ORIGINAL ARTICLE

N Pandis
K Vlachopoulos
A Polychronopoulou
P Madianos
T Eliades

Periodontal condition of the mandibular anterior dentition in patients with conventional and self-ligating brackets

Authors' affiliations:

N. Pandis, K. Vlachopoulos, Private practice, Corfu, Greece

A. Polychronopoulou, Department of Preventive and Community Dentistry, School of Dentistry, University of Athens, Athens, Greece

P. Madianos, Department of Periodontology, School of Dentistry, University of Athens, Athens, Greece

T. Eliades, Department of Orthodontics, School of Dentistry, Aristotle University of Thessaloniki, Thessaloniki, Greece

Correspondence to:

Theodore Eliades
57 Agnoston Hiroon Str.
Nea Ionia 14231
Greece
E-mail: teliades@ath.forthnet.gr

Structured Abstract

Authors – Pandis N, Vlachopoulos K, Polychronopoulou A, Madianos P, Eliades T

Objectives – To explore whether the use of self-ligating brackets is associated with better values for periodontal indices because of the lack of elastomeric modules and concomitantly, reduced availability of retentive sites for microbial colonization and plaque accumulation.

Setting and Sample Population – Private practice of the first author. Patients were selected using the following inclusion criteria: age range 12–17 years, fixed appliances on both arches, aligned mandibular arch, and absence of oral habits and anterior crossbites.

Materials and Methods – Prospective cohort investigation. Participants were grouped for bracket type, thus 50 patients formed the conventional bracket cohort and 50 patients the self-ligating bracket cohort. Both cohorts were followed with the purpose to examine periodontal status. Average length of follow-up was 18 months. This time period was considered adequate for a proportion of study participants to experience the outcome of interest. Outcome variables were plaque index, gingival index, calculus index, and probing depth for the two bracket cohorts.

Results – No difference was found in the indices recorded between the two bracket cohorts studied.

Conclusion – Under the conditions as applied in this study, the self-ligating brackets do not have an advantage over conventional brackets with respect to the periodontal status of the mandibular anterior teeth.

Key words: orthodontic appliances; orthodontics; periodontal indices; periodontium; self-ligating brackets

Introduction

One of the proposed favorable aspects of self-ligating brackets is associated with the elimination of elastomeric or stainless steel ligatures. This feature brings two basic advantages: the eradication of the cross-contamination, which may accidentally be involved in the process of ligature handling and

frequent change, and the claimed improvement in the oral hygiene of patients. The latter has been attributed to the fact that the patient is given the opportunity to clean surfaces of reduced complexity and with less retentive sites for microbial colonization.

Oral microbiota attachment in orthodontic patients has been mainly associated with increased risk of *Streptococcus mutans* and Lactobacilli colonization, among other species, thus manifesting a series of events, which may lead to the development of pathology of the hard tissues such as decalcification and caries development in specific cases (1–6). Moreover, the accumulation of plaque and the resultant alteration of the local microbial milieu may expose the tissues to risks for developing periodontal inflammation, with notable changes in the microbiota (7, 8). Even though the aforementioned effects have been studied extensively, there is a lack of substantiation of the hypothesis of decreased plaque retention related to the use of self-ligating brackets.

The objective of this study was to investigate the effect of bracket type (conventional or self-ligating) on the periodontal condition of the mandibular anterior teeth of orthodontic patients through a clinical prospective cohort investigation.

Subjects and methods

The individuals participating in the study group were selected from a larger pool of patients from the practice of the first author. Patients were selected using the following inclusion criteria: age range 12–17 years, fixed appliances on both arches, aligned mandibular arch, and absence of oral habits and anterior crossbites. Participants were grouped on the basis of bracket type, thus 50 patients formed the conventional bracket cohort (Micro arch; GAC International, Central Islip, NY, USA) and 50 patients the self-ligating bracket cohort (In-Ovation-R, GAC International). Both cohorts displayed similar periodontal condition before treatment, and they were followed examine periodontal status during orthodontic therapy. Average length of follow-up was 18 months. This time period was considered adequate for a proportion of study participants to experience the periodontal outcome of interest. Additionally, complete alignment of the mandibular arch was required to eliminate crowding as a con-

founder. All patients/parents were informed and their consent was given prior to entering the study.

Routine oral hygiene instructions were given to all 100 subjects, and with specific care for the orthodontic appliances, at the beginning of treatment according to the standard office protocol. No brushing or other hygiene measure was applied immediately prior to periodontal examination. For both groups, the following clinical variables were assessed by the same periodontist:

1) *Plaque index* (PI), as described by Löe (9), was evaluated with a disclosing agent (Dual Tone; Young Dental, Earth City, MI, USA) on the buccal surfaces for all anterior mandibular teeth (incisors and canines). Plaque accumulation was categorized using the following scale:

0 – absence of plaque;

1 – plaque disclosed after running the probe along the gingival margin;

2 – visible plaque; and

3 – abundant plaque.

