Effect of self-ligating bracket appliance on the periodontal tissues in patients with chronic periodontitis after orthodontic treatment

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ABSTRACT

Objective: To explore the effect of self-ligating bracket appliance on the periodontal tissues in patients with chronic periodontitis after orthodontic treatment. Methods: A total of 56 patients with chronic periodontitis who were admitted in our hospital were included in the study and divided into the observation group and the control group according to different treatment protocols. The patients in the observation group were given self-ligating brackets, while the patients in the control group were given traditional brackets. The periodontal tissues and tooth motility (TM) before and after treatment in the two groups were observed and recorded. IL-1 \( \beta \) and TNF-\( \alpha \) levels in the gingival crevicular fluid (GCF) before and after treatment in the two groups were detected. Results: PD, CAL, SBI, and PLI after treatment in the two groups were significantly reduced, while GR was significantly elevated when compared with the control group. PD, CAL, SBI, and PLI after treatment in the observation group were significantly lower than those in the control group, while GR was significantly higher than that in the control group. TM after treatment in the two groups was significantly improved, among which the number of 0° TM was significantly increased, while the number of 1° -3° TM was significantly reduced. IL-1 \( \beta \) and TNF-\( \alpha \) levels in GCF after treatment in the two groups were significantly reduced when compared with before treatment. IL-1 \( \beta \) and TNF-\( \alpha \) levels in GCF after treatment in the observation group were significantly lower than those in the control group.

Conclusions: The self-ligating brackets can effectively improve the periodontal tissues and TM in patients with chronic periodontitis, and reduce the levels of inflammatory cytokines in periodontal tissues, with an accurate efficacy.

1. Introduction

The chronic periodontitis is mostly developed from gingivitis, and is a common type of periodontitis, with an increased morbidity as the age increases. According to the statistics[1], about 2/3 adults are suffering from periodontal diseases in different degrees in our country. Due to the continuous damage on periodontal tissues, this kind of periodontal disease can promote the tooth displacement and extension, and cause the production of secondary malocclusion, resulting in tooth motility or detachment. The orthodontic treatment is an effective adjuvant therapy for chronic periodontitis, and can strengthen the periodontal stability[2]. Currently, the brackets are widely applied in the treatment of adult malocclusion. The self-ligating bracket is a new technology developed in recent years, can effectively reduce the friction between the brackets and arch wire, reduce the dental plaque retention, and is beneficial for maintaining the oral hygiene and improving the prognosis[3,4]. The study is aimed to explore the effect of self-ligating bracket appliance on the periodontal tissues in patients with chronic periodontitis after orthodontic treatment.

2. Materials and methods

2.1. Clinical materials

A total of 56 patients with chronic periodontitis who were admitted in our hospital from January, 2015 to May, 2016 for orthodontic treatment were included in the study, among which 31 were male, and 25 were female; aged from 21 to 64 years old. Inclusion criteria: (1) those who were in accordance with the diagnostic criteria of...
chronic periodontitis in the periodontology; (2) those whose oral mucosa was normal; (3) those whose oral hygiene was in a good condition; (4) those whose PLI was less than 2; (5) those whose intraoral tooth leaving number was greater than 20; (6) those whose inflammation was in a stationary phase after 3-6 month treatments. Exclusion criteria: (1) those who were merged with dental body, dental pulp, or root tip lesions; (2) those who had severe heart, liver, and kidney diseases.

2.2. Methods

According to different treatment protocols, the patients were divided into the observation group and the control group with 28 cases in each group. The periodontal status was evaluated before orthodontic treatment. The patients in the two groups were given supragingival and subgingival cleaning, root planning, and oral hygiene propaganda and education. An individualized treatment protocol was formulated according to the patients' specific conditions. The principles of tiny tooth displacement, filament, and light force should be abided by. The patients in the control group were given MBT straight wire brackets, while the patients in the observation group were given Damon Q self-ligating brackets. After the treatment was finished, the systemic occlusion adjustment was performed. The lingual fixed retainer was used for the long-term maintaining. During the treatment process, if there was gingival congestion and edema or periodontal abscess, the orthodontic treatment should be ceased, and related periodontal treatments should be given to control the progression of periodontitis.

2.3. Observation indicators

PD, CAL, GR, SBI, PLI, and TM before treatment and 3 months after treatment in the two groups were compared. The gingival crevicular fluid (GCF) of orthodontic teeth before and after treatment in the two groups was collected. ELISA was used to detect the supernatant IL-1β and TNF-α levels.

2.4. Statistical analysis

SPSS 12.0 software was used for the statistical analysis. The measurement data were expressed as mean ± SD. The paired t test was used for the intra-group comparison, and the independent t test was used for the comparison between the two groups. The enumeration data were expressed as percentage, and chi-square test was used. P<0.05 was regarded as statistically significant.

### Table 1.
Comparison of the periodontal tissues before and after treatment between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>PD</th>
<th>CAL</th>
<th>GR</th>
<th>SBI</th>
<th>PLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>28</td>
<td>Before treatment</td>
<td>3.71±1.45</td>
<td>3.78±1.82</td>
<td>0.38±0.25</td>
<td>1.75±1.13</td>
<td>0.95±0.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>2.23±0.86</td>
<td>2.13±1.56</td>
<td>0.75±0.41</td>
<td>0.96±0.42</td>
<td>0.58±0.41</td>
</tr>
<tr>
<td>Control</td>
<td>28</td>
<td>Before treatment</td>
<td>3.82±1.42</td>
<td>3.81±1.82</td>
<td>0.42±0.23</td>
<td>1.76±1.12</td>
<td>0.93±0.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>2.51±0.63</td>
<td>2.73±1.32</td>
<td>0.56±0.39</td>
<td>1.24±0.42</td>
<td>0.78±0.36</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before treatment; **P<0.05, when compared with the control group.

