INTRODUCTORY ARTICLE

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Introducing the Oral-B iO electric toothbrush: next generation oscillating-rotating technology

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Purpose: A novel oscillating-rotating electric toothbrush (Oral-B iO) has been developed with a linear magnetic drive, resulting in oscillation-rotations with micro-vibrations. The mechanism directs motor energy directly to the bristle tips. The brush also has a redesigned round brush head and smart pressure sensor to enhance plaque removal and encourage proper brushing technique. **Methods:** The plaque removal and gingival health effects of this new electric toothbrush technology were evaluated in three randomized controlled studies summarized in this supplement, including an 8-week trial *versus* a manual toothbrush, an 8-week trial *versus* a premium sonic toothbrush, and a single-brushing, repetitive-use study *versus* a manual toothbrush. **Results:** Outcomes from these studies demonstrate statistically significantly greater plaque removal and gingival health improvements for the Oral-B iO toothbrush technology *versus* manual and sonic toothbrush controls. Plaque removal advantages demonstrated in the replicate-use single-brushing trial resulted in significant gingival health benefits as evidenced in the longer-term trials. In addition, gingivitis case status assessments based on the American Academy of Periodontology (AAP) and European Federation of Periodontology (EFP) guidelines show that over 80% of subjects using the Oral-B iO transitioned from 'gingivitis' (≥10% bleeding sites) at baseline to 'generally healthy' (<10% bleeding sites) at week 8 in both longer-term clinical trials, *versus* 24% in the manual toothbrush group and 53% in the sonic toothbrush group. **Conclusions:** This uniquely designed oscillating-rotating electric toothbrush with a linear magnetic drive delivers significantly greater plaque removal and gingival health benefits with additional features to improve brushing experience and clinical outcomes.

Key words: *Dental plaque, gingivitis, oscillating-rotating electric toothbrush, micro-vibrations*

INTRODUCTION

The electric toothbrush has been progressively gaining in popularity due to its ease of use and importantly, proven superior plaque removal and gingival health improvements for certain models compared to manual brushes[1-4]. The oral health improvements are of vital importance, given that thorough daily plaque control with solely manual toothbrushing proves unattainable for many[5,6] and plaque-induced gingivitis continues to be prevalent globally[7,8]. While gingivitis is reversible, a lack of intervention can propel a transition to periodontitis and the threat of tooth loss, impact on quality of life, and possible systemic involvement in at-risk individuals[7,9,10].

The oscillating-rotating (O-R) electric toothbrush with a round brush head, introduced by Oral-B in the 1990s, has been recognized in clinical research, systematic reviews, and meta-analyses (e.g. Cochrane Collaboration) to offer superior plaque removal and gingivitis reductions relative to various manual and electric toothbrush models[1-3,11-27]. Gingival health benefits have been demonstrated across various patient populations, including post-surgical patients, pediatric patients, orthodontic patients, and adolescents[28-32]. The O-R movements disrupt and remove plaque via rapid shearing forces while the round brush head maximizes access in hard-to-reach areas.

Since its introduction, Oral-B has continuously innovated the O-R rechargeable electric toothbrush design to further improve cleaning, compliance, and the brushing experience. Advancements have included increased oscillations, more ergonomic handle designs, improved brush head design and filament technology, timers, pressure sensors, brushing mode selections, and customizable interactive features via 'Smart' technology for real-time feedback and coaching linking a mobile app and the brush to monitor brushing habits[12,14,33-39].

The Oral-B iO: next-generation O-R technology

The latest innovation in the Oral-B O-R electric toothbrush line-up is the Oral-B iO. (*Figure 1*) This unique O-R electric toothbrush represents an internal and external redesign based on more than 6 years of research with nearly 250 granted patents and pending patent applications globally. Key features of the brush include:

- *A linear magnetic drive*: The new magnetic drive delivers clinically-proven O-R technology, but with the benefit of micro-vibrations resulting from controlled energy being directed to the bristle tips. The brush also provides a noticeably quieter brushing experience, which some consumers find appealing[40].
- *Redesigned round brush head*: The Oral-B Ultimate Clean brush head features the round shape from Oral-B but has increased bristle density and newly-developed 'Tuft-in-Tuft' technology. (*Figure 2*) CrissCross bristles are angled at 16°[41] in a novel arrangement of thinner, longer tufts in the inner region for maximal interdental penetration, encircled by shorter, supporting high surface area tuft regions for thorough surface cleaning. Additionally, there is a slight twisting of the tufts to adapt to the curvature of each tooth. These design iterations maximize tooth surface coverage and cleaning.
- *Smart pressure sensor:* The Oral-B iO augments brushing feedback with a 'smart' pressure sensor that guides the user to brush in the optimal pressure range of 0.8–2.5 Newtons (N). This range was determined via results of preclinical laboratory robot testing of plaque removal effectiveness across a range of pressures. The sensor light changes color based on brushing force and thereby coaches the brusher to maintain consistent pressure in the ideal window via positive reinforcement. A green light provides the user with positive feedback that the most favorable brushing pressure (0.8–2.5 N) for plaque removal and safety is being applied (*Figure 3*), and a red light indicates there is too much force (>2.5 N). If a user applies too much pressure, a variable-speed smart drive causes the oscillation angle to automatically decrease and operate the power brush in 'sensitive' mode.

