Evaluation of Subgingival Dental Plaque Microbiota Changes In Fixed Orthodontic Patients with Syber Green Real Time PCR

Naser Sargolzaie 1, Saeed Amel-Jamedar 2, Majid Reza Mokhtari 3, Hamid Reza Arab 1, Soodabe Piroozi 4

1 Dental Research Center, Department of Periodontology, Mashhad University of Medical Sciences, Mashhad, Iran
2 Department of Microbiology, Ghaem Educational, Research, and Treatment Center, Mashhad University of Medical Sciences, Mashhad, Iran
3 Oral and Maxillofacial Diseases Research Center, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran
4 General Dentist, Mashhad, Iran

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Abstract

Introduction: One of the most common problems we confront in orthodontic therapy is periodontal diseases. Initial factor which causes these diseases is colonization of anaerobic microorganisms in subgingival plaque. Technically, local environmental changes related to orthodontic band and brackets may influence the bacterial species in periodontal plaque. However, it seems necessary to assess variations in subgingival plaque caused by orthodontic appliances. The aim of this study was to investigate changes in subgingival microbiota and clinical parameters before and after bracket placement. Methods: Clinical parameters including probing depth (PD), plaque index (PI), clinical attachment level (CAL), bleeding on probing (BOP) and gingival index (GI) were recorded and subgingival microbial samples were collected in 30 people aged between 13 and 25. As a control group, 15 persons getting matched as to their age and sex with no need to orthodontic treatment were opted using specific primers, SYBER Green Real-Time PCR was carried out in order to determine bacterial flora in stored samples. All mentioned procedures were reassessed in experimental group and in control group three months after band and bracket bonding. A descriptive analysis was conducted, and paired t test and Wilcoxon test were used for differences between groups (P<0.05). Results: No changes in clinical attachment level were observed, but scores for bleeding on probing, plaque index, and gingival index increased 3 months after bracket placement in experimental group (P<0.05). Prevotella intermedia rose in experimental group after brackets placement compared with control group but Actinobacillus actinomycetem comitans and Tanerella forsythia proportions did increase. Conclusions: treatment with fixed appliances may transitionally raise the growth of periodontopathogenic bacteria and consequently result in gingival inflammatory response but without destructive effect on deep periodontal tissues.

Key words: Dental plaque, orthodontic bracket, subgingival microflora, syber green real time PCR.

Introduction

The oral cavity is colonized by commensal microflora which is relatively stable in individuals and the composition of which is the result of a long-term relationship between the microorganisms and the action of numerous external and internal factors (1-3). These factors can lead to the colonization of important microorganism implicated in gingival inflammation and periodontal destruction (4). Tanerella forsythia,
porphyromonas gingivalis, actionobacillus
actionomycetem comitans, and prevotella intermedia
/nigrescens have been found more frequently in patients
with inflammation and periodontal pockets than in
healthy subjects (5). Inflammatory reaction of gingival
tissue appears very often during orthodontic therapy
with fixed appliances (6). The presence of new retentive
places around bands and brackets is considered to be the
main factor for an increased accumulation of dental
plaque and inflammatory responses (7,8). Improper
plaque control and undetected gingival inflammation
might promote periodontal destruction that can be
aggravated by orthodontic treatment.

The aim of this study was to compare the changes in
subgingival microbiota and periodontal parameters
before and after the placement of orthodontic brackets.

Materials and Methods

This prospective study was carried out on 30 persons
(16 males and 14 females) aged 13 - 25 years. Fifteen of
these subjects wore no orthodontic appliances, thus
considered as control group. The other had worn fixed
orthodontic appliances for at least 3 months. All of the
participants in the study were recently referred to the
Department of Orthodontics at the Dental School of the
Mashhad University of Medical Sciences. The study
design was approved by the ethics committee on human
research. All subjects signed informed written consent,
parents signed and approved the participation of
underage patients (<18 year of age). Exclusion criteria
included periodontitis, antibiotic intake in the previous 3
months, pregnancy and systemic illness. A full
examination was performed using a marked periodontal probe (UNC-15, Hu Fridy, Chicago, III) before and 3 months after
the placement of orthodontic brackets. The changes of three putative periodontopatogens in
subgingival plaque were detected, and are shown in
Table 3. These clinical parameters were assessed on the
middle aspects of tooth surface on the examined teeth.

