In Vitro Study on the Control of Interdental Area and Around the Bracket on Orthodontic Dental Model

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Objective: In order to compare the dental plaque removal effect on the proximal area and around the bracket for orthodontic dental patient between by using the electric interdental brush and by using the manual one.

Methods: Electric interdental brush was designed and developed by Industry and Academy Co-Operation Center of Honam University on December in 2018, and used it as experimental group and the manual interdental brush which was the similar shaped of the brush head with the electric one was used as a control group. Fifty times of tooth-brushing at the proximal side and around the bracket was done with use of two kinds of interdental brushes at the right side and left side for a patient, in order to compare the plaque removal effect after using them after checking of the residual plaque.

Results: The comparison of the removal amounts of the dental plaque by use of two types of interdental brush. 3 Electric 30 3.79±3.08, 3 Manual 30 1.10±0.24 5 Electric 30 4.92±5.46, 5 Manual 30 1.36±0.51.

Conclusion: Electric interdental brush which was developed for the experiment was effective to remove the dental plaque at the proximal side and around the bracket for the orthodontic dental patient, and recommended to use for fixed typed orthodontic dental patient in clinical.

Keywords: dental plaque, tooth brushed, orthodontic brackets, electric interdental toothbrush, manual interdental toothbrush

Introduction

Both of the major oral diseases as dental caries and periodontal disease which can be occurred by dental plaque has been reported as the most prevalent and he cause of the tooth loss in Korea [1]. Dental caries is known to cause by eroding of the tooth surface by acid production from the acid exudate by acid product micro-organisms in the dental plaque which attached at the tooth surface, and periodontal disease as beginning from the inflammation of the gingival tissue, can be occurred by toxin from the dental plaque or mechanical irritation by calculus from the mineralization of the dental plaque at the tooth surface [2]. It has been known that the basic method to eliminate the dental plaque is tooth-brushing [3]. Forrest and Miller [4] reported that tooth-brushing not only inhibits the formation of bacterial membranes, but also cleans the teeth and inhibits re-adhesion of food residues and resurfacing of tooth surfaces.

Interdental brush as one of the oral hygiene devices, is designed for effective removing of the dental plaque and the foreign bodies at the proximal area of the tooth surface where is hardly to eliminate them easily [5]. It has been used for ortho-
odontic and prosthodontic dental patients to remove out the
dental plaque at the detailed area of the appliance [5]. It has
been designed several types as cylinder type or conical type,
and small size or middle size according to the shape and the
size of the bristle. Wolff et al. [6] reported that the effect of re-
moving the dental plaque from the conical interdental tooth-
brush was higher than that of the cylindrical toothbrush and
conical interdental toothbrush. However, Kiger et al. [7] re-
ported that plaque removal was more effective when tooth-
brushes and floss were used together. Particularly, it is effec-
tive to use oral hygiene products after tooth brushing in order
to remove plaque from adjacent teeth. Orthodontic treatment
using a calibration device within the oral cavity may pose a
risk of developing dental caries and periodontal disease. Fixed
orthodontic appliance changes the amount and pathogenicity
of the dental plaque membrane in the oral cavity and changes
the periodontal tissue. Therefore, when orthodontic treatment
is initiated in the absence of awareness of tooth-brushing man-
agement, dentition improves, but dental caries and period-
donatal disease exacerbate the oral condition [8,9]. The princi-
ple of electric toothbrush is to remove plaque or food residue
through movement generated by sound wave of saliva or
moisture in oral cavity.

The purpose of this study was to develop an electric tooth-
brush that develops an electric interdental toothbrush and
wipes around brackets to remove dental plaque between or-
thodontic brackets and teeth. Another purpose of this study
was to evaluate the change of plaque between two braces us-
ing orthodontic toothbrush and manual interdental tooth-
brush, which are essential for oral hygiene between ortho-
dontic bracket and tooth. The use of an interdental tooth-
brush wiping around the orthodontic bracket and a manual
interdental toothbrush were used to compare the effective-
ness of removal of the dental floss around the orthodontic
bracket.

Materials and Methods

This study was carried out on December in 2018 with devel-
oping an electric toothbrush by the Industry and Academy
Co-Operation Center of Honam University. To analyze the
difference of plaque after brushing with a toothbrush with an
electric interdental toothbrush and a manual interdental tooth-
brush, the plaque dying with a disclosing agent was applied to
the orthodontic dental model, and perform the tooth-brushing
with an electric toothbrush and a manual interdental tooth-
brush were repeated for 50 times, one by one and check the arti-
ficial residual plaque index at the tooth surface to compare,
shown in Figure 1 to 5. The fixed type orthodontic dental mod-
el used in this study was model (Gwangmyeong Auscom,
Seoul, Korea) shown in Figure 3. Model and the manual inter-
dental toothbrush was a 1-Type (Reader Co., Seoul, Korea).

