

## GINGIVAL RESPONSE IN ORTHODONTIC PATIENTS. COMPARATIVE STUDY BETWEEN SELF-LIGATING AND CONVENTIONAL BRACKETS

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### ABSTRACT

Orthodontic brackets contribute to the accumulation of bacterial plaque on tooth surfaces because they hinder oral hygiene. In contrast to conventional brackets, self-ligating brackets do not require additional parts to support the arches, thus improving dental hygiene. The aim of this study was to compare the gingival response in orthodontic patients wearing self-ligating or conventional brackets. A sample of 22 patients aged 16 to 30 years was divided into two groups: Group A, treated with self-ligating brackets (Damon system) and Group B, treated with conventional brackets (Roth technique). The following were assessed during the treatment: Plaque Index (PI), Gingival Index (GI) and Probing Depth (PD), and sub-gingival samples were taken from teeth 14/24 for microbiological observation.

No statistically significant difference was found between Groups A and B;  $p > 0.05$  (sign-ranked) or between PI, GI and PD at the different times (Friedman's Analysis of Variance), even though the indices were found to increase at 14 days, particularly for self-ligating brackets. The quantity and quality of microorganisms present were compatible with health on days 0, 28 and 56. As from day 14 there is a predominance of microbiota compatible with gingivitis in both groups. In the samples studied, orthodontic treatment increases bacterial plaque and inflammatory gingival response, but gingival-periodontal health can be maintained with adequate basic therapy. Self-ligating and conventional brackets produced similar gingival response.

**Key words:** Gingival disease; Orthodontic bracket; Biofilm

## RESPUESTA GINGIVAL EN PACIENTES ORTODÓNICOS. ESTUDIO COMPARATIVO ENTRE BRACKETS AUTOLIGABLES Y CONVENCIONALES.

### RESUMEN

Los brackets ortodóncicos contribuyen al acúmulo de placa bacteriana en las superficies dentarias, debido a que dificultan la higiene oral. A diferencia de los brackets convencionales, los brackets autoligables no requieren elementos adicionales para sujetar los arcos, lo cual favorecería la higiene dentaria. El objetivo del presente trabajo fue comparar la respuesta gingival en pacientes ortodóncicos, utilizando brackets autoligables y brackets convencionales. Se estudiaron 22 pacientes, entre 16 y 30 años, divididos en dos grupos: A, tratado con brackets autoligables, Sistema Damon) y B, tratado con brackets convencionales, Técnica de Roth. Durante el tratamiento, se evaluaron los Índices de Placa (IP), Índice Gingival (IG) y Profundidad de Sondaje (PS) y se tomaron muestras subgingivales de las piezas 14/24 para su observación microbiológica. En la evaluación estadística no se encontraron diferencias estadísti-

camente significativa entre los grupos A y B;  $p > 0.05$  (de los rangos con signo) y ni en los IP, IG y PS en los diferentes tiempos evaluados (Análisis de varianza de Friedman), sin embargo se observa un aumento en los índices a los 14 días, sobre todo en autoligables. Los microorganismos se presentaron en cantidad y calidad compatible con salud el día 0, 28 y 56; a partir del día 14 predomina microbiota compatible con gingivitis para ambos grupos. En las muestras estudiadas el tratamiento ortodóncico produce incremento de placa bacteriana y respuesta gingival inflamatoria, pero con terapia básica adecuada puede mantenerse la salud gingivo-periodontal. Los brackets autoligables y los o convencionales, produjeron respuesta gingival similar.

**Palabras clave:** Enfermedad gingival; Brackets ortodóncicos; Biofilm

### INTRODUCTION

Orthodontic attachments are known to contribute to the accumulation of bacterial plaque and make it difficult to maintain appropriate hygiene. Mateu et al.<sup>1</sup> studied clinical indices and conducted microbi-

ological evaluation, finding that patients visited the clinic with initial indices compatible with gingival-periodontal disease, but after receiving instruction on how to perform proper oral hygiene and undergoing plaque control before beginning their ortho-

dontic treatment, they achieved indices compatible with periodontal health, as is needed in order to attach the brackets.

