Cleaning efficacy of manual (reference) and power toothbrushes


Objectives
To compare the mechanical cleaning efficacy of an ADA reference manual toothbrush with the Braun Oral-B 3D Plaque Remover and sonicare® Plus electric toothbrushes using laboratory model systems to simulate plaque and stain on human dentition.

Design
This was a laboratory study.

Materials and Methods
A laboratory model system was employed to measure mechanical cleaning efficacy of three toothbrushes. The system comprised a flat bed cross-brushing machine operating at a speed of 40 strokes per minute and a brushhead load of 150 gm for the manual and 3D toothbrushes, and the recommended load of 50 gm for the sonicare toothbrush. Using this system, the ability of the three brushes to remove plaque substitute from acrylic strips and stain substitute from plastic models of human dentition, was evaluated.

For the plaque studies, flat acrylic strips were coated with a white latex paint to simulate plaque and brushed at the loads detailed above for 100 strokes. After brushing, the back of the acrylic strips were sprayed with black paint prior to being photographed. This facilitated measurement of the amount of plaque substitute that had been removed using a Minolta Chroma Meter CR-100.

For the stain studies, two sets of plastic models of teeth were used to allow stain removal from the facial and proximal surfaces of anterior and posterior portions of the human dentition to be evaluated. After the models were sprayed with black acrylic paint to represent dental stain, they were brushed, as described for the acrylic strips, and the backs were then sprayed with white acrylic paint, before being photographed. The amount of stain substitute removed was then measured using the Minolta Chroma Meter. In all experiments, brushing was carried out with a 1:4 slurry of Crest Regular dentifrice.

Results

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<tr>
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<th>Removal of simulated plaque</th>
<th>Removal of simulated stain from posterior buccal surfaces</th>
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<tbody>
<tr>
<td></td>
<td>Cleaning efficacy</td>
<td>Cleaning efficacy</td>
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<tr>
<td>Manual</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>sonicare</td>
<td>1.0</td>
<td>0.9</td>
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<tr>
<td>3D</td>
<td>4.1*</td>
<td>2.8*</td>
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* Significant difference from manual and sonicare Plus, p<0.001
Cleaning efficacy (plaque and stain) with the reference manual toothbrush was set at 1.0 in each experiment.

The Braun Oral-B 3D Plaque Remover was found to be significantly more effective at removing simulated plaque from acrylic strips than either the manual toothbrush or sonicare Plus (p<0.001). The cleaning efficacy for sonicare Plus and the 3D was found to be 1.0 and 4.1, respectively.

For removal of simulated stain, the 3D was significantly more effective at most surfaces tested (p<0.001). At posterior buccal surfaces, cleaning efficacy for the 3D was 2.8, compared with 0.93 for sonicare. For anterior facial surfaces cleaning efficacy was 1.5 for the 3D and 1.0 for sonicare, while at anterior proximal surfaces efficacy was 1.2 for the 3D and 1.0 for sonicare. In each case, cleaning efficacy of the manual toothbrush had been set to 1.0. None of the toothbrushes tested removed stain well from deeper posterior proximal surfaces.

The results showed that the ADA reference manual toothbrush and the sonicare Plus toothbrush were comparable in removing simulated plaque from flat acrylic strips and simulated stain from facial and buccal surfaces of anterior and posterior dentition. For most surfaces, the 3D with its oscillating/rotating/pulsating action, was significantly more effective than both the manual toothbrush and sonicare Plus.

Clinical Comment
The function of a toothbrush is not only to remove plaque and thus control gingivitis, but also to efficiently deliver toothpaste in order to clean the teeth. These laboratory findings support the results from many clinical studies which have shown the Braun Oral-B Plaque Removers to be significantly more effective than a manual toothbrush and the sonicare toothbrush at removing both plaque and stain. Although results from laboratory studies must always be considered with caution, the fact that the findings from this study are in agreement with clinical studies is encouraging.