A COMPARISON OF THE EFFICACY AND SAFETY OF AN ELECTRIC AND A MANUAL CHILDREN’S TOOTHBRUSH

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ABSTRACT

Effective plaque control of the primary dentition can be particularly difficult to achieve because of problems with motivation and manual dexterity in some children. This study compared plaque control efficacy of a new electric toothbrush designed specifically for use by children with a children’s manual brush. Results showed that in a pediatric population aged between 8 and 12 years, the electric brush achieved significantly greater plaque removal from both primary and permanent dentition.

Compared with caries, periodontal disease in children is often considered to be of secondary importance. But when left untreated, it can lead to unnecessary problems in adulthood. According to one source, it is estimated that by puberty, almost 100 percent of children will have gingivitis.1 However, gingivitis is both preventable and controllable if a regular routine of brushing and flossing is established. It is often difficult to achieve good oral hygiene in children, because of a lack of motivation and poor manual dexterity.

Several studies in adults have compared plaque removal with electric and manual brushes.2,3 It would appear that when the study design reflects normal home use, with minimal instruction in a nondentally aware population, there is a clear advantage in favor of the electric toothbrush.4 In comparison, there have been relatively few published studies of electric toothbrush use by children, and those reports refer to models from the 1960s.

In one early study, Lefkowitz and co-workers5 compared the use of an electric toothbrush with that of a manual brush in two groups of children, one group aged between 7 and 9 years, and another group between 10 and 12 years, and found that in both groups more plaque was removed by the electric brush. In contrast, a crossover study involving children with a mean age of 4.28 years compared use of an electric and a manual toothbrush; there were no statistically significant differences between the two groups with respect to plaque removal, although plaque reduction in the electric toothbrush group was somewhat greater than that with the manual brush.6 Other studies have shown that electric toothbrushes are valuable for mentally handicapped children7 and adults,8,9 and for handicapped children with poor manual dexterity.10

More recent studies10 have confirmed the importance of motivation and manual dexterity in achieving good oral hygiene in children. Using an electric toothbrush, which will help to overcome these problems, should result in greater plaque removal than that achieved using a conventional manual toothbrush.

A new electric toothbrush, the Braun Oral-B Plaque Remover for Kids (Braun AG), has been developed specifically for use in children and has a brush head that is redesigned from the adult version.

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Volunteers appeared to understand what was involved and that they wished to participate.

Volunteers were excluded if they had a medical history of diabetes mellitus, rheumatic fever, leukemia, AIDS or any physical condition that would limit manual dexterity. They were also excluded if they had received any antibacterial or nonsteroidal anti-inflammatory agent within one month of the start of the study, or had any oral disease or lesions, orthodontic bands or prosthetic appliances, or accumulations of supragingival calculus. The study was conducted in accordance with the ethical standard set forth in the Declaration of Helsinki (1964), including all amendments up to Hong Kong 1989.

Study design. The study was a randomized, single-use, crossover design. Before the study began, all volunteers were instructed—verbally and in writing—in the use of the electric toothbrush and the manual toothbrush, and were allowed time to become accustomed to their use. Volunteers were then divided into two groups and randomly assigned to use either the electric toothbrush (Braun Oral-B Plaque Remover for Kids) (Figure 2) or the control manual toothbrush (Reach 6-12, Johnson and Johnson Consumer Products).

At the beginning of the study, all volunteers were re instructed and checked in the use of their toothbrush and given a thorough prophylaxis. They were then instructed to refrain from oral hygiene for 24 hours. Following this period, volunteers were scored for whole-mouth plaque, after which they brushed for two minutes with...
their respective toothbrushes, under supervision but away from the examiner. Both groups brushed with Colgate Junior Toothpaste (Colgate-Palmolive Co.). Immediately after the volunteers brushed, whole-mouth plaque was again scored. In this way, the efficacy and safety of the two toothbrushes were assessed.

For the next seven days volunteers returned to their normal method of oral hygiene. They then switched to the other toothbrush and were re instructed in its use, and the study procedure was repeated.