The results of the PI were averaged for all six mandibular teeth and a mean value for each subject was estimated.

2) *Gingival index* (GI) as described by Löe (9), was estimated on a participant basis as an average of the measurements of the individual GI on the mesial buccal, buccal, and distal buccal surfaces of the six mandibular anterior teeth according to the following scale:

0 – absence of inflammation;

1 – mild inflammation, with a slight change in color and subtle change in texture; no bleeding on probing;

2 – moderate inflammation with a moderate glazing, redness, edema, and hypertrophy; bleeding on pressure; and

3 – severe inflammation with marked redness and hypertrophy tendency to spontaneous bleeding ulceration.

3) *Calculus index* (CI) was evaluated as an estimate of the coronal extension of supragingival calculus and/or the presence of separate flecks of a continuous band of subgingival calculus (10). The following scale was used:

0 – absence of calculus;

1 – presence of calculus covering up to one-third of the tooth surface;

2 – presence of calculus covering up to two-thirds of the tooth surface and/or the presence of separate flecks of subgingival calculus; and

3 – presence of calculus covering more than two-thirds of the tooth surface and/or the presence of a continuous band of subgingival calculus.

The results of the buccal CI were averaged for all six anterior mandibular teeth and a mean value for each subject was calculated.

4) *Probing Depth* (PD), measured in millimeters with a periodontal probe (NC 15; Hu-Friedy, Chicago, IL, USA), was recorded as the distance from the gingival margin to the most apical part of the sulcus. Three readings were carried out per tooth (mesiobuccal, buccal, distobuccal). The results of the PD were averaged for all six anterior mandibular teeth and a mean value for each subject was calculated.

Statistical analysis

Demographic and periodontal characteristics of the sample were investigated with conventional descriptive statistics. Differences in proportions between the two study cohorts were investigated with the chi-squared test, whereas comparisons of the different periodontal indices were conducted with the Wilcoxon rank sum test. Data analysis was conducted with the STATA® 10 statistical package (StataCorp LP, College Station, TX, USA), at the 0.05 level of significance.

Results

Table 1 shows the distribution of demographic variables into the two groups. The distributions of gender

and age did not differ between the two bracket cohorts, and thus no difference between the baseline characteristics of the two cohorts existed, precluding the assignment of potential index scores to subject characteristics.

In Table 2, the results of the statistical analysis of the index scores of the conventional and the self-ligating groups are shown. For all indices (PI, GI, CI, and PD), no difference was found between the two bracket patient groups.

Discussion

The introduction of periodontal indices initially focused on individual patient needs, such as assessing the progression of pathology or hygiene compliance in specific dental arch sites. However, their application has expanded to involve research with the objective of characterizing the periodontal status of a population and the effectiveness of treatment protocols. The latter application may be viewed a violation of their use because index scores, which are basically ordinal data, are treated as interval or scale, and a mean and a standard deviation from multiple measurements are extrapolated. Apart from the inappropriateness of this notion, the results obtained have no physical meaning: for example, a PI index of 2 does not mean that the area

Table 1. Demographic characteristics of the study cohorts

	Conventional n = 50 (%)	Self-ligating n = 50 (%)	p-value*
Gender			
Female	29 (58.00)	35 (70.00)	NS
Male	21 (42.00)	15 (30.00)	
Age (years)			
<14	9 (18.00)	15 (30.00)	NS
14 to <15	15 (30.00)	16 (32.00)	
15 to <16	14 (28.00)	11 (22.00)	
≥16	12 (24.00)	8 (16.00)	

NS, non-significant.
*Based on chi-squared test.

Table 2. Periodontal characteristics of the study cohorts by the end of follow up

	Conventional n = 50	Self-ligating n = 50	p-value
Periodontal index			
Median	1.50	1.65	NS*
Range	0.00–2.83	0.00–3.00	
Gingival index			
Median	1.13	1.17	NS*
Range	0.22–3.34	0.67–1.73	
Probing depth, mm			
Median	1.83	1.83	NS*
Range	0.92–2.83	1.00–2.72	
Calculus, n (%)			
Absent	42 (84.00%)	47 (94.00%)	NS†
Present	9 (16.00%)	3 (6.00%)	

NS, non-significant.
*Based on Wilcoxon rank sum test.
†Based on chi-squared test.

of tooth covered by plaque is 200% of that with an index of 1. Nonetheless, there have been numerous publications on this issue, and this fact coupled with their popularity as a research tool, render their use valid in the comparative assessment of periodontal status of patients before and after the initiation of treatment or a change in a hygiene routine (9). Analysis of indices in this study was performed with a non-parametric test based on the ordinal nature of data.