In this study, reliability, descriptive statistics, and sample
t-test were applied with IBM SPSS Statistics 21.0 program
(IBM Corp., Armonk, NY, USA).

The effect of toothbrush removal rate was examined after
brushing the upper and lower parts of the orthodontic bracket
with an electric interdental toothbrush and a manual inter-
dental toothbrush, with normal forces. The left plaque was
checked by use of patient hygiene performance (PHP) index
as 5 points for maximum score at the buccal side and proximal
site and around the bracket and shown in Table 1.

The data of the residual plaque were compared with the us-
Figure 3. Orthodontic dental model.

Figure 4. Electric tooth brushing.

Figure 5. Manual interdental brushing.

Table 1. The comparison of the removal amounts of the dental plaque by use of two types of interdental brush

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Type</th>
<th>No. of interdental brushes</th>
<th>Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Electric</td>
<td>30</td>
<td>3.79±3.08</td>
<td>0.000**</td>
</tr>
<tr>
<td>3</td>
<td>Manual</td>
<td>30</td>
<td>1.10±0.24</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Electric</td>
<td>30</td>
<td>4.92±5.46</td>
<td>0.001**</td>
</tr>
<tr>
<td>5</td>
<td>Manual</td>
<td>30</td>
<td>1.36±0.51</td>
<td></td>
</tr>
</tbody>
</table>

*p-values by t-test. SD: standard deviation. **p<0.01.

In order to maintain a healthy oral hygiene condition and to prevent two oral diseases, it is important to manage the plaque. Especially, it is effective to use oral hygiene products after tooth brushing in order to remove the bacterial membrane from the tooth surface.

Kim et al. [10] asserted the need for information and education on oral care products, and Paik [11] argued that comprehensive preventive measures and appropriate oral hygiene products were necessary. Lee et al. [12] showed that 99.3% of the residents of Seoul citizens are brushing daily, but the use rate of auxiliary oral hygiene products such as floss and inter-
dental toothbrushes is very low. Among dental hygiene products, interdental toothbrushes can effectively remove bacterial membranes from dental flosses or toothpicks, and there is also a report that the depth of the periodontal pockets has decreased after using the interdental toothbrush [13]. Patients with fixed orthodontia can have temporary or permanent damage such as gingivitis, periodontitis, enamel demineralization and dental caries, root resorption, and dimensional changes due to the management of dental floss. This enamel demineralization can be seen only after 4 weeks of bracket mounting [14].

It was considered that the plaque control could not be performed completely by routine tooth-brushing for the orthodontic dental patient because of the complexity of the appliances on the tooth surface, to cause the dental caries and periodontal disease and need for use of interdental toothbrush at the proximal area and around bracket. Electric interdental toothbrush could be effective to use for eliminating the dental plaque at detailed area on the tooth surface and it could be helpful for successful orthodontic dental treatment.

In this study, there was a significant difference in the plaque removal rates between the electric interdental toothbrush and the manual interdental toothbrush at a significance level of 0.05, with a significant probability of 0.00 for a mean of removal plaque amounts as 3.79±3.08 in experimental group and 1.10±0.24 in control group at 3 minutes brushing, before and after experiment shown in Table 1.

The average removal amounts of the plaque were 4.92±5.46 in experimental group using an electric interdental toothbrush and, 1.36±0.51 in control group as using the manual interdental brush. There was significantly difference between two groups, both in 3 and 5 minutes; tooth-brushing.

It means that there was more effect for removal of dental plaque for orthodontic dental patient by use of electric interdental brush. It is considered as due to the effective elimination of plaque at the complexity and detailed area for orthodontic appliance and proximal area. But there was a limitation of this experiment for a little bit variation for the brushing force at every time for experiment, even though the same shape and hardness of the bristle for the head of the interdental brush by using for the experiment. So it needed for the clinical experiment in the future.

The purpose of this study is to make the orthodontic toothbrush wiping around the bracket of the orthodontic patient bracket more effectively to manage the circumference of the bracket and the interdental space when using orthodontic patients with tooth-brushing.

Conclusion

It was concluded that the electric interdental tooth-brush which was designed and developed by Industry and Academy Co-Operation Center of Honam University was more effective to remove out the dental plaque at the detailed area for orthodontic dental patient than using with a manual type of the interdental toothbrush, according to the in vitro experiment. It left a clinical experiment for these results in the future.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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References