**Clinical evaluation.** Whole-mouth plaque was assessed using the Global Plaque Index after a commercial disclosing agent was used. Facial and lingual surfaces of all teeth were scored for areas covered by plaque, in 5 percent increments from 0 to 95 percent. Primary teeth that were loose or in the process of exfoliation were excluded from the scoring.

Safety was assessed by detailed examination of hard and soft oral tissues for evidence of irritation related to toothbrushing, in accordance with the procedure recommended by the American Dental Association Council on Scientific Affairs. This assessment included the tongue, hard and soft palate, gingiva, mucobuccal folds, the inner surfaces of the cheeks, sublingual areas and the cervical areas of all teeth.

All clinical examinations were performed by one examiner, who did not know which group the volunteers belonged to and which toothbrush they used.

**Statistical analysis.** Prebrushing plaque buildup scores were compared in the two groups using analysis of variance, or ANOVA. Comparison of plaque removal in the two groups was made using analysis of covariance, or ANCOVA, appropriate for the analysis of crossover data. The prebrushing scores were used as covariables.

The mean percentage of plaque removed in the two groups was also compared using a similar ANOVA.

In addition, 90 percent Fieller confidence intervals were calculated to provide an estimate of the ratio of the mean pre- to postbrushing plaque differences (electric toothbrush mean over manual toothbrush mean).

**RESULTS**

All volunteers successfully completed the study, and the results from 32 children for each brush were available for analysis. After the single use of each toothbrush, there was no evidence of either soft- or hard-tissue trauma in either group.

Analysis of the Global Plaque Index scores revealed significantly greater plaque removal at all sites in the electric toothbrush group (Tables 1 and 2). For the whole mouth, use of the manual toothbrush resulted in a 41.8 percent reduction in the

### TABLE 1

<table>
<thead>
<tr>
<th>TEETH MEASURED</th>
<th>PREBRUSHING</th>
<th>POSTBRUSHING</th>
</tr>
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<tbody>
<tr>
<td>Whole Mouth</td>
<td>Mean 13.81 SD* 4.24</td>
<td>Mean 12.85 SD 3.70</td>
</tr>
<tr>
<td>Anterior</td>
<td>Mean 15.85 SD 6.93</td>
<td>Mean 14.98 SD 5.24</td>
</tr>
<tr>
<td>Posterior</td>
<td>Mean 11.88 SD 3.55</td>
<td>Mean 10.68 SD 3.11</td>
</tr>
<tr>
<td>Facial</td>
<td>Mean 14.60 SD 5.95</td>
<td>Mean 13.52 SD 5.63</td>
</tr>
<tr>
<td>Lingual</td>
<td>Mean 13.04 SD 4.18</td>
<td>Mean 12.18 SD 3.18</td>
</tr>
<tr>
<td>Primary</td>
<td>Mean 11.99 SD 4.77</td>
<td>Mean 10.02 SD 3.38</td>
</tr>
<tr>
<td>Permanent</td>
<td>Mean 15.38 SD 6.07</td>
<td>Mean 14.44 SD 4.81</td>
</tr>
</tbody>
</table>

* SD: standard deviation.
Global Plaque Index, compared with 65.4 percent for the electric toothbrush group \((P < .0001)\). This difference was consistent across all the sites examined, with the increased plaque removal in the electric toothbrush group ranging from 20.4 percent at facial sites to a maximum of 26.1 percent at lingual sites (Figure 3). Analysis of site-specific data showed greater consistency for the electric toothbrush group, with plaque removal in this group ranging from 61.68 percent at lingual sites to a maximum of 69.2 percent at posterior sites. In comparison, plaque removal in the manual toothbrush group ranged from 35.63 percent at lingual sites to 47.89 percent at facial sites.

With respect to the ability to remove plaque from primary as well as permanent teeth, the results demonstrated that within each group, there was no difference in plaque removal from these two tooth types. The amount of plaque removed from both tooth types, however, was significantly greater in the electric toothbrush group \((P < .0001)\) compared with the manual toothbrush group.

