A Study on the Effect of Sonic Vibration Toothbrush That Has Omnidirectional Bristles on Children’s Oral Hygiene

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Objective: To compare the efficiencies of removing dental plaque and tongue plaque by toothbrushes that has omnidirectional bristles, the experiment was implemented with manual toothbrush type and sonic vibration toothbrush type.

Methods: Sixty children who had agreed to participate in the clinical study were divided into the experimental group and the control group for 30 each. For each experimental and control group, the sonic vibration toothbrush that has omnidirectional bristles and the manual toothbrush that has omnidirectional were provided and the instruction for proper tooth brushing were given as well. Both a simplified patient hygiene performance (S-PHP) index and a tongue plaque index were checked for both the groups prior to the experiment and 1 week and 2 weeks after. The repeated measure ANOVA analysis was performed to check the difference between two groups.

Results: Both the S-PHP index and the tongue plaque index decreased for experimental group compared to the control group, which showed a significant difference statistically at 1 week and 2 weeks after the clinical experiment (p<0.05).

Conclusion: Based on the results of the clinical trials, the sonic vibration toothbrush was statistically more efficient than the manual toothbrush in the removal of tongue plaque as well as in the perspective of oral hygiene management.

Keywords: oral hygiene, toothbrushing, dental plaque, sonic vibration toothbrush, kids toothbrush

Introduction

The purpose of toothbrushing is to prevent oral related diseases and keep one’s oral freshness as well as for an aesthetic purpose by eliminating the dental plaque adapted onto the tooth surface to have the oral hygiene cleaned [1].

To eliminate the dental plaque, the manual type of toothbrush was generally used to keep oral hygiene cleaned by mechanically brushing tooth surface [2].

There are various types of toothbrushes which eliminate dental microfilm on the tooth, and the type of which varies depending on factors, such as the size or the inclination of the toothbrush head, the shape of the handle, the way it operates, the number of the tuft lane, etc. [3].

In recent years, the studies have been active, which are related to the varying form of bristles mounted on toothbrush head [4], and the sonic vibration toothbrush [5,6].
The objective of the research dealing with in this paper is to compare and analyze the effect between a manual toothbrush and a sonic vibration toothbrush under the usage of toothbrush with omnidirectional bristles that differs from a toothbrush with single-sided bristles.

Materials and Methods

1. Subjects

1) Subject

The clinical study was conducted on sixty primary school children whose central incisor and the first molar are sufficiently erupted among those who were aged 8 to 12, and whose parents have agreed for their child to participate in the clinical study.

2) Control factors

The types of toothbrush and their model for each experimental group and control group are shown in the Table 1 and Figure 1, 2.

2. Method

1) Institutional Review Board (IRB) approval

IRB review was approved at the scientific institute of science in Dankook University (DKU 2018-07-017).

2) Subjects recruitment

Those whose parents agreed for their child to participate in the experiment were recruited as subjects.

3) Subjects classification

(1) Prior to the experiment, an oral examination to record a plaque index for all the subjects were performed.

(2) To prevent the difference in the average of the plaque index between each subjects groups (experimental group, control group), those who have similar plaque index were paired and arranged into each group.

(3) In the above manner, subjects are divided into the experimental group and the control group for 30 each.

4) Subjects pre-training

For both the groups, pre-training of rolling method and tongue brushing technique were conducted in advance of the clinical experiment as below.

5) Oral examination

Both the simplified patient hygiene performance (S-PHP) index and the tongue plaque index were checked for both the experimental and the control groups prior to the experiment.

<table>
<thead>
<tr>
<th>Variable</th>
<th>The experimental group</th>
<th>The control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of toothbrush</td>
<td>An omnidirectional sonic vibrational toothbrush</td>
<td>An omnidirectional manual type toothbrush</td>
</tr>
<tr>
<td>Name of model</td>
<td>Megaten Character Sonic, One-Star International Co. Korea</td>
<td>LUX 360 kids step3, One-Star International Co. Korea</td>
</tr>
</tbody>
</table>

Figure 1. Toothbrush for experimental group.

