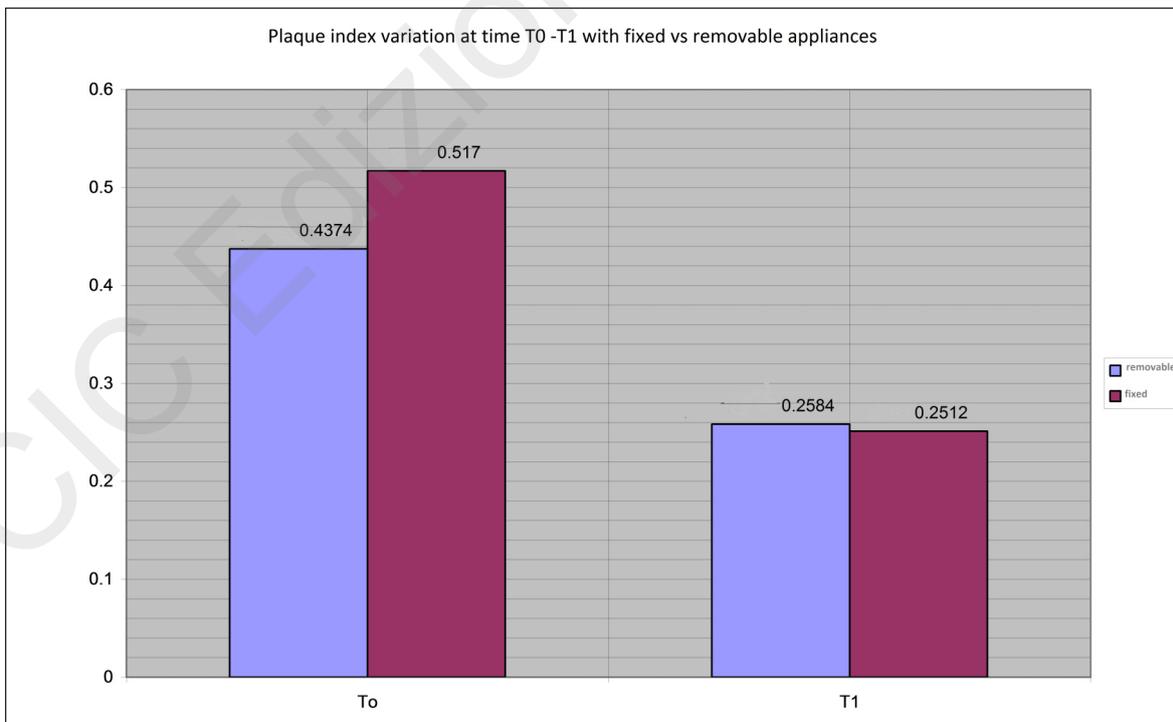


Figure 4. Total change of the plaque indices to T1 and T2 (public structure + private structure) for different types of appliances (removable/fixed).