In addition, real-time brushing encouragement is communicated via a unique intuitive smart interface, and a menu of features promotes compliance through coaching on brushing time, location, and pressure. Users can additionally experience interactivity using artificial intelligence for guidance in a 2-minute brushing session with 3D teeth tracking, via a compatible Oral-B iO app with Bluetooth connectivity, without having to bring their Smartphone into the bathroom or mount it on the mirror.

Figure 1. The Oral-B iO oscillating-rotating electric rechargeable toothbrush

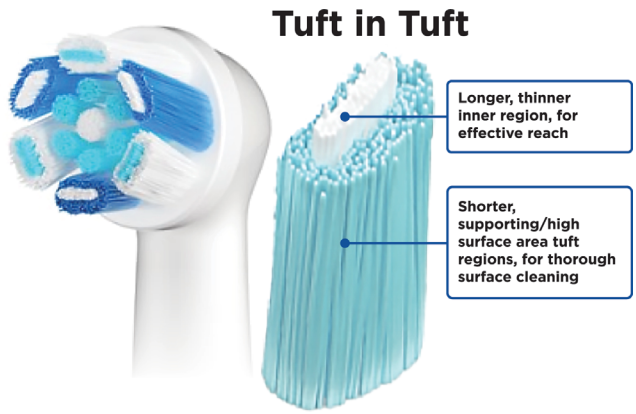

Figure 2. The Oral-B Ultimate Clean brush head with 'tuft in tuft' technology

Figure 3. Smart pressure sensor provides positive feedback (green light) when optimal pressure (0.8–2.5 N) is used

Clinical research evidence

The results of three recent randomized and controlled, examiner-blinded clinical trials assessing the efficacy of the novel Oral-B iO electric toothbrush technology are presented in this special issue[42-44]. The first clinical investigation by Grender *et al.*[42] summarizes an 8-week, parallel group study in adults with pre-existing plaque and gingivitis wherein subjects brushed unsupervised with either the Oral-B iO electric toothbrush or a manual control brush. Those assigned to the Oral-B iO electric toothbrush saw statistically significantly greater relative plaque and gingivitis reductions *versus* those using the manual toothbrush throughout the 8 weeks, with performance differences seen as early as the first brushing. Importantly, when assessing gingivitis case

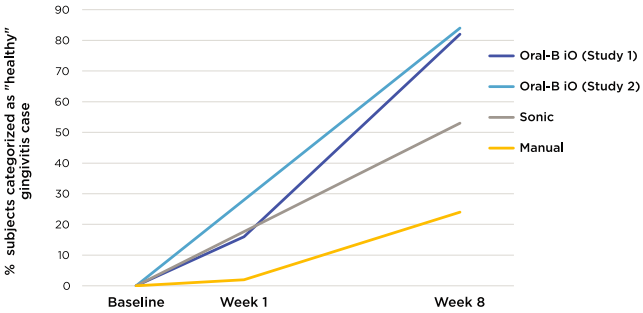

Figure 4. The Oral-B iO group had a higher percentage of subjects categorized as having a 'healthy' gingivitis status (<10% bleeding sites)[45] at week 8 compared to a manual toothbrush and sonic toothbrush: results from two clinical studies[42,43]

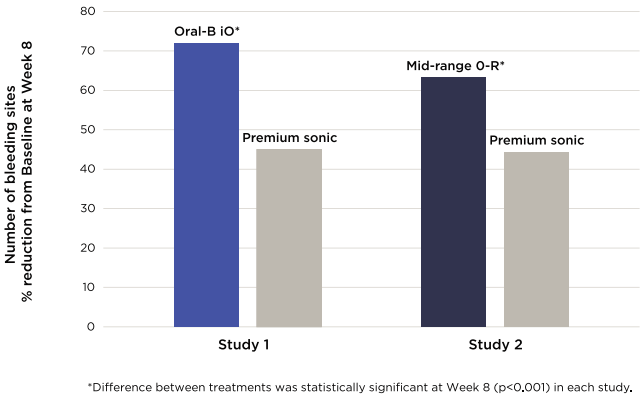

Figure 5. Number of bleeding sites percent change from baseline at week 8 for Oral-B iO and a mid-range O-R brush *versus* the same comparator sonic brush: results from two randomized clinical trials conducted at the same clinical site, using the same clinical design with the same investigator[25,43]