Figure 2. Toothbrush for control group.
Table 2. The comparison of simplified patient hygiene performance index according to the time passing

<table>
<thead>
<tr>
<th>Group</th>
<th>Before</th>
<th>1 week</th>
<th>2 weeks</th>
<th>Time</th>
<th>Group</th>
<th>Time×group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. (n=30)</td>
<td>3.58±0.59</td>
<td>2.90±0.52</td>
<td>2.23±0.50</td>
<td>0.00**</td>
<td>0.04*</td>
<td>0.00**</td>
</tr>
<tr>
<td>Con. (n=30)</td>
<td>3.60±0.57</td>
<td>3.09±0.47</td>
<td>2.78±0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation. Exp.: experiment group, Con.: control group. *p<0.05, **p<0.01 by repeated measure ANOVA test.

Table 3. The comparison of simplified patient hygiene performance index by use of the repeated measure ANOVA test

<table>
<thead>
<tr>
<th>Source</th>
<th>Examined time</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Exp. × 1 week</td>
<td>101.362</td>
<td>0.00**</td>
</tr>
<tr>
<td></td>
<td>1 week × 2 weeks</td>
<td>152.751</td>
<td>0.00**</td>
</tr>
<tr>
<td></td>
<td>Before Exp. × 1 week</td>
<td>1.977</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>1 week × 2 weeks</td>
<td>20.613</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

Exp.: experiment group. **p<0.01 by repeated measure ANOVA test.

and 1 week and 2 weeks after.

(1) S-PHP index: After spreading a disclosing solution with a cotton pellet on a tooth surface, simply rinse it out with water. By subdividing the tooth surface into 5 areas, each tooth gains score 0 to 5 points depending on the amount of remained disclosing solution on tooth surface.

Six teeth (the buccal side of the right and left upper first molar, the labial side of the right upper central incisor and left side of lower central incisor, and the lingual side of right and left lower first molar) were investigated, and a mean value of those scores is considered S-PHP index.

(2) The tongue plaque index: After subdividing the entire tongue from the root to the tip of the tongue into 9 areas by equally segment into 3 portions for each transverse and longitudinal direction, 1 point would be counted for each portion if the plaque is found, and thus each subject can have the maximum 9 points of tongue plaque index level.

6) Data analysis

Repeated measure ANOVA analysis (via IBM SPSS ver. 19.0; IBM Corp., Armonk, NY, USA) was performed to analyze the difference between the experimental group and the control group, and to check the interaction for each S-PHP index and plaque index according to the moment those were measured (prior to the experiment, 1 week and 2 weeks after).

Results

1. S-PHP index

The S-PHP index was 3.58±0.59 in the experimental group and 3.60±0.57 in the control group before the experiment, and statistically, the difference of the index level was not significant. The index level changed to 2.90±0.52 in the experimental group and 3.09±0.47 in the control after 1 week and 2.23±0.50 in the experimental group and 2.78±0.47 in the control group after two weeks shown in Table 2.

Thus, the index level of the experimental group decreases over time and it caused a significant difference between the two groups’ index level. An interaction was found as well in the data of 2 weeks later from the experiment shown in Table 3 and Figure 3.

2. Tongue plaque index

The tongue plaque index was 4.37±1.22 in the experimental group and 4.73±1.53 in the control group before the experiment, and statistically, the difference of the index level was not significant. The index level changed to 3.03±0.67 in the experimental group and 3.43±0.82 in the control after 1 week and 2.47±0.57 in the experimental group and 3.27±0.69 in the
Table 4. The comparison of the tongue plaque index between the experimental group and the control

<table>
<thead>
<tr>
<th>Group</th>
<th>Before</th>
<th>1 week</th>
<th>2 weeks</th>
<th>Time*</th>
<th>Group*</th>
<th>Time×group*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. (n=30)</td>
<td>4.37±1.22</td>
<td>3.03±0.67</td>
<td>2.47±0.57</td>
<td>0.00**</td>
<td>0.02*</td>
<td>0.02*</td>
</tr>
<tr>
<td>Con. (n=30)</td>
<td>4.73±1.53</td>
<td>3.43±0.82</td>
<td>3.27±0.69</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation. Exp.: experiment group, Con.: control group. *p<0.05, **p<0.01 by repeated measure ANOVA test.

