A laboratory comparison of the efficacy of two brush heads.


Abstract

A new brush head (EB17) with soft co-extruded bristles has been developed for a new generation of power toothbrushes. The efficacy of this new brush head was compared with an established brush head (EB15) in combination with two driving systems: The Braun Oral-B Ultra Plaque Remover (D9) and the Braun Oral-B 3D Plaque Remover (3D). This laboratory study used a robot system, previously shown to be highly reproducible and predictive of clinical outcome. In each experiment, the toothbrush handle and two brush heads were tested 6 times in a cross-over design. Each typodont was brushed for 1 minute at an average brushing force of 1.95 N. Mean values for percentage removal of plaque substitute were calculated for buccal, lingual, occlusal, gingival margin and interproximal sites, plus all sites combined (buccal/lingual and occlusal).

In the first experiment using the D9 driving system, the new EB17 removed consistently more plaque substitute than the EB15 at all investigated surfaces. Differences between the two brush heads were, however, not statistically significant. A similar result was obtained in the second experiment with the 3D driving system. In both experiments, the greatest difference between the two brush heads was observed at interproximal sites. With the D9, the EB17 was 4.6% more efficient, whilst with the 3D, the difference was 3.0%. It is concluded that when used with either the established D9 or the 3D handles, the new EB17 brush head is numerically more efficient than the EB15 brush head. The greatest advantage was seen at interproximal surfaces.

Materials and Methods

The efficacy of two toothbrush heads was evaluated using a third-generation robot brushing system1. Artificial teeth on upper and lower typodonts were sandblasted, and coated with a plaque substitute prepared from a mixture of commercially available water soluble paints. Using the robot system (Figure 1), each typodont was brushed in a controlled manner for 1 minute.

Each toothbrush and brush head combination was tested 6 times in a cross-over design with respect to the typodonts, at an average force of 1.95 N. Brushing force is controlled by means of a sensor (Kistler AG, Switzerland) which continually measures force and momentum-of-force every millisecond during brushing. The brush head position is adjusted every 3 milliseconds such that a consistent brushing force is maintained with a reproducibility of ± 0.2%. In this study, brush heads were used wet, with no dentifrice.

The toothbrush/brush head combinations compared in the study were the Braun Oral-B Ultra Plaque Remover (D9) and the Braun Oral-B 3D Plaque Remover tested with an EB15 and an EB17 brush head (Figures 2 & 3). The experiments with respect to brush head action (D9 and 3D) were performed, subsequently, at different times. Hence, this study does not allow an absolute comparison of efficacy of the different toothbrush driving systems.

The D9 has an oscillating/rotating action (frequency 63 Hz, free angle of oscillation 56°) combined with a pulsating action in the direction of the oscillation axis of the brush head at a frequency of 170 Hz (total amplitude with no load, 0.15mm). The EB15 is a small circular brush head with soft end-rounded bristles. The longer tufts are designed to enhance interproximal penetration. The EB17 brush head is similar in size and configuration to the EB15; however, the EB17 brush head differs in that the blue crimped filaments in the inner field are replaced by co-extruded bifilaments. These novel bifilaments bend...
slightly when wet, which reduces their axial stiffness, making the bristles softer. As a result, tooth surface contact is enhanced, leading to greater interproximal penetration and overall polishing of the tooth surface.

Following brushing, plaque substitute remaining on the typodonts was measured by means of a computerised analysing system, the Vision system. This plaque analysing system automatically assesses levels of plaque substitute remaining after brushing on buccal, lingual, palatal and occlusal surfaces, plus interproximal and gingival margin tooth surfaces. Efficacy was expressed as the percentage of plaque substitute removed (mean ± the standard deviation).

Results

A comparison of the new EB17 brush head with the established EB15 brush head revealed a consistent numerical advantage in favour of the EB17 at all sites investigated, except on occlusal sites with the 3D driving system.

As shown in Table 1, when tested with the D9 driving system, for all surfaces (weighted average buccal/lingual + occlusal) the EB15 removed 81.8 ± 3.4% plaque substitute compared with 82.3 ± 2.4% for the new EB17 brush head. Analysis of results for individual surfaces revealed that both brush heads were most effective at buccal/lingual and occlusal surfaces. The greatest difference between the two brush heads was found to be at gingival margin and approximal sites, which are known to be the most difficult areas of the dentition to clean effectively. At the gingival margin, the EB17 was 3.2% more effective than the EB15, whilst at approximal sites the EB17 was 4.6% more effective. Although there was a consistent numerical advantage in favour of the EB17, the differences were not statistically significant.

Similar results were found when the two brush heads were tested with the 3D driving system, as shown in Table 2. In this experiment, for all surfaces (weighted average buccal/lingual + occlusal) the EB15 removed 83.5 ± 2.7% plaque substitute compared with 84.2 ± 1.2% for the new EB17 brush head. As with the D9 driving system, the greatest differences between the established EB15 and the new EB17 brush head occurred at gingival margin and approximal surfaces where the EB17 was 2.5% and 3.0% more effective, respectively. Differences between the two brushes were, however, not statistically significant.

Figure 4 shows the differences in favour of the EB17 over the EB15 at gingival margin and approximal sites when used with the D9 and 3D driving systems.

Conclusions

- Using a laboratory robot brushing system, a new brush head (EB17) has been shown to be highly effective at removing plaque substitute, when used either with an oscillating/rotating driving system (D9) or a combined oscillating/rotating-pulsating driving system (3D).
- Apart from occlusal surfaces the differences in favour of the EB17 were found when tested with both driving systems, but the differences did not achieve statistical significance.
- The greatest advantage in favour of the EB17 was observed at gingival margin and approximal surfaces, where efficient plaque removal is difficult to achieve.
- The EB17 may offer advantages in terms of plaque removal when used with either the D9 or the 3D driving systems, but this remains to be confirmed by clinical studies.

References