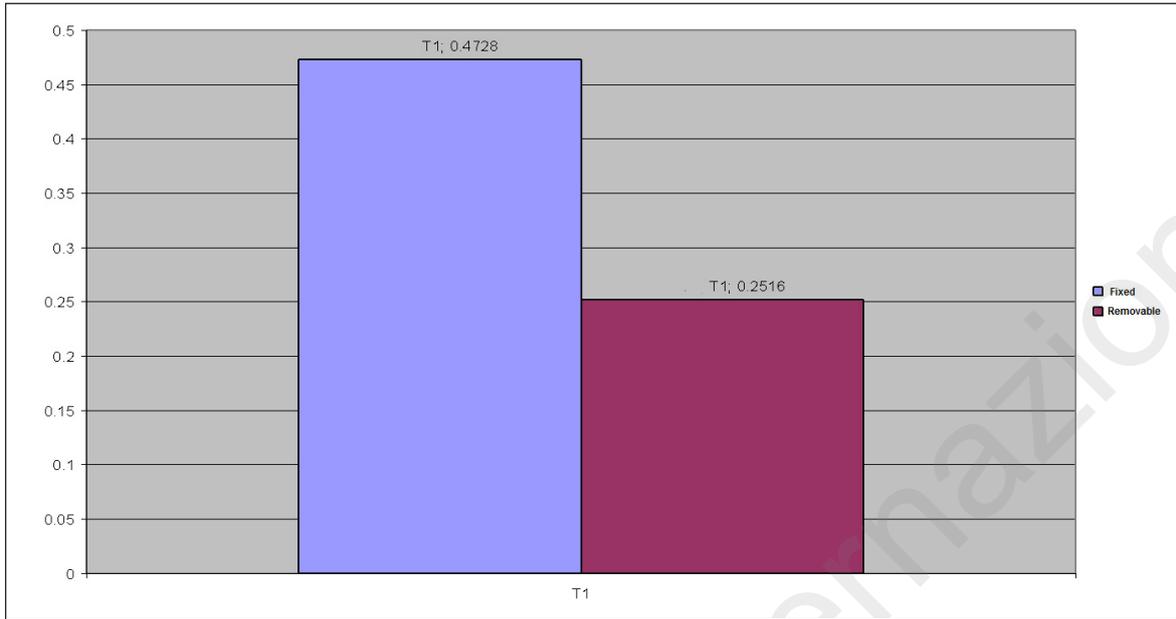


Figure 5. Plaque indices difference at time T1 in public and private structures between mobile and fixed devices.

Table 5. Plaque indices in fixed appliances (public structure + private structure).

Time	Group	Media	Dev Std	ESM
T0	155	0.5170	0.2777	0.0223
T1	155	0.4728	0.2516	0.0202
<b>Difference</b>		<b>0.0442</b>	<b>0.0261</b>	<b>0.0021</b>

95% Confidence Interval of diff. average: 0.02751 to 0.06076;  
 T = 5246 with 154 degrees of freedom; P=0.000

Table 6. Test T. Plaque indices comparison between fixed and mobile devices (public structure + private structure).

Time	Group	Media	Dev Std	ESM
T1	155	0.4728	0.2516	0.0202
T1	45	0.3856	0.2400	0.0358
<b>Difference</b>		<b>0.08728</b>	<b>0.04218</b>	

95% Confidence Interval of diff. average: 0.004112 to 0.1705;  
 T= 2.070 with 198 degrees of freedom; P=0.040.