Table 5. The comparison of tongue plaque by use of the repeated ANOVA test

<table>
<thead>
<tr>
<th>Source</th>
<th>Examined time</th>
<th>F</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examined time</td>
<td>Before Exp.×1 week</td>
<td>105.90</td>
<td>0.00**</td>
</tr>
<tr>
<td></td>
<td>1 week×2 weeks</td>
<td>30.12</td>
<td>0.00**</td>
</tr>
<tr>
<td>Examined time×group</td>
<td>Before Exp.×1 week</td>
<td>0.02</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>1 week×2 weeks</td>
<td>8.96</td>
<td>0.00**</td>
</tr>
</tbody>
</table>

Exp.: experiment group. **p<0.01 by repeated measure ANOVA test.

Thus, the index level of the experimental group decreases over time and it caused a significant difference between the two groups’ index level. An interaction was found as well in the data of 2 weeks later from the experiment shown in Table 5 and Figure 4.

Discussion

The major purpose of toothbrushing is to keep one’s oral tissue healthy by softly massaging one’s oral gum, and to eliminate the dental plaque [7].

In general, the manual type of toothbrush has been mainly used for oral care and various types of which have been developed and provided in a market and thus the elimination of the dental plaque has become more efficient [8].

Since the electric toothbrush does not require any special toothbrushing technique, it is recommended for those who are not capable of self-oral management such as physically disabled, children and seniors.

In recent years, various types of electric toothbrush have been developed and among which sonic vibration type is the most recent type. It generates powerful sonic waves making bristle mechanical mechanism act as a fluidic motion to eliminate the dental plaque from all around the tooth surface [9].

The experiment was performed to verify the removal effect of plaques on the tooth surface and the tongue surface by comparing two types of same shaped toothbrushes, which are the one with sonic vibration function and the other without it.

Like former research that proved the toothbrush with sonic vibration function is more adequate for dental health and the plaque elimination than the one without it, the result of the experiment showed that the toothbrush with sonic vibration function is more effective in the removal of the plaque on a tooth surface as well [10,11].

Moreover, the clinical study was aimed for children who are not capable of self-oral management only with the manual toothbrush, and to verify the removal capability of the plaque on both tooth surface and tongue surface.

The results of this study showed that the plaque removal effect of the sonic vibration toothbrush was superior to the manual toothbrush.

Presumably, this is due to the fact that the sonic vibration had further stimulated on the tongue plaque removal, and the pre-training of toothbrushing technique for tooth and tongue maximized the effect of it as well.

However, the result might be hardly generalized due to the number of subjects as little as 60, and the fact that the influential factors were not completely excluded from the experiment as well. If more specific and objective criteria are established and evaluates the results in the future, accurate results can be obtained. Long-term comparative studies are also thought to be necessary rather than short-term comparative studies.
Conclusion

To verify the clinical effect for a child of using the sonic vibration toothbrush with omnidirectional bristles, the experimental group was given the sonic vibration toothbrush with omnidirectional bristles and the control group was given the same toothbrush without a function of the sonic vibration.

Prior to the experiment and 1 week and 2 weeks after, both the S-PHP index and the tongue plaque index were checked for both the experimental and the control groups. Through the experiment, the difference between the two groups and the oral condition change over time were to be analyzed and the obtained results were as followings.

1. The S-PHP index was similar for both the experimental and the control group before the experiment (p>0.05), but the difference between the two groups had become significantly increased over time and the index level for both had decreased (p<0.05). Thus, the interaction with the time and the groups’ index level exists.

2. The tongue plaque index was similar for both the experimental and the control group before the experiment (p>0.05), but the difference between the two groups has become significantly increased over time and the index level for both had decreased (p<0.05). Thus, the interaction with the time and the groups’ index level exists.

3. It is recommended for children to use the sonic vibration toothbrush with omnidirectional bristles that is effective for the dental plaque and tongue plaque removal.

Conflict of Interest

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

References