EVALUATION OF THE PLAQUE REMOVING ABILITY OF CONVENTIONAL AND CURVED BRISTLE TOOTHBRUSH IN PEDIATRIC PATIENTS

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Abstract

The aim of this study was to determine the plaque-removing ability of curved bristle toothbrush compared to conventional, straight bristle, toothbrush. The study group consisted of 100 children 12 to 16 years of age. A four week post-prophylaxis, parallel, longitudinal, double-blind clinical study was conducted; all volunteers were instructed in specific oral hygiene techniques. Plaque was assessed at baseline and at the end of 1, 2, 3, and 4 weeks using the Quigley-Hein plaque index after disclosing with erythrosine red. Gingival status was assessed at baseline and at the end of 1, 2, 3 and 4 weeks by using the gingival index of Loe and Silness.

Comparative assessment showed a mean of 2.11 + 0.086 mm for group 1 and 2.37 + 0.216 mm for group 2, indicating a significant difference between the plaque-removing efficacy of the curved bristle and straight bristle toothbrush.

The curved bristle toothbrush was more effective in removing plaque than the conventional toothbrush.

Keywords: Dental plaque, Toothbrush, Bristle, Periodontium.

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Introduction

The effect of plaque on the periodontium plays a vital role in the initiation and progression of periodontal diseases. The bacterial plaque initiates an inflammatory process in the supporting structures of the tooth, and if allowed to continue, ultimately may lead to the loss of teeth. Thus, emphasis must be placed on the effectiveness and efficiency of plaque removal devices used to facilitate oral hygiene in these areas.

Tooth brushing twice daily is recommended by most of the dentists in order to improve plaque control and tooth brushing is also regarded as an important vehicle for application of anti-caries agents, such as fluorides. The design of the modern conventional manual toothbrush can be attributed to Dr. Robert Hutson, a Californian periodontist, who in the early 1950s developed the multitufted, flattrimmed, end-rounded nylon filament brush.

However, a few well-controlled clinical trials have compared the effectiveness of various manual toothbrushes. The results of these trials have been inconclusive, but there has been a strong indication that all brushes are least effective on the lingual aspects of lower molars and that a correct preset angulations of the brush head improves plaque control in such areas.

Previous studies have shown that curved bristle toothbrushes were more effective in removing plaque when used in assisted brushing.
and in handicapped children\textsuperscript{4}. The aim of this study therefore was to investigate in children whether the curved bristle toothbrush was more efficient in removing plaque than the conventional toothbrush.

**Materials and Methods**

**Criteria for Grouping**

One hundred children participated for the study. Their age was with a range of 12 to 16 years. Informed consent was obtained from each participant in the present study.

All the children who were selected satisfied the following criteria: 1) no clinical gingival inflammation; 2) no adverse restorations; 3) no dental caries; 4) no history of antibiotics or oral antiseptic therapy.

The subjects were divided into two groups of 50 depending on the toothbrush assigned: group 1, curved bristle toothbrushes; and group 2, conventional, slender head toothbrushes (both manufactured by Colgate-Palmolive Limited). The subjects were informed about the project and written consent for participation was obtained. The study was a 4-week post-prophylaxis, parallel, longitudinal, double-blind design. The two brushes used in the study were an experimental curved bristle toothbrush and a conventional toothbrush; i.e. one with a slender head with 3 rows of bristles.

At the time of the initial examination, the subjects randomly picked toothbrushes that were numbered from 1 to 100 and the coded numbers marked on the covers were recorded. All the participants in the study were provided with common toothpaste and were asked to follow the instructions. Plaque was assessed at the end of 1, 2, 3, and 4 weeks. After 4 weeks, the findings obtained were subjected to statistical analysis by using z test.

**Brushing Techniques**

*Curved bristle toothbrush.* The brush is applied in an occlusal/incisal direction to hug the tooth. The curved bristles thus engage the labial and lingual aspects of the tooth and are directed at an approximately 45° angle; the middle row occupies the occlusal areas.

The brush is activated with very short horizontal strokes. No vertical motion is used so that the brushing technique is similar to the modified Bass technique. The terminal ends of the curved bristle resemble the shape of a curet. It is directly applied to the junctional epithelium unlike the straight bristles, which can easily puncture the epithelial lining.

*Conventional toothbrush.* The Modified Bass technique\textsuperscript{5} was used, in which the brush is applied at a 45° angle to the long axis of the tooth and directed into the gingival sulcus. A small back-and-forth motion is performed, without disengaging the bristle ends from the sulcus.

**Recommended measures for hygienic tooth brushing in: children.\textsuperscript{1,2}**

- Ensure that each child has his or her own toothbrush, clearly marked with identification. Do not allow children to share or borrow toothbrushes.
- To prevent cross contamination of the toothpaste tube, ensure that a pea-sized amount of toothpaste is always dispensed onto a piece of wax paper before dispensing any onto the toothbrush.
- After the children finish brushing, ensure that they rinse their toothbrushes thoroughly with tap water, allow them to air-dry, and store them in an upright position so they cannot contact those of other children.
- Provide children with paper cups to use for rinsing after they finish brushing. Do not allow them to share cups, and ensure that they dispose of the cups properly after a single use.

**Plaque Measurement**

After thorough oral prophylaxis and polishing, plaque was disclosed with erythrosine red and assessed on the buccal, lingual, and inter proximal surfaces of all teeth excluding third molars, according to the plaque index of Quigley and Hein\textsuperscript{6} Plaque scores were then reviewed and recorded at 1, 2, 3 and 4 weeks.