### Table 2.
Comparison of TM change before and after treatment between the two groups [n (%)].

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>28</td>
<td>Before treatment</td>
<td>0(0.0)</td>
<td>15(27.78)</td>
<td>32(59.26)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>42(77.78)</td>
<td>5(9.26)</td>
<td>7(12.96)</td>
</tr>
<tr>
<td>Control</td>
<td>28</td>
<td>Before treatment</td>
<td>0(0.0)</td>
<td>17(30.91)</td>
<td>30(55.56)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>39(70.91)</td>
<td>6(10.91)</td>
<td>10(18.18)</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before treatment.

3. Results

3.1. Comparison of the periodontal tissues before and after treatment between the two groups

The comparison of PD, CAL, SBI, PLI, and GR before treatment between the two groups was not statistically significant (P>0.05). PD, CAL, SBI, and PLI after treatment in the two groups were significantly reduced, while GR was significantly elevated when compared with the control group (P<0.05). PD, CAL, SBI, and PLI after treatment in the observation group were significantly lower than those in the control group (P<0.05), while GR was significantly higher than that in the control group (P<0.05) (Table 1).

3.2. Comparison of TM change before and after treatment between the two groups

TM after treatment in the two groups was significantly improved, among which the number of I° TM was significantly increased, while the number of [I° - III°] TM was significantly reduced (P<0.05), but the comparison of TM distribution after treatment between the two groups was not statistically significant (P>0.05) (Table 2).

3.3. Comparison of the levels of inflammatory cytokines in GCF before and after treatment between the two groups

IL-1β and TNF-α levels in GCF after treatment in the two groups were significantly reduced when compared with before treatment (P<0.05). IL-1β and TNF-α levels in GCF after treatment in the observation group were significantly lower than those in the control group (P<0.05) (Table 3).

### Table 3.
Comparison of the levels of inflammatory cytokines in GCF before and after treatment between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>IL-1β</th>
<th>TNF-α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>28</td>
<td>Before treatment</td>
<td>36.55±2.36</td>
<td>3.14±0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>29.64±1.03*</td>
<td>2.24±0.15**</td>
</tr>
<tr>
<td>Control</td>
<td>28</td>
<td>Before treatment</td>
<td>35.86±2.24</td>
<td>3.16±0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>30.15±1.04*</td>
<td>2.53±0.15**</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before treatment; **P<0.05, when compared with the control group.
4. Discussion

The chronic periodontitis is a common stomatological disease, and can be manifested as the formation of deep periodontal pocket, alveolar absorption, and tooth loss in the progression stage; therefore, early control of periodontal disease and tooth displacement is of great significance. The orthodontic treatment is an effective adjuvant therapy for chronic periodontitis, and can move and lean the affected tooth in order to reach the goal of reducing the accumulation of dental plaque, aligning the dentition, and recovering the normal neighbourhood of teeth[7]. Currently, the self-ligating brackets are commonly adopted in the clinic for orthodontic treatment to reduce the periodontal stimulation, and protect the periodontal tissues. When compared with the traditional bracket appliance, the self-ligating bracket appliance can take advantage of its own lock catch structure to fix the arch wire, and reduce the friction, which is more beneficial for the tooth displacement, and the reduction of subjective discomfort and treatment time[8,9].

Some researches demonstrate that PLI is the most common indicator to evaluate the oral hygiene[10,11]. Effective reduction of PLI can maintain the gingival health. The results in the study showed that PD, CAL, SBL, and PLI after treatment in the observation group were significantly lower than those in the control group (P<0.05), while GR was significantly higher than that in the control group (P<0.05), indicating that the self-ligating brackets can not only maintain the beauty and comfort, but also reduce the stimulation on the periodontal tissues, decrease the dental plaque, and contribute to improve the periodontal status[12]. Occlusal trauma is an important factor for developing tooth mobility. Occlusal trauma can cause the vertical absorption in alveolar bones, the broadening between periodontal intermembrane space in a wedge shape, and tooth mobility which can shift the anterior teeth in a fan shape, which can not only affect the anesthetics, but also reduce the masticatory function[13,14]. Some researches demonstrate that the levels of inflammatory cytokines in GCF are highly sensitive to estimate the periodontal inflammation, among which IL-1 level in GCF is increased with the aggravation of periodontal inflammation degree and the increased depth of periodontal probing[15,16], while TNF-α can inhibit the osteoblast activity, induce the production of osteoclast, promote the synthesis of PG and protease, aggravate the periodontal tissue damage, and maintain the synergistic effect with IL-1 during the bone absorption process. The results in the study showed that TM after treatment in the two groups was improved, but the comparison between the two groups was not statistically significant (P>0.05), IL-1 β and TNF- α levels in GCF after treatment in the observation group were significantly lower than those in the control group (P<0.05), indicating that the self-ligating brackets and traditional brackets can effectively improve TM, but the self-ligating brackets have a slight mechanical and chemical stimulation on the periodontal soft tissues, can significantly reduce the probability of bacterial invasion, and contribute to promote the aerobic metabolism of periodontal tissues and maintain the oral micro-ecological environment.

In conclusion, the self-ligating brackets can effectively improve the periodontal tissues and TM in patients with chronic periodontitis, and reduce the levels of inflammatory cytokines in periodontal tissues, with an accurate efficacy.

References