Construction of confidence intervals for the ratio of the means for the Global Plaque Index confirmed the superiority of the electric toothbrush over the manual brush. It can be seen that for the whole mouth, the true ratio of the means lies within the range of 141.0 to 195.1 percent, indicating that the mean plaque removed by the electric toothbrush exceeded that removed by the manual brush by at least 41 percent (with 90 percent confidence). For all sites analyzed, the lower level of the ratio exceeded 120 percent and in the majority of cases exceeded 140 percent.

**DISCUSSION**

Since the introduction of electric toothbrushes in the 1960s, many studies have compared their efficacy with conventional brushes. As new electric toothbrushes are developed, more and more trials are conducted. Nearly all these investigations, however, have been done in adult populations. Perhaps the main advantage of an electric toothbrush is that it may help to overcome the need for professional training in brushing technique and good manual dexterity.

Theoretically, it could be anticipated that these devices would be of particular value for children, for whom manual dexterity is a problem. It has been shown that when using a manual brush, 5-year-olds can reach only 25 percent of tooth surfaces, and even 11-year-olds can reach only 50 percent of the surfaces. Despite the potential for the electric toothbrush to enhance plaque removal in this group of patients, few studies
have been conducted with children, other than those involving children with fixed orthodontic appliances. Published studies describe only electric toothbrushes developed in the 1960s, but they tend to suggest that use of an electric brush can help overcome the limitations of this patient group with respect to manual dexterity. As children grow older, manual dexterity improves. Addy and colleagues found that adolescents still brush better with an electric toothbrush than with a manual brush.

The results of the study reported here, which represents the first such study in children published since 1975, appear to agree with the results of earlier studies showing the advantages of an electric toothbrush in terms of plaque removal. There was a statistically significant increase in removal of plaque at all sites by the electric toothbrush group, compared with the manual toothbrush group (P < .0001). Plaque removal throughout the mouth was also more consistent when the electric toothbrush was used. This finding is consistent with the hypothesis that electric toothbrushes can overcome the need for good brushing technique and manual dexterity, since the differences between sites that are more difficult to reach (lingual) and those that are relatively easy to reach (facial) were less pronounced in the electric toothbrush group.

This study also demonstrated that plaque was removed equally effectively from primary and permanent dentitions, despite the different contours of the tooth types. The electric toothbrush was, however, significantly better at removing plaque than the manual brush (P < .0001).

Another important aspect associated with achieving good plaque control in children is motivation. Even if manual dexterity is not a problem, it is often difficult to motivate younger children, and anything that can enhance motivation is likely to help ensure good oral hygiene. In a study of children between 9 and 15 years of age, Crawford and co-workers demonstrated that when motivated by use of disclosing tablets that reveal supragingival plaque, a 30 to 50 percent decrease in plaque could be achieved during a three-month period. It has been recognized for some time that electric toothbrushes can have a motivational effect, through what has been described as their "gadget appeal." In adults known to be poor compliers, an electric toothbrush has been beneficial. Although this may be of limited importance in adults, for children this motivational aspect may be significant.

Children have been described as being brief, haphazard and erratic toothbrushers. Owen concluded from his studies that for some children, an electric toothbrush may be of real value, if only to motivate them to brush more often. Although the design of this study did not allow any assessment of motivation in the two groups, the fact that the electric toothbrush was significantly more effective, coupled with a potential for increased motivation, could be significant.

**CONCLUSION**

The findings of the study reported here, which is the first to compare an oscillating/rotating electric toothbrush with a man-
ual brush in a pediatric population, confirm the findings of earlier studies—that using an electric brush can benefit children in the removal of supragingival plaque. The electric toothbrush minimizes both the need for professional instruction with regard to brushing technique and the importance of good manual dexterity. Published studies with electric toothbrushes suggest that they may also enhance motivation. We conclude that the Braun Oral-B Plaque Remover for Kids is a safe electric toothbrush that removes significantly more supragingival plaque in a single-use situation than a comparable manual toothbrush also designed for use by children.


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