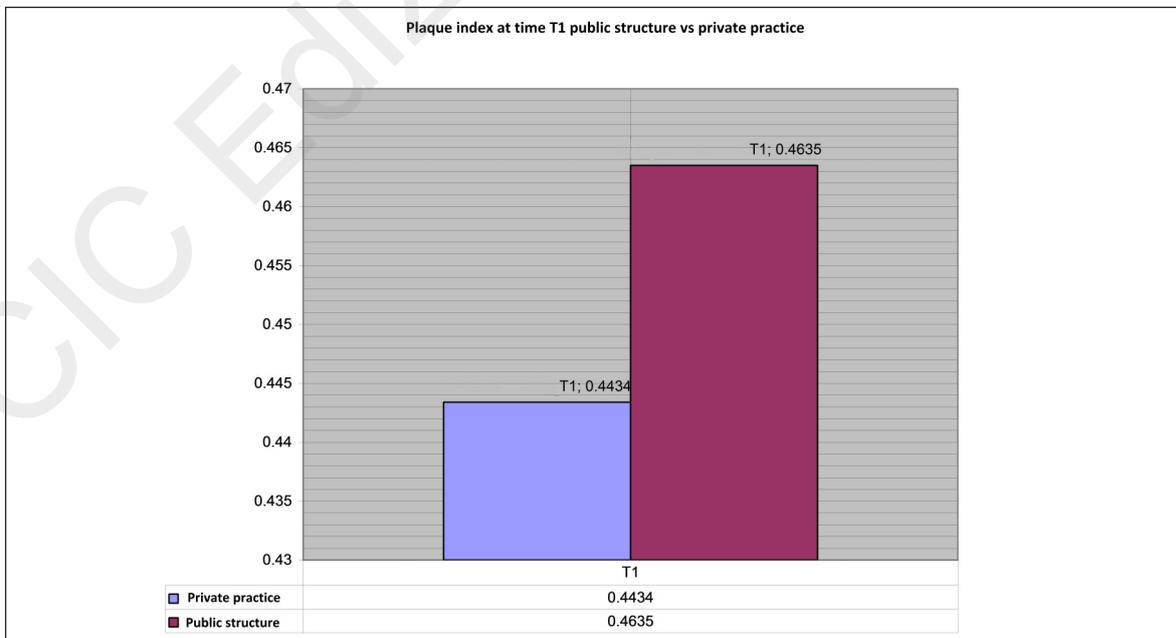


Figure 6. Difference of time T1 plaque indices in the different welfare structures (public structure vs private structure).

Table 7. Differences between the different welfare structures. (public structure vs private structure).

Time	Group	Media	Dev Std	ESM
T1	100	0.4434	0.2598	0.0260
T1	100	0.4635	0.2432	0.0243
<b>Difference</b>		<b>0.0201</b>	<b>0.03558</b>	

95% Confidence Interval of diff. average:-0.09027 to 0.05007.

T= 0.565 with 198 degrees of freedom; P=0.573.

Table 8. Plaque index correlation with respect to length of the orthodontic treatment. Regression and linear correlation.

Total sample group	200
Angular coefficient	-0.0658
Intercept	30.317
es slope	0.5862
es Int	0.3471
es r	24.659
r	0.0092
t	-0.1122
GL	198
P	0.9108

cant value,  $P=0.9108$  and  $r=0.0092$ , between the plaque index and the duration of therapy.

This result, however, did not imply a lack of correlation between the real treatment duration and bacterial plaque index. It is therefore important to stimulate the patient's motivation for oral hygiene maneuvers and orthodontic collaboration; it is very much possible to obtain the best results in terms of orthodontic treatment by reducing the risk of diseases such as caries or gingivitis.

## Discussion

In collecting our records of oral and food hygiene habits and the level of compliance, we found a series of parameters that were not analyzed in the present study but which we propose to include in a prospective study of wider scope.

This study highlighted that, even in the presence of orthodontic devices, usually considered responsible for the increase of plaque, gingival inflammation and demineralization around orthodontic brackets and bands (20), in the presence of a correct oral hygiene prevention and instruction program, plaque indices can improve.

The importance of a high level of oral hygiene care, so fundamental in everyday life, becomes even more

so in the presence of orthodontic appliances.

The average improvement of the level achieved in the first months, as evidenced by the modified OHI-S found in the study conducted, was significant in all cases.

Nevertheless, at inter-proximal level, where the patient's greatest difficulty in maintaining an adequate level of hygiene is usually found, and also in this study, we have always found a greater accumulation of plaque and food residues, compared to other dental surfaces.

This data probably demonstrates both a poor habit prior to keeping the interdental spaces clean, and the need for a greater degree of manual skill that is required in the presence of an orthodontic appliance, especially if fixed, in keeping such surfaces clean.

Usually, in patients who had not been recalled and did not receive oral hygiene instructions again, the plaque tends to increase or at least to return to the initial levels, before the hygienist appointments (21). In our sample, the control performed at the time T2=6 months indicated an almost overlapping value with the other controls; it is to be emphasized that probably the demotivation occurs quickly in patients without planned recall, indicating how crucial their continuous and constant reinforce is.

From a comparison of the data obtained both from clinical and statistical observations regarding the correlation between the different type of orthodontic devices and plaque indices, we can state that in patients in fixed orthodontic therapy, we have a more difficult control of hygiene is present, compared to patients in mobile orthodontic therapy.

This aspect is certainly affects by the presence, as we know, of brackets and bands that with their irregularities, retain food residues with formation of greater percentage of plaque, if the hygiene maneuvers are not carried out correctly (16).

The role of the hygienist is therefore essential, in constantly keeping alive the motivation of the orthodontic patient and to be ready to stimulate it when compliance is reduced.

