Cleaning efficacy of a new electric toothbrush

Driesen, G.M. et al.
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Objectives
To evaluate the cleaning efficacy of the Braun Oral-B 3D Plaque Remover and compare it to the Braun Oral-B Ultra Plaque Remover (D9), using a robot system to simulate normal clinical toothbrush use.

Design
A cross-over design with respect to typodonts and brush heads.

Materials and Methods
A laboratory robot system was used to simulate average clinical toothbrush use with an electric toothbrush. The brushing motion and time are computer controlled, at a brushing force in the range 1.8 - 2.0 N. Upper and lower typodonts are mounted in front of the robot’s brushing arm, which cleans with a standardized brushing technique throughout the whole mouth.

Artificial teeth on upper and lower typodonts were sandblasted and covered with a plaque substitute solution prepared from a mixture of commercially available paints. After a drying period, the typodonts were mounted onto the robot system and the teeth were cleaned by the robot for 2 minutes (1 minute upper and 1 minute lower typodont) with either the 3D or the D9 electric toothbrushes. After each 2-minute brushing cycle, plaque substitute remaining on the typodonts was measured by means of a robot controlled computerised analysing system. The percentage of plaque substitute removed was calculated for buccal + lingual/palatal, occlusal, interproximal and gumline surfaces.

The two toothbrushes tested (3D and D9) were similar in that both have an oscillating/rotating action of the brush head. The 3D differs from the D9, however, in that it has an additional pulsating action in the direction of the oscillation axis of the brush head, at a frequency of 170 Hz (20 400 movements per minute).

Results

<table>
<thead>
<tr>
<th>Surface</th>
<th>Percentage removal of plaque substitute</th>
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<tbody>
<tr>
<td>Buccal + lingual</td>
<td>80.6%</td>
</tr>
<tr>
<td>Occlusal</td>
<td>80.5%</td>
</tr>
<tr>
<td>Gumline</td>
<td>44.5%</td>
</tr>
<tr>
<td>Interproximal</td>
<td>29.1%</td>
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* Statistically significant difference in favour of the 3D, (p<0.001).
The new 3D was found to be significantly more effective than the D9 in removing plaque substitute at all sites (P < 0.001). These results indicate that the additional pulsating motion of the 3D results in improved efficacy over the established D9.

The percentages of plaque substitute removed by the established D9 and the new 3D are shown in the accompanying figure. Both combinations were highly effective at removing plaque substitute, particularly from buccal/lingual and occlusal surfaces. The 3D was significantly more effective than the D9 on all tooth surfaces investigated (P < 0.001), including occlusal and interproximal surfaces. Analysis of weighted averages for buccal + lingual and occlusal surfaces combined showed that the D9 removed 80.6±2.7% of plaque substitute compared with 90.7±1.3% for the 3D.

A relative comparison of the cleaning efficacy of the two toothbrushes, calculated by expressing the additional plaque substitute removed by the 3D as a percentage of that removed by the D9, revealed that the 3D was consistently more effective than the D9, the 3D removing 10.0% more plaque substitute from buccal + lingual surfaces, and 20.5% and 39.5% more plaque substitute from occlusal surfaces and gumline sites, respectively. The greatest advantage in favor of the 3D was at interproximal surfaces where it was found to be 50.0% more effective than the D9.

**Clinical Comment**

This laboratory study clearly shows that the new Braun Oral-B 3D Plaque Remover is more effective than the Braun Oral-B Ultra Plaque Remover (D9) at removing plaque substitute from typodonts. It was anticipated that the additional action of the 3D in the direction of the oscillation axis of the brush head would result in deeper penetration of interproximal sites, and the results from this robot study support this hypothesis. The greatest advantage of the 3D over the D9 was found to be at interproximal sites where it was 50% more effective. It can be anticipated that this laboratory finding will be confirmed in clinical studies, as the robot evaluation system has been previously shown to be a good predictor of the clinical situation.