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RESEARCH ARTICLE

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DENTAL PLAQUE REMOVAL AND MOTIVATION OF A MANUAL TOOTHBRUSH VERSUS AN INTERACTIVE POWER TOOTHBRUSH IN YOUNG PEOPLE WITH FIXED ORTHODONTIC APPLIANCES: A SINGLE EXAMINER-BLIND RANDOMIZED CONTROLLED CLINICAL TRIAL

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ABSTRACT

Introduction: The goal of this 2-arm equal preliminary clinical trial was to decide the plaque expulsion efficacy (primary result) and the motivation assessment (auxiliary result) looking at a manual versus an interactive power toothbrush in orthodontic patients. **Methods:** Sixty teenagers with fixed orthodontic appliances who reported to the Department of Periodontics for routine oral prophylaxis in the both arches were randomized in a 1:1 proportion parallel, randomized, examiner-blind controlled clinical preliminary. Qualification criteria included in any event 16 characteristic teeth, 1-6 "center consideration zones," plaque score of ≥ 1.75 , no serious caries, gingivitis and periodontitis, no dental prophylaxis, no smoking, no anti-microbials, and no chlorhexidine mouth wash. Subjects were to brush solo with either an interactive power toothbrush (Oral-B Professional Care 6000, D36/EB20) with Bluetooth innovation or a customary manual toothbrush (Oral-B Indicator 35 delicate). Center consideration regions were each brushed for 10 extra seconds like inter-proximal spaces. Plaque removal was surveyed with the utilization of the Turesky Modification of the Quigley-Hein Plaque Index (TMQHPI) to decide change from standard at 2 weeks followed by 6 weeks. Supervised brushing at screening and post-treatment visits recorded real brushing times. Subject-revealed motivational viewpoints were recorded at screening and week 6. **Results:** Fifty-nine subjects between 13-17 years finished the investigation. The interactive power toothbrush gave significantly ($P < 0.001$) more noteworthy plaque decrease versus the manual toothbrush at 2 and 6 week as indicated by the entire mouth TMQHPI. The treatment contrast in balanced mean plaque change from standard was 0.777 (95% CI 0.614-0.940) at week 2 and 0.834 (0.686-0.981) at week 6. Mean decreases in the quantity of center consideration regions were likewise significantly more noteworthy ($P < 0.001$) in the power brush bunch at weeks 2 and 6. Brushing times increased significantly at weeks 2 and 6 ($P < 0.013$) versus standard baseline in the interactive power toothbrush group only. Subject-revealed motivation was significantly increased in the interactive power toothbrush group at week 6 as opposed to screening ($P < 0.005$). **Conclusions:** An interactive power toothbrush produced increased brushing times and significantly more prominent plaque removal versus a manual brush.

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INTRODUCTION

Teenagers are at increased hazard for caries and periodontal disease by uprightness of merging challenges basic to this age group: reducing parental oversight of oral cleanliness, consumption of high sugar and acidic beverages and snacks, and increased social and scholarly

demands and interruptions that can influence motivation to perform ordinary, principled toothbrushing (Babey *et al.*, 2013; Broughton *et al.*, 2020; Bourke, 2016; McMurray, 2004). Individually and all in all, these variables can add to more prominent degrees of undisturbed dental plaque, which could advance caries progression and gingival disease in helpless people by means of the creation of corrosive delivering,

cariogenic, and pathogenic microbiota in the plaque biofilms (Crall, 2007; Loe, 1965; Theilade, 1966). Unfortunately high paces of gingivitis and caries in adolescents have been found across assorted geologies and populations (Dye *et al.*, 2012). With fixed orthodontics, an oral hygiene protocol incorporating viable and advantageous home consideration items to expel plaque, especially in difficult-to-get to zones, is critical to improving patient consistence and evading sickness. Powered (electric) toothbrushes have been assessed over a wide exhibit of population groups and study plans and have shown comparative or significantly more prominent (for oscillating toothbrushes class) plaque removal compared to standard manual tooth-brushes (Rebelo *et al.*, 2009).

Some further more offer alternatives for focused requirements, for example, orthodontic brush heads to improve interbracket cleaning. Beyond their clinically demonstrated efficacy in expelling plaque, power toothbrushes can upgrade tolerant motivation, prompting increased toothbrushing recurrence and duration. In a randomized preliminary of 40 subjects, members utilizing a swaying pivoting power brush