The advent of orthodontic treatment for adults gave rise to the increasing popularity of esthetic brackets, and with them, new questions about the adhesion of microorganisms and their organization in the biofilm<sup>2</sup>. Adhesion of microorganisms to tooth surfaces is the result of specific reactions, electrostatic interactions and Van der Waals forces, but depends on the type of surface and its capacity to retain microorganisms<sup>3,4</sup>. Numerous studies have demonstrated the viability of *Candida albicans* and *S. mutans* on removable orthopedic devices, but little is known about their survival on fixed orthodontic braces<sup>3,5</sup>.

The use of orthodontic appliances contributes to gingival-periodontal and cariogenic alterations because it modifies the oral microbiota<sup>6,7</sup>. Numerous clinical studies have demonstrated that patients undergoing orthodontic treatment are more susceptible to periodontal disease and white spots<sup>8-12</sup>. Some authors claim that this is because orthodontic braces act as a "trap" which retains microorganisms, and thus serve as an ideal niche for normal microbiota which may become established and act as an opportunist, inducing imbalance and subsequent disease<sup>13</sup>.

There is controversy regarding whether self-ligating brackets can retain less or more bacterial plaque than conventional brackets. Comparisons of the two systems have produced varying results, possibly because different bracket designs within each system determine how much plaque is trapped and the response induced in the tissues. This study compares gingival responses induced by self-ligating Damon brackets and conventional Synthesis brackets in terms of quantity and quality of accumulated bacterial plaque and gingival-periodontal lesion indices.

## MATERIALS AND METHODS

The study included 22 patients of both sexes, aged 16 to 30 years, with cast discrepancy less than 7mm, and with comparable relative crowding. They signed informed consent to participate in the clinical trial.

**Inclusion criteria:** Patients aged 16 to 30 years, of either sex, with permanent dentition, in whom bone-tooth discrepancy allowed alignment without the need for prior extractions, interproximal reduction or rapid expansion.

**Exclusion criteria:** Patients with joint disorders, periodontal disease or untreated caries on the day the brackets were attached; mixed or deciduous dentition; retained or impacted canines or missing permanent teeth.

**Experimental design:** Participants were divided into two groups of 11 and treated by 4 calibrated professionals. Patients were randomized for assignment to each group and each professional.

Group A was treated with low-friction, self-ligating system Damon III brackets (A Company) and .014 Copper Ni-Ti Damon arches.

Group B was treated with Roth straight arch technique system with friction, Synthesis brackets (A Company) and elastomers which were replaced every 14 days whose function was to attach the arches to the bracket slot. Ni-Ti .012, .014 and .016 arches were used.

The following routine diagnoses were performed on the patients.

## Operational definition of variables

All patients were given the same information about oral care, oral and appliance hygiene, in writing, before the brackets were bonded (day 0) and by means of practical explanation at each visit. Basic periodontal therapy was provided to patients who needed it. Patients were instructed to brush their teeth using Bass's technique<sup>15</sup>. To supplement hygiene, they were instructed on how to use the inter-tooth brush vertically, placing it behind the arch and between the brackets.

A specialist in periodontology calibrated the professionals to take bacteriological samples and clinical indicators of gingival-periodontal status. The following indicators were taken on each tooth present in the mouth: Silness and Loe plaque index, Loe and Silness gingival index<sup>14</sup>, probing depth and bleeding on probing, using a pressure-sensitive probe, at 0, 14, 28 and 56 days after bonding the appliances. At the same times, subgingival samples were taken from teeth 14 and 24 for microbiological analysis.

## Clinical indicators were evaluated as follows

*Plaque index (PI):*

0. No plaque

1. Plaque when the probe is passed along the gingival margin

2. Visible plaque

3. Abundance of plaque

*Gingival index (GI):*

0. Complete absence of visual signs of inflammation
1. Slight change in color and texture
2. Visible inflammation and tendency to bleeding when the probe is passed lightly along the gingival margin
3. Clear inflammation with tendency to spontaneous bleeding

*Probing Depth (PD)*

Normal:

0 to 1 millimeter on free surfaces and up to 3 millimeters on proximal surfaces.