Sample collection

The samples for microbiological examination were
obtained from subgingival areas of index teeth. If some
of the represented vital tooth was missing, the adjacent
tooth was used instead. The subgingival plaque samples
were collected after appropriate tooth isolation from
saliva. Visible supragingival plaque was removed and a
to isolate into the subgingival sulcus and kept for 15 seconds before it was removed.

The paper points were inserted in a microtube containing 1ml phosphate buffer (PK=8.0). Samples
were placed on ice and immediately transported to the
microbiology laboratory.

Lyophilized primers were used as received from the
manufacturer. The sequence of primers is shown in
Table 1. Following DNA extraction, Syber Green real
time PCR was performed using a Sprime kit in a total
volume of 25ml containing Real Master Mix Syber
ROX 2.5x at 11.25ml, forward primer at 1ml, reverse
primer at 1ml, template at 6ml and D.D.W at 6.75ml.
Real-time PCR was run on a thermal cycler (Astech
Japan) under the following conditions: primary
denaturation at 95°C for 8min, denaturation at 95 ºC at
20 sec, annealing at 53 °Cat 20 sec and extension at
72 ºC at 20 sec.

Results

Clinical parameters, plaque index, gingival index
and bleeding on probing were elevated after 3 months.
This elevation was significantly greater in test group
than in control group (Tables 2 and 3).

The changes of three putative periodontopatogens in
the subgingival plaque were detected, and are shown in
Table 3. Prevotella intermedia was significantly more
prevalent in the experimental group than in two other
microorganisms., A. actionomycetem comitans and T.
forysthia were found in subgingival plaque after 3
months but the changes were not significant as
compared to baseline (P > 0.05).

Table 1. Primers for syber green real time polymerase chain reaction analyses

<table>
<thead>
<tr>
<th>Bacteria name</th>
<th>Sequence</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. actinomycetem comitans</td>
<td>Forward: AAA CCC ATC TCT GAG TTC TTC</td>
<td>551 nt</td>
</tr>
<tr>
<td></td>
<td>Reverse: ATG CCA AAC AGC TTA AAT</td>
<td></td>
</tr>
<tr>
<td>T. forsythia</td>
<td>Forward: GCG TAT GTA ACC TGC CCG CAT</td>
<td>641 nt</td>
</tr>
<tr>
<td></td>
<td>Reverse: TGC TTC AGT GTC AGT TAT ACC</td>
<td></td>
</tr>
<tr>
<td>P. intermedia</td>
<td>Forward: CAA AGA TTC ATC GGT GGA</td>
<td>294 nt</td>
</tr>
<tr>
<td></td>
<td>Reverse: GCC GGT CCT TAT TCG AAG</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Mean, standard deviation (S.D), minimum and maximum of changes Plaque index and gingival index

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>N</th>
<th>Mean±S.D</th>
<th>Minimum</th>
<th>Maximum</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>d.PI†</td>
<td>Experimental</td>
<td>15</td>
<td>-1.09±0.44</td>
<td>-1.80</td>
<td>-0.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>control</td>
<td>15</td>
<td>.11±0.29</td>
<td>-0.40</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>d.GI†</td>
<td>Experimental</td>
<td>15</td>
<td>-.78±0.25</td>
<td>-1.50</td>
<td>-0.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>control</td>
<td>15</td>
<td>.04±0.15</td>
<td>-.20</td>
<td>.40</td>
<td></td>
</tr>
</tbody>
</table>

†: Difference between baseline and 3 month after operation for Plaque index
T: Difference between baseline and 3 month after operation for gingival index

Table 3. The changes of Treponema Forsythia, Actinobacillus actinomycetem, Prevotella intermedia and BOP before and 3 month after operation

<table>
<thead>
<tr>
<th>Treponema Forsythia</th>
<th>Actinobacillus actinomycetem</th>
<th>Prevotella intermedia</th>
<th>BOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>yes</td>
<td>No</td>
<td>yes</td>
</tr>
<tr>
<td>Before</td>
<td>14</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>After</td>
<td>11</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>P-value</td>
<td>0.25</td>
<td>1.00</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Discussion

The inflammatory reaction of gingival tissue can often be detected among patients wearing fixed orthodontic appliances (11,12). The lack of adequate oral hygiene in these patients is presented as the main cause of bacterial plaque accumulation, increased number of bacterial colonies and consequent inflammatory response.