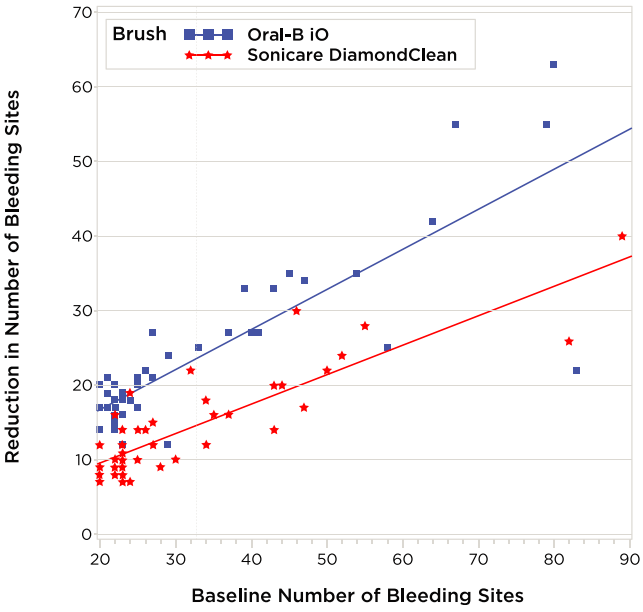

Figure 6. Reduction in the number of bleeding sites at week 8 *versus* baseline number of bleeding sites for Oral-B iO and the comparator sonic brush[43]

status at baseline and week 8 according to the new periodontitis staging/grading system of the American Academy of Periodontology (AAP) and European Federation of Periodontology (EFP)[45], there were three times as many 'healthy' (<10% bleeding sites) subjects in the Oral-B iO group at week 8 as compared to those in the manual brush group (82% *vs.* 24%, respectively) (*Figure 4*).

In the second featured 8-week, randomized and controlled, examiner-blinded, parallel design clinical trial, the Oral-B iO electric toothbrush was compared to the Sonicare DiamondClean among adults with plaque and gingivitis[43]. At study end, subjects using the Oral-B iO electric toothbrush had a significantly greater reduction in plaque (29–49%) and gingivitis (51–62%) *versus* the sonic brush. These outcomes are consistent with several published studies of classic O-R electric brushes evaluated against sonic control brushes[11]. Those subjects reaching the 'healthy' (<10% bleeding sites) gingivitis case definition category at week 8 represented 84% of those assigned to the iO power brush, as compared to 53% of those using the premium model sonic toothbrush (*Figure 4*).

Last, Adam and colleagues investigated the single-use plaque removal efficacy of a prototype Oral-B iO electric toothbrush as opposed to a manual toothbrush in a randomized 4-period crossover, replicate-use clinical trial of generally healthy adults[44]. As with the outcomes of the other two clinical trials detailed in this supplement, the plaque removal results revealed the O-R electric toothbrush delivered statistically significantly greater plaque reduction relative to the manual brush control. Compared with manual brushing, the prototype Oral-B iO electric brush was shown to give more toothbrushing evenness and consistency in the plaque removal results of the facial and lingual regions.

The new Oral-B iO electric toothbrush delivers Oral-B's most impressive clinical results to date, as illustrated in *Figure 5*. Results from two randomized controlled trials using the same clinical design, conducted at the same clinical site with the same investigator and a well-established gingivitis clinical efficacy index show a greater relative benefit in the reduction of bleeding sites for the Oral-B iO toothbrush compared to a premium sonic toothbrush than the relative benefit seen with a mid-range O-R toothbrush compared to the same premium sonic toothbrush.[25,43] Importantly, the gingival bleeding advantage for Oral-B iO has been demonstrated across the range of baseline bleeding sites (as shown in *Figure 6*) differentiating the two treatments.

CONCLUSIONS

The novel Oral-B iO O-R electric rechargeable toothbrush features a linear magnetic drive that results in controlled micro-vibrations, directing energy to the bristle tips for effective plaque removal and a noticeably quieter brushing experience. Three randomized controlled trials described in this supplement demonstrate significantly greater plaque removal and gingivitis reduction benefits for the novel O-R brush *versus* a reference manual toothbrush control and a marketed premium sonic toothbrush. Significantly more patients were transitioned to a 'healthy' gingivitis case status according to AAP/EFP guidelines after 8 weeks of using the Oral-B iO electric toothbrush, underscoring its value as a core part of a gingivitis intervention strategy to transition patients from more diseased to generally healthy in the spectrum of gingival health.

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Conflict of Interest

Dr. Adam is an employee of Procter & Gamble Service GmbH. Funding for medical writing was provided by Procter & Gamble.

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