**Microbiological analysis (MA)**

The zones of teeth 14 and 24 were relatively isolated with cotton rolls. One of the active parts of Gracey 7/8 curettes was used to eliminate supragingival plaque, and the other was used to take subgingival samples which were placed in Eppendorf tubes with 0.5 milliliters of saline physiological and VMGA III transport medium. At the same time, smears were prepared from the material collected from teeth 14 and 24 (first upper premolars) for Gram and Giemsa staining. Samples of microbiota were taken from the brackets on the same teeth, because they are difficult sites to reach with a toothbrush.

The samples from the VMGA III were processed individually after homogenizing by sonication in a water bath and spinning in microcentrifuge at 12,500 rpm. An aliquot of the sample was diluted 1/100 in recently recovered anaerobic broth, 20 µl were seeded on Anaerobe Laked Blood Agar, NAM and PY broth. 20 µl aliquots of the pure sample were seeded in TSB, VK medium. The plates for anaerobes were incubated in a jar with controlled atmosphere for 7 days at 36°C±1°C. The samples from the physiological saline were plated on CHROMagar Candida in anaerobic conditions. Micromorphology was observed on milk 1%-Tween 80 agar, urease production, and carbohydrate assimilation profile were determined using commercial systems Api ID 32D (BioMérieux, France). In addition, species which developed green color in chromogenic medium were tested for Xilose assimilation, micromorphology on Staib's medium, growth at 45° to confirm the species.

Brackets were bonded on the same day that the initial samples were taken (day 0). Clinical records and microbiological studies were taken at baseline and repeated at 14, 28 and 56 days.

**Statistical analysis**

Sigmaplot v.11 software was used for the statistical analysis. Each parameter (gingival index, plaque index and probing depth) was analyzed separately. There were some times at which it was not possible to measure the indices in all the patients, thus groups of 10, 11 and 12 data were obtained. In order to make the tests symmetrical, only the first ten data from each group were used.

Wilcoxon's signed-rank test was used to compare the two groups of brackets (self-ligating vs. conventional), a non-parametric test that pairs the values of days (0, 14, 28 and 56) for each type. Friedman's two-way analysis of variance by ranks for more than two dependent samples was used to compare the four groups of days (0, 14, 28 and 56), a non-parametric test which pairs bracket values (self-ligating vs. conventional) for each group.

**RESULTS**

Figs 1, 2 and 3 show values of gingival parameters from both groups under study. There was no statistically significant difference for any of the cases (Friedman's analysis of variance) although indices tend to increase after 14 days, particularly in self-ligating brackets.

Although self-ligating brackets tend to have higher indices, the comparison of techniques using Wilcoxon's Signed-Rank Test shows no statistically significant difference between groups at any of the evaluation times (P = 0.250). The comparison between days by Friedman's Analysis shows no statistically significant difference (P = 0.458) although the indices tend to increase on day 14.

Microbiological analysis. The following were found in the day 0 sample: *Actinomyces*, *Candida albicans*, *Cocci* with prevalence of Gram (+). As from day 14, the predominant microorganisms were: *Prevotella intermedia*, *Candida dubliniensis*, *Porphyromona gingivalis*, spirochaetes, *Candida* spp, rods, with prevalence of Gram (-), in quantities compatible with gingivitis. The same microorganisms were found in the samples taken on days 28 and 56, as on day 14, although in lower quantity and quality, compatible with gingival health.

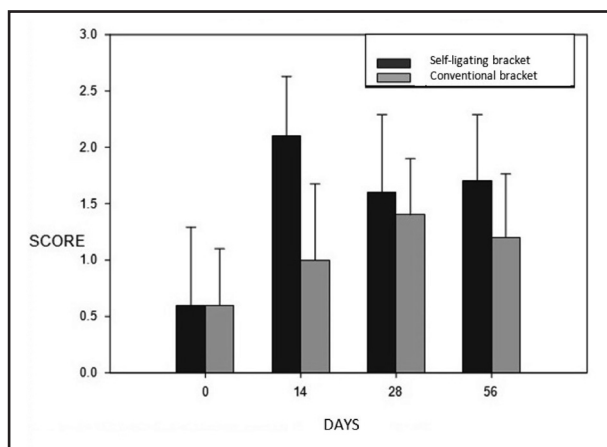


Fig. 1: Plaque index. Means and 95% confidence interval (upper half).