In this study, we compared the sub-gingival microbiota composition before and after the placement of brackets in patients scheduled for orthodontic treatment. It was found that brackets influenced on the composition of the sub-gingival microbiota indirectly. Clinical parameters (PI, GI and BOP) increased after orthodontic treatment, indicating that dental plaque accumulation might be the main reason for the gingival inflammation observed in these patients. Using Syber-Green real time PCR technique, we described the changes in the sub-gingival microbiota in patients receiving orthodontic treatment. Advantages of PCR technique compared to other techniques is that the technique may provide significant additional information regarding microbiote by detecting bacterial species that are otherwise difficult or impossible to culture (13) and this technique yield results in less time (14). Moreover the technique is also capable of detecting DNA from dead bacteria. Supra-gingival plaque accumulation is important because it influences the composition of the sub-gingival microbiota. After a short time (3 months) of bracket placement, the counts and frequencies of A. actinomycetem comitans, P. intermedia and T. forsythia increased and frequencies of A. ac was significantly more prevalent in orthodontic patients. This finding suggests that orthodontic treatment might affect the presence of periodontal microorganisms (15).

The microorganisms evaluated in this study, are the most of ten implicated microorganisms as etiologic causes of periodontal damage (16).

Dramatic and significant surge in P. intermedia is very important finding because the increase of anaerobe microbes may be the preceding event for changes of clinical parameters. In orthodontic patients, as bacterial plaque accumulates, t inflammatory cell infiltration could increase in size and number causing the gingival tissues to swell, bleed and become edematous (17).

One of the most implicated periopatogenic anaerobe is A. actinomyctem comitans which causes aggressive periodontitis (18-20). In previous studies authors found a significant increase of A.a in dental plaque samples after application of fixed appliances, followed by constant presence during the whole treatment and finally with a decrease after the removal of fixed appliance (21).

However, the results of this study show that P.I as a periodontopathic anaerobe is more frequent in dental plaque collected from teeth with fixed appliances compared to A.a. It could be concluded that transient changes in the microbial flora of sub-gingival dental plaque during fixed orthodontic treatment will not have destructive effects on the periodontal tissues at least up to 3 months. The mere presence of a specific microorganism does not mean that the patient has periodontal disease, but it depends on a complex bacteria-host interaction modulating the host's response leading to inflammation and future loss of attachment (22,23). From this view point, the results of present study are similar to several previous studies (14,24-26).
Periodontal conditions in patients undergoing orthodontic treatment should be monitored carefully. Removable and fixed orthodontic appliances impede correct periodontal hygiene, resulting in more plaque accumulation, inflammation and bleeding (27). Therefore, appropriate oral hygiene methods and instruments should be used to control plaque (28). Powered and interdental toothbrushes and special types of floss have been shown to improve plaque control in orthodontic patients (27,28).

**Conclusion**

The results of this study confirm the fact that treatment with fixed appliances may increase the growth of pathogenic bacteria and anaerobes. These microbiological changes are strictly limited to subgingival dental plaque collected from the teeth with elements of fixed appliances and they do not have the destructive effect on periodontal tissues. Since these changes in subgingival micro flora increase the risk of periodontal tissue damaging, it is necessary to provide instructions for good oral hygiene among patients undergoing fixed treatment and to maintain their constant re-motivation and continual control during the whole time of orthodontic therapy.

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**References**


Corresponding Author:
Majid Reza Mokhtari
Dental Research Center
School of Dentistry
Vakilabad Blvd, Mashhad, Iran
Tel: 09153147930
Fax: 00985118829500
E-mail: mokhtarimr@mums.ac.ir