Otherwise, the use of a removable appliance with the possibility of being able to be removed both during meals and during daily hygiene maneuvers, allows the patients to carry out the instructions indicated by dentists with greater ease.

Based on clinical data and statistical results related to oral hygiene behavior in the two different care facilities examined, it was shown that there are no statistically significant differences. This result is probably because both samples under examination were subjected to a hygiene education program, as a function of a subsequent orthodontic treatment. This protocol probably produced a positive behavioral response in patients, resulting in improved plaque index even at the first control performed three months after the hygiene instructions given to them.

In fact, the statistical comparison of the data related to the plaque index shows that there is a statistically significant improvement in patients in orthodontic treatment in the two different samples belonging to

both the public and private structure. This situation reflects the importance of health education through motivation and oral hygiene instructions and the implementation of prevention programs and oral hygiene protocols.

A further elaboration concerning the different types of apparatus (removable, fixed) gave a statistically significant  $P=0.040$  value. The value highlights how mobile devices, when it is possible to use them, would be preferable to fixed devices in patients with special needs or in patients with cooperating difficulty.

The patient in fixed orthodontic therapy must have greater motivation to maintain hygiene, since the retention of bacterial plaque by fixed orthodontic devices providing additional retention areas can lead to gingivitis, from the lightest to the most severe forms, with gingival hypertrophy, in particular of the papillae and presence of pseudo-pockets (14).

In the last question addressed in the present study, concerning the course of the plaque index with respect to the expected duration of treatment, we found the lack of a statistically significant linear correlation between plaque index and the possible duration of the therapeutic treatment.

This does not mean that a long treatment duration does not affect the worsening of patient plaque indices; however, if they are frequently monitored and subjected to hygiene sessions, the risk of damage to the gingival tissues can be reduced in some way, through the least accumulation of potentially harmful plaque (15).

On the basis of this research and the experience of other Authors, the following recommendations to the patient assume importance:

- carefully brush both the surface of the attachments and the gingival margins by means of both vibratory and rotary motions;
- use interdental brushes for interdental spaces, dental floss for less accessible areas.
- use mirror and plate detection substances for greater control.
- refer to professional oral hygiene whenever the orthodontist and/or hygienist advice the need.

## Conclusion

In conclusion, the study highlights the need to implement oral hygiene protocols before, during and after orthodontic treatment in the various care facilities; it highlights, also, how important the figure of dental hygienist is in teaching and motivating patients to oral hygiene.

The results obtained by statistical survey of linear regression performed by data collection at time  $T=0$  months;  $T=3$  months;  $T=6$  months on the plaque index determined that the presence of orthodontic devices, if the patient is enrolled in a rigorous recall of oral hygiene instructions, is not associated with a worsening of the level of oral hygiene.

Moreover, there does not seem to be a linear correlation between expected duration of treatment and level

of oral hygiene, while there is a slight difference between fixed and removable appliances in the level of plaque index.

Orthodontic treatment performed in different care facilities has shown statistically insignificant results, even if in the public structure it is more complex to rigorously implement the oral hygiene protocols because of the large number of patients daily coming for the control before, during and after orthodontic treatment, compared to the private structure.

From the data shown, the importance that health education assumes during these treatments is finally evident, as is the fact that, to obtain significant results, a simple act of motivation, performed at the beginning of orthodontic treatment, is not sufficient, and this must necessarily be repeated periodically, with a minimum interval of three months.

About the methods used to monitor the patient's acquisition of the correct oral hygiene technique, we believe that the simplified oral hygiene index (OHI-S), alone or associated with the bleeding index, is a simple method of good practical efficiency.

## Conflict of interest

No sources of support in the form of grants was received for the present paper.