Despite the shortcoming of this method, more sensitive tools of monitoring specific periodontal features have not yet been widely utilized. Crevicular fluid markers as indicators of inflammation may be more sensitive, and their use has been adopted in studies assessing determinants of tooth movement (11). However, these markers are influenced by both, the movement variants (force magnitude and duration) as well as local factors such as plaque accumulation and inflammation, and therefore, their use in assessing the effect of appliances on periodontal condition is not indicated. Moreover, these markers still lack clinical meaning and may not be suitable for large-scale applications because of the high cost involved.

Calculus accumulation relates to the increased availability of retentive sites for microbial colonization, which are being calcified at a later stage. The basic assumption behind the use of self-ligating brackets as they pertain to effects on oral hygiene, is the hypothesis that, ligatures, elastomerics in particular, increase plaque accumulation. The outcome of biofilm adsorption is dependent on the biological fluid flow rate at the site of contact, the type of interfacial interactions involved, and the attachment strength with the substrate (12). The choice of the mandibular anterior teeth as a site of index recording in this study was based on the shorter interbracket distance, reduced crown width, and smaller overall tooth size, which contribute to exacerbated plaque retention rates relative to adjacent sites.

It was initially proposed that the elimination of elastomeric modules would supposedly reduce the site available for colonization thereby decreasing plaque and calculus. Moreover, these changes would probably affect gingival index favorably, considering the proximity of the appliances to the cervical portion of the crown in mandibular anterior teeth. Despite the extensive literature on the broader importance of fixed orthodontic appliances in promoting plaque retention in the oral cavity of orthodontic patients (13), there has

been a scarcity of evidence with respect to the specific effect of self-ligating bracket to this effect. A recent randomized split-mouth trial demonstrated that 1 week following bonding, the patients with self-ligating brackets presented higher anaerobe and aerobe colony-forming units and increased hypertrophy relative to those bonded with conventional appliances, whilst no differences in bleeding on probing were observed between the two groups (14).

On the contrary, a laboratory report has indicated that increased plaque accumulation was consistently correlated with conventional brackets (15). However, in vitro setups lack fundamental properties, which modulate microbial colonization and plaque retention intraorally, and thus should only be considered when clinically derived evidence is unavailable.

The difference noted between the results of the present study and the sole similar report in the literature (14) may relate to a number of factors including: the variations in the design and size between the self-ligating brackets selected in the two studies; the level of oral hygiene of the subjects, which may reflect cultural differences; and treatment variables, such as bonding procedures and the age of the subjects. Also, the study supporting the detrimental role of self-ligating brackets in the periodontal condition examined basically microbiological parameters, whilst the present investigation dealt with clinical variables. It may be possible that the changes noted represent an initial pattern, which is transient while the long-term condition is reversed to normal levels. Periodontal index recording in this study was performed after completion of the alignment in the mandibular anterior region to exclude the effect of crowding on measurements. Apparently, these periodontal indices may differ in the initial stages of treatment when crowded crowns overlap.

Even though the self-ligating brackets eliminate the use of elastics, they often incorporate intricate opening and closing mechanisms, which may provide additional plaque retention sites. These components are not subjected to regular renewal such as the elastomeric modules. Thus, a theoretical advantage may be eliminated in reality, where calcification of the plaque leads to obstacles in the functioning of the opening–closing mechanism.

Aged elastomeric ligatures have been shown to present a pattern, which involves adsorption of K and Na at early stages, followed by Ca and P precipitations,

which stabilize the integument formed (16). This greatly alters the surface properties of the material, potentially favoring additional plaque build-up. Even though this surface profile may favor plaque retention relative to smoother and polished stainless steel ligatures, no difference in periodontal conditions of patients treated with these two modes of ligation has been observed (17). The results of this study emphasize the critical importance of a structured oral hygiene program to efficiently eliminate predisposing factors for periodontal disease regardless of the type of appliances used.

Conclusion

Under the conditions as applied in this study, the self-ligating brackets do not have an advantage over conventional brackets with respect to the periodontal status of mandibular anterior teeth.

Clinical relevance

Advantages such as improved periodontal condition, because of the elimination of elastomerics ties and the resultant decrease of the microbial attachment retentive sites, have been proposed for self-ligating brackets. However, no evidence has been published so far on the effects of self-ligating appliances on the periodontal status of orthodontic patients. This investigation examines and comparatively evaluates the periodontal status of patients undergoing orthodontic treatment with self-ligating and conventional appliances. The results reveal a lack of such an effect probably because of the reduced significance of ligating medium in the presence of good oral hygiene and the potentially limited contributory effect of elastomeric ligatures to the periodontal health.

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