Gingival index in each patient, gingival inflammation was clinically assessed at 6 sites (mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual) on teeth. Scores were then reviewed at 1, 2, 3, and 4 weeks using the Loe and Silness gingival index.\textsuperscript{7} The investigators reproducibility was tested prior to the trial by examining plaque scores in 50 subjects twice with an interval of 15 minutes between examinations and calculated by expressing the percentage of duplicated scores. This was found to be 98%.
Results

Results showed that the experimental brush was significantly more effective in removing plaque than the conventional brush. Table 1 shows a comparison of means and standard deviations between groups 1 and 2 and reveals statistical significance at a 1% level.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>z Score</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.11</td>
<td>0.086</td>
<td>0.0329</td>
<td>7.9077</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>2</td>
<td>2.37</td>
<td>0.216</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Comparison of Mean Plaque Values between the Groups.

Table 2 shows a comparison of means and standard deviations in the anterior and posterior teeth within the groups and demonstrates statistical significance. When means and standard deviations in the two groups and at different weeks were compared, there was reduction in plaque scores. It was found to be statistically significant at a 1% level when comparison was made between weeks 1 and 2, 1 and 3, and 1 and 4 between the two groups.

<table>
<thead>
<tr>
<th>Teeth</th>
<th>Groups</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>z Score</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>1</td>
<td>2.085</td>
<td>0.086</td>
<td>0.0275</td>
<td>6.0261</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.24</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior</td>
<td>1</td>
<td>2.12</td>
<td>0.079</td>
<td>0.0218</td>
<td>9.6598</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.10</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Comparison of Mean Plaque Values between the Groups in Anterior and Posterior Teeth.

Table 3 shows the baseline scores between groups 1 and 2, which were not significant. However, weeks 2 and 4 demonstrated significance at the 5% level, and no significance was found between weeks 2 and 3 and 3 and 4 in group 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.59</td>
<td>0.279</td>
<td>0.1438</td>
<td>0.1966</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>2</td>
<td>2.5617</td>
<td>0.1737</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Comparison of Mean Plaque Values and Standard Deviation at Baseline Between the Groups.

Table 4 shows a comparison of means and standard deviations between the groups and at different weeks. It reveals statistical significance at a 1% level.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Week 1 Mean (SD)</th>
<th>Week 2 Mean (SD)</th>
<th>Week 3 Mean (SD)</th>
<th>Week 4 Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.13 (0.13)</td>
<td>1.75 (0.10)</td>
<td>1.00 (0.07)</td>
<td>0.72 (0.07)</td>
</tr>
<tr>
<td>2</td>
<td>2.16 (0.10)</td>
<td>1.80 (0.06)</td>
<td>1.08 (0.08)</td>
<td>0.78 (0.12)</td>
</tr>
</tbody>
</table>

Table 4. Mean Plaque Values and Standard Deviation in Different Weeks and Different Groups.

Table 5 shows gingival scores, with no significant difference at baseline and at different weeks.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Baseline Mean (SD)</th>
<th>Week 1 Mean (SD)</th>
<th>Week 2 Mean (SD)</th>
<th>Week 3 Mean (SD)</th>
<th>Week 4 Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.59 (0.1438)</td>
<td>2.07 (0.138)</td>
<td>1.56 (0.124)</td>
<td>1.00 (0.07)</td>
<td>0.52 (0.07)</td>
</tr>
<tr>
<td>2</td>
<td>2.5617 (0.1737)</td>
<td>2.10 (0.10)</td>
<td>1.80 (0.06)</td>
<td>1.08 (0.08)</td>
<td>0.78 (0.12)</td>
</tr>
</tbody>
</table>

Table 5. Mean Gingival Score and Standard Deviation in Different Weeks and Different Groups.

Discussion

The children who participated in the study exhibited great variations in their ability to clean their teeth and were presumably dependent on manual dexterity, motivation, and ability to follow instructions as in the study by Gibson et al. Kang BH et al examined the effect of tooth-brushing education on the oral health of preschoolers and said that tooth-brushing education was partially effective in improving oral health of preschoolers.

The effectiveness of a curved bristle toothbrush shown in this study may, in part, be due to the brushing time being effectively reduced or to prolonged contact duration of the brush and teeth, compared to techniques used with the conventional brush. However, it may also be attributed to the curvature of the bristles, which allows entry into sulcular areas with a drawing action. Because of the softness of the curved bristles, any resistance theoretically causes the bristles to bend back on themselves. Other studies using curved bristle brushes found them to be effective in children and when used by home care providers.

The results of the current study strongly indicate that the curved tooth brush is more effective on the lingual and inter proximal aspects of lower molars, it may be due to better adaptation of the correctly angulated bristles reaching the protected areas. This is in contrast
with results of previous trials indicating that brushes were least effective on lingual and inter proximal aspects of lower molars it may be due to better adaptation of the correctly angulated bristles reaching the protected areas\textsuperscript{7,8}. This is in contrast with results of previous trials indicating that brushes were least effective on lingual aspects of lower molars. According to Cohen, trial periods of 3 weeks are advisable if a brush is to be tested accurately\textsuperscript{9,10}.

The findings of this study support this view showing the trend towards progressively reduced plaque score with the curved bristle brush during the third and fourth weeks of the trial. This contrasts with the results of a previous trial, where an experimental toothbrush was found to produce lowest plaque scores in the first week. One explanation may be that patients tend to revert to the technique they are most comfortable with\textsuperscript{11}.

The present study, revealed that 90% of the subjects found the curved bristle brushes more comfortable to use.

Conclusions

In conclusion, this study has shown that a curved bristle toothbrush is comparatively more effective in removing plaque than a conventional toothbrush.

Declaration of Interest

The authors report no conflict of interest and the article is not funded or supported by any research grant.

References