## References

1. Guastamacchia C, Ardizzone V. Igiene orale domiciliare. Prevenzione e igiene dentale. Ed. Masson. 2001;200-209.
2. Darby ML, Walsh M. Dental Hygiene Theory and Practice. 3rd edition. Saunders. 2010:56-70.
3. O'Neill J. Little evidence exists about optimal caries-prevention strategies during orthodontic treatment. *Evid Based Dent.* 2004;5(4):97.
4. Derks A, Katsaros C, Frencken JE, van't Hof MA, Kuijpers-Jagtman AM. Caries-inhibiting effect of preventive measures during orthodontic treatment with fixed appliances. A systematic review. *Caries Res.* 2004 Sept-Oct;38 (5):413-420.
5. Palmer C, Wolfe SH. American Dietetic Association. Position of the American Dietetic Association: the impact of fluoride on health. *J Am Diet Assoc.* 2005 Oct;105(10):1620-1628.
6. Levrini L, Trezzi G, Tagliabue A. Assistenza ed igiene orale in ortodonzia. Elsevier 1999.
7. Gray D, McIntyre G. Does oral health promotion influence the oral hygiene and gingival health of patients undergoing fixed appliance orthodontic treatment? A systematic literature review. *J Orthod.* 2008 Dec;35(4):262-269.
8. Perry DA, Beemsterboer PL, Essex G. Periodontology for the Dental Hygienist. Elsevier Health Sciences. 2015.
9. Hagg U, Kaveewatcharanout P, Samaranayake YH, Samaranayake LP. The effect of fixed orthodontic appliances on the oral carriage of *Candida* species and Enterobacteriaceae. *Eur J Orthod.* 2004 Dec;26(6):623-629.
10. Garwood D. Oral Hygiene. *The Pharmaceutical Journal.* 2003 May;270(3):619-621.
11. Jung MH. Evaluation of the effects of malocclusion and orthodontic treatment on self-esteem in an adolescent population. *Am J Orthod Dentofacial Orthop.* 2010 Aug;138(2):160-166.

12. Sarul M, Lewandowska B, Kawala B, Kozanecka A, Antoszevska-Smith J. Objectively measured patient cooperation during early orthodontic treatment: Does psychology have an impact? *Adv Clin Exp Med*. 2017 Nov;26(8):1245-1251.
13. Richter DD, Nanda RS, Sinha PK, Smith DW, Currier GF. Effect of behavior modification on patient compliance in orthodontics. *Angle Orthod*. 1998 Apr;68(2):123-132.
14. Maret D, Marchal-Sixou C, Vergnes JN, Hamel O, Georgelin Gurgel M, Van der sluis L, Sicou M. Effect of fixed orthodontic appliances on salivary microbial parameters at 6 months: a controlled observational study. *J Appl Oral Science*. 2014;22(1):38-43.
15. Freitas AO, Marcuezan M, Nojima Mda C, Alviano DS, Maia LC. The influence of orthodontic fixed appliances on the oral microbiota: a systematic review. *Dental Press J Orthod*. 2014 Mar-Apr;19(2):46-55.
16. Saloom HF, Mohammed Salih HS, Rasheed SF. The influence of different types of fixed orthodontic appliance on the growth and adherence of microorganism (in vitro study). *J of Clinical Experim Dent*. 2013;5(1):36-41.
17. Boyd RL. Periodontal consideration during orthodontic treatment. In Bishara SE. *Text book of Orthodontics*. WB. Saunders Company. 2001:442-451.
18. Beckwith RF, Ackerman RJ, Cobb CM, Tira DE. An evaluation of factors affecting duration of orthodontic treatment. *Am JOrthod Dentofacial Orthopedics*. 1999;115:439-447.
19. Mavreas D, Athanasiou AE. Factors affecting the duration of orthodontic treatment: a systematic review. *Eur J Orthod*. 2008 Aug;30(4):386-395.
20. Salmerón-Valdés EN, Lara-Carrillo E, Medina-Solis CE, Robles-Bermeo NL, Scougall-Vilchis RJ, Casanova-Rosado JF, et al. Tooth demineralization and associated factors in patients on fixed orthodontic treatment. *Scientific Reports*. 2016;6:363-383.
21. Atassi F, Awartani F. Oral hygiene status among orthodontic patients. *J Contemp Dent Pract*. 2010;11:25-32.