A 4-week clinical comparison of an oscillating-rotating power brush versus a marketed sonic brush in reducing dental plaque

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Abstract: Purpose: To assess the plaque removal efficacy of an oscillating-rotating power brush relative to a newly-introduced sonic power brush. Methods: This study used a randomized, examiner-blind, single-center, two-treatment, parallel group 4-week design. Subjects with pre-existing plaque scores of at least 1.75 on the Turesky Modification of the Quigley-Hein Plaque Index (TMQHPI) were evaluated for baseline whole mouth and approximal plaque scores. They received either the oscillating-rotating brush (Oral-B Professional Care 1000, sold as Oral-B Professional Care 600 in some regions, with the Oral-B Precision Clean brush head, D16u/EB20) or the sonic brush (Colgate ProClinical C200 with Colgate Triple Clean brush head) and brushed twice-daily with the assigned brush and a standard fluoride dentifrice for 4 weeks before returning for plaque measurements. Prior to baseline and the Week 4 measurements, participants abstained from oral hygiene for 12 hours and from eating, chewing gum and drinking for 4 hours. Results: A total of 131 subjects were enrolled in the study at baseline, with all completing the study: 65 in the oscillating-rotating group, and 66 in the sonic group. Both brushes significantly reduced plaque over the 4-week study period. The oscillating-rotating brush was statistically significantly more effective in reducing plaque (P < 0.001) than the sonic brush. Compared to the sonic power brush, the adjusted mean plaque reduction scores for the oscillating-rotating power brush were more than five times greater for whole mouth and approximal areas. (Am J Dent 2014;27:56-60).

Clinical significance: When recommending brushes to patients, the superior plaque reductions observed in this study with an oscillating-rotating power brush are an important consideration for dental professionals.

Introduction

Dental caries and periodontal disease are endemic globally. Dental caries is the most common childhood disease and has a high prevalence in all age groups. Globally, many countries are estimated to have dental caries prevalence in the general population (all ages) as high as 89%. In the United States, untreated dental caries exists in more than 21% of the US population. While the prevalence of dental caries has declined in the overall population compared to 30 years ago, untreated dental caries exists in more than 21% of the US population. While the prevalence of dental caries has declined in the overall population compared to 30 years ago, it is still unacceptably high for a disease that is preventable. Dental caries may lead to irreversible tooth damage, with the potential for tooth loss.

Periodontal disease, including reversible gingivitis, is also highly prevalent. Globally, as much as 75% of the adult population may experience gingivitis and up to 15% of the adult population is estimated to experience advanced periodontal disease (periodontal pockets at least 6 mm in depth). Despite the high prevalence of periodontal disease, the first stage of the disease, gingivitis, is preventable and reversible. Gingivitis occurs as an inflammatory response to the accumulation of dental plaque, and is evident 2 to 4 days after plaque formation begins. By 2 to 3 weeks, an established gingivitis is present. From the early phase of reversible gingivitis, the disease process can gradually transform into one of irreversible periodontal disease in susceptible hosts, with the potential for significant attachment loss and tooth loss.

Dental caries and periodontal disease are multifactorial, and both are associated with the presence and build-up of dental plaque containing cariogenic and periodontopathic microorganisms that are causal for the respective diseases. As such, the reduction of dental plaque and its thorough twice-daily removal are key factors in preventing oral disease and its progression. Reductions in plaque levels can be achieved chemotherapeutically and mechanically by brushing. It is, however, widely acknowledged that patients and consumers do not brush as frequently or for as long as required for oral health and may have difficulty brushing appropriately. This highlights the need for oral hygiene aids that encourage use and that are highly effective in removing plaque. Using a brush that removes the most plaque in a given period of time helps to counter the frequently less-than-optimal brushing times observed in many studies, and promotes oral health.

Increasingly sophisticated designs have been introduced, in particular for power brushes, in the last two decades. Studies have shown that plaque removal with power brushes is more effective than with various manual brush controls. The most common power brushes are based on oscillating-rotating and sonic technologies. Oscillating-rotating toothbrushes, introduced by Oral-B, move back and forth with alternating turns clockwise and counterclockwise while sonic brushes move side-to-side. In the most recent systematic review, evaluating the plaque removal efficacy of power versus manual toothbrushes, oscillating-rotating power brushes were found to remove plaque and reduce gingivitis more than manual brushes in the short and long term. No other power brush designs were consistently superior to manual toothbrushes.

One of the latest designs for the Oral-B oscillating-rotating power brush is the Precision Clean brush head, which has 29% more filaments than previous designs and a trim profile for superior three-dimensional tooth wrapping. In three separate trials, the brush head showed significantly
greater plaque removal versus an ADA manual brush. One of
the trials\textsuperscript{11} also assessed gingivitis; significant reductions (by almost 3 times) were demonstrated for the Precision Clean brush head versus the ADA manual brush after 4 weeks of use.

Recently, a new sonic brush has been introduced as the Colgate ProClinical C200.\textsuperscript{b} This brush is manufactured by Omron Healthcare Co. Ltd., in Japan and distributed by Colgate. The ProClinical C200 is described as having a unique sonic wave cleaning action that combines a pulsation-like up-and-down motion with a side-to-side motion and up to 30,000 strokes/minute. It has a Triple Clean\textsuperscript{6} brush head, one manual mode, a 2-minute timer and a 30-second pacer. The ProClinical C200 is reported to result in five times greater plaque removal at the gingival margin compared to a manual flat trim brush after 12 weeks of use.\textsuperscript{12}

This study compared the efficacy of an Oral-B oscillating-rotating power brush with the Precision Clean brush head versus the new Colgate sonic power toothbrush in reducing plaque in a well-controlled randomized clinical trial in adults with confirmed plaque levels (Fig. 1).

Materials and Methods

Study design - This clinical trial was a 4-week single-center, randomized, examiner-blind, two treatment, parallel group study. The study was first reviewed and approved by the University Hospital of Jena Institutional Review Board (N° 3673-01/13), after which potential study participants were evaluated to determine if they met the study inclusion criteria. In order to qualify for the study, participants were required to be in good health and be at least 18 years of age. They also had to have refrained from any oral hygiene for 12 hours prior to baseline measurements as well as refrained from chewing gum, eating or drinking for 4 hours. In addition, potential participants were excluded if they were found to have severe and active dental caries, extensive restorations, fixed or removable appliances, severe periodontitis, be pregnant/lactating or if they had used antibiotics or oral chlorhexidine within the previous 2 weeks. At Baseline, written informed consent was obtained from potential participants and plaque measurements were obtained using the Turesky Modification of the Quigley-Hein Plaque Index (TMQHPI, 168 sites) to screen for participants. Participants were required to have a TMQHPI of $\geq 1.75$ (on a scale of 0-5) to be included in the study and were stratified based on age, gender, typical toothbrush used, and baseline whole mouth mean TQHPI score and randomized to the oscillating-rotating power brush (Oral-B Professional Care 1000\textsuperscript{c} oscillating-rotating power brush, sold as Oral-B Professional Care 600\textsuperscript{d} in some regions with the Oral-B Precision Clean brush head, D16u/EB20) or to the sonic power brush group (Colgate ProClinical C200 sonic power toothbrush with Colgate Triple Clean brush head). Participants were instructed to brush twice daily for 4 weeks with the allocated brush and a standard fluoride dentifrice (Blend-a-Med Classic,c 1,450 ppm F as NaF), following the power brush manufacturer’s instructions, and to refrain from using any other oral hygiene products.

At the end of Week 4, participants again refrained from performing oral hygiene for 12 hours and from eating, drinking or chewing gum as previously instructed, before returning to the clinic. As at the baseline visit, plaque was scored using the TMQHPI to assess plaque reduction efficacy of the brushes. The same examiner, who was previously trained and calibrated on the method, evaluated clinical measurements for each subject at all time points.\textsuperscript{14}

Turesky Modification of the Quigley-Hein Plaque Index (TMQHPI)\textsuperscript{13} - Plaque was scored using the TMQHPI with a scale of 0-5 as follows: ‘0’= no plaque/debris; ‘1’= separate flecks of plaque at the cervical margins of a tooth; ‘2’= a thin continuous band of plaque at the cervical margins of a tooth; ‘3’= a band of plaque with a width $>1$ mm and covering less than one-third of the crown of a tooth; ‘4’= plaque covering at least one-third and less than two-thirds of the crown of a tooth; and ‘5’= plaque covering at least two-thirds of the crown of a tooth. Measurements were taken at six sites/tooth: mesio-buccal, buccal, disto-buccal, mesio-lingual, lingual and disto-lingual. Sites that had extensive restorations or that were hypoplastic were excluded from grading. TMQHPI whole mouth scores were calculated by summing the scores from all sites graded and dividing this by the number of gradable sites. Approximal site scores were calculated by summing the scores of all mesio-buccal, disto-buccal, mesio-lingual and disto-lingual sites and then dividing this by the number of gradable mesial and distal sites.

Statistical analyses - Pre-study sizing was achieved using power analyses with $\alpha=0.05$, using a two-sided test and a sample size of 65 and 66 subjects in the two groups respectively (131 subjects total). This sample size was sufficient to pro-
vide 90% power to detect differences in plaque reductions measured using the TMQHPI. Between-group baseline subject demographics were assessed for balance using a two sample t-test for age, and a chi-square test for gender and brush type. Statistical analyses for plaque reduction efficacy were based on whole mouth and approximal average TMQHPI from the respective baseline and Week 4 scores. An ANCOVA was performed to analyze whole mouth and approximal plaque differences by using the respective baseline plaque measurements as the covariates. Additionally, confidence intervals were generated on the treatment differences for the respective whole mouth and approximal changes from baseline scores.

Results

A total of 131 subjects were enrolled in the study at baseline, with all completing the study: 65 in the oscillating-rotating group, and 66 in the sonic group. In accordance with the inclusion criteria, all subjects had a whole mouth TMQHPI score of at least 1.75 at the start of the study. More than half of the participants in each group entered the trial as manual toothbrush users (63.1% and 57.6%, respectively). Participant demographics can be found in Table 1.

Whole mouth plaque - Baseline whole mouth plaque scores for the oscillating-rotating and sonic power brush groups were 2.283 and 2.377, respectively (P= 0.09). Use of either power brush resulted in a statistically significant whole mouth plaque reduction at Week 4 versus baseline (Table 2). The adjusted mean change from baseline was 0.390 (P< 0.001) for the oscillating-rotating brush group and 0.075 (P= 0.016) for the sonic brush group. This represents more than five times greater whole mouth plaque reduction for the oscillating-rotating brush versus the sonic brush (P< 0.001) (Fig. 2).

Significantly more participants showed a reduction in whole mouth plaque at Week 4 with the oscillating-rotating brush than with the sonic brush (96.8% vs. 63.6%, P< 0.001). The number of subjects showing an improvement of more than 0.5 on the TMQHPI scale was also significantly greater in the oscillating-rotating group versus the sonic group (27% vs. 7.6%, P= 0.005) (Table 3).

Discussion

Poor oral hygiene is a known risk factor for dental caries and periodontal disease. Since neither dental caries nor bacterial periodontal disease can exist in the absence of the respective causative microorganisms, preventing the build-up of plaque and reducing its presence are critically important for maintenance of oral health. It is generally accepted that brushing twice-daily for 2 minutes will control plaque on an on-going basis, provided thorough brushing occurs. Nonetheless, barriers to achieving adequate plaque control include infrequent brushing, brushing for an inadequate length of time...
(less than 2 minutes) and difficulty in performing oral hygiene. Given all of these facts, there is considerable drive to design efficient and user-friendly power brushes.

This trial is the first comparative report of the Oral-B Professional Care 1000 oscillating-rotating power brush and the novel Colgate ProClinical C200 sonic power brush for plaque removal. Both brushes significantly reduced plaque over the 4-week study period, but the oscillating-rotating brush removed statistically significantly more plaque (P<0.001) than the sonic brush. Other studies have demonstrated the superiority of oscillating-rotating power brushes compared to various sonic brushes. A 2010 systematic review of 17 trials with over 1,300 participants compared power brush technologies, including oscillating-rotating power brushes and sonic (side-to-side) power brushes, over a period of at least 4 weeks. It was concluded from a review of seven trials of up to 3 months duration that oscillating-rotating brushes were superior, resulting in statistically significantly greater plaque reductions in the short term (1-3 months) compared to side-to-side powered brushes.

Most recently, a 12-week randomized, controlled, parallel group and examiner-blind clinical trial involving 127 subjects was published that evaluated an Oral-B premium oscillating-rotating power brush (Triumph D34) with the premium Colgate ProClinical model (A1500) for plaque and gingivitis reductions. Plaque and gingivitis measurements were taken at Baseline, Week 4 and Week 12 using the Modified Gingival Index (MGI), Gingival Bleeding Index (GBI) and the Rustogi Modified Navy Plaque Index (RMNPI). Similar to the results of the 4-week clinical trial reported here, the oscillating-rotating power brush showed significantly greater efficacy versus the sonic brush. Statistically superior plaque and gingivitis reductions were found for all measures with the oscillating-rotating power brush. At 12 weeks, a 24% greater mean adjusted reduction in whole mouth plaque was observed (P<0.001), as well as a 26% greater reduction in approximal plaque (P<0.001). A 29% and 17% greater reduction in the mean adjusted MGI (P<0.001) and GBI (P=0.047), respectively, was also found, as well as a 30% reduction in the total number of bleeding sites (P=0.002).

A review of six randomized, controlled, examiner-blind clinical trials of 4 or 12 weeks duration comparing the efficacy of plaque removal in hard-to-clean areas with oscillating-rotating power brushes versus sonic power brushes or manual brushes also supports the superiority of oscillating-rotating power brushes. Depending on the study, either the TMQHPI or the Rustogi Modification of the Navy Plaque Index (RMNPI) was used to measure lingual, gingival, marginal and approximal plaque. In comparison to sonic power brushes, the oscillating-rotating power brushes resulted in 18% to 34% greater reductions in adjusted mean plaque on the lingual surfaces (P≤0.044) and 32% to 49% on the lingual approximal surfaces (P<0.001), as well as 31% and 32% greater plaque reductions in the lingual mandibular anterior and lingual mandibular sites (P≤0.005). Given the propensity for greater plaque build-up and gingivitis at these hard-to-clean sites, the superior plaque reductions observed with oscillating-rotating power brushes demonstrated their benefits in reducing gingivitis and improving oral health.

In conclusion, the current study demonstrated superior plaque reductions with an advanced oscillating-rotating power brush compared to a novel sonic brush, corroborating previous studies demonstrating the superiority of oscillating-rotating power brushes relative to sonic brushes.

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b. Colgate-Palmolive, New York, NY, USA.

c. Procter & Gamble, Gross Gerau, Germany.

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References