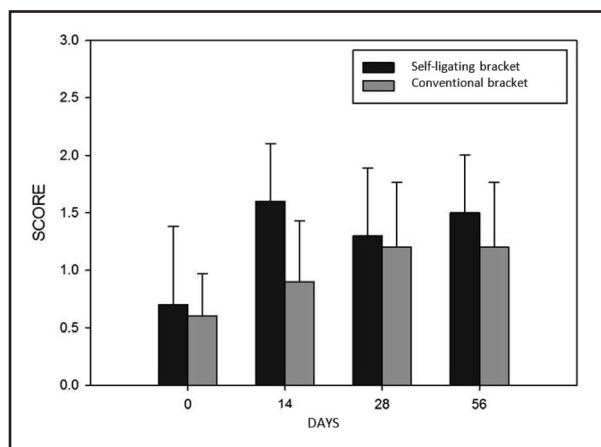


Fig. 2: Gingival index. Means and 95% confidence interval (upper half).

## DISCUSSION

The results of our study agree with those in Ristic et al.<sup>5</sup>, who report that probing depth, total number of microorganisms and number of patients with positive results for *Prevotella intermedia* and other periodontal pathogenic anaerobes increased from the time before the braces were attached, attaining maximum values after 3 months. Both the clinical and the microbiological values declined 6 months after the beginning of orthodontic treatment. Therapy with fixed appliances may temporarily increase bacterial growth, producing gingival inflammatory response, although with no destructive effect on deep periodontal tissues.

According to the literature, bracket design may influence the gingival response in orthodontic patients. A study comparing self-ligating brackets (Speed) to conventional brackets (GAC)<sup>16</sup> found statistically significant differences between the values obtained by counting microorganism colonies and the anaerobe/aerobe ratio shortly after cementing brackets (0, 3 and 7 days), with more colonization at sites cemented with Speed brackets. This study found more hypertrophy at sites near self-ligating brackets, although the gingival bleeding response was similar in both groups. These results agree with the tendency to increasing values found in our experience for self-ligating brackets when assessed at 14 days; although subsequent evaluations at 28 and 56 days showed that the indices approached values compatible with health for both groups. This suggests that if the dental care provider insists on the instructions for hygiene and reinforces

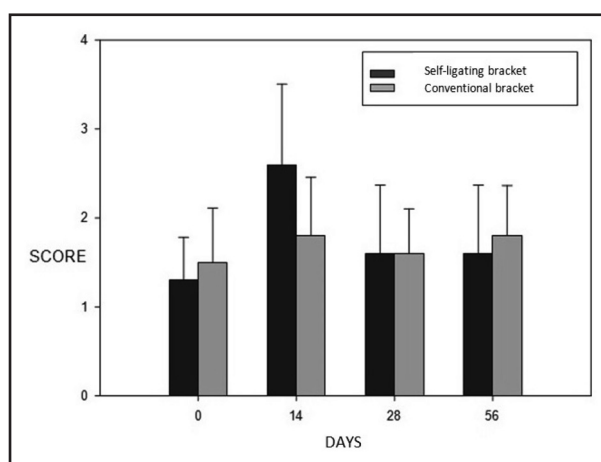


Fig. 3: Probing depth. Means and 95% confidence interval (upper half).

instruction of oral hygiene at successive visits, patient cooperation, improved hygiene, and thus, better clinical indices may be achieved.

Pellegrini et al.<sup>17</sup> evaluated bioluminescence 1 and 5 weeks after placing the appliances and found that self-ligating brackets had less bacterial adhesion than conventional brackets. However, the findings of Pandis et al. (2010)<sup>18</sup> suggest that *S. mutans* levels in complete saliva from patients treated with orthodonty do not differ significantly between conventional and self-ligating brackets, based on total bacteria and *Streptococcus mutans* counts in saliva samples taken at time 0 and 2 or 3 months after cementing.

Our study was performed on a relatively small sample of patients with a wide range of ages. Preliminary data reported contribute to supporting the

hypothesis that the inflammatory response to orthodontic treatments depend on multiple factors. The data reported to date are not conclusive regarding whether the choice of brackets has a direct influence on gingival response. On the contrary, professional care and patient cooperation seem to be more decisive in maintaining periodontal health.

## CONCLUSIONS

Damon self-ligating brackets and Synthesis conventional brackets seem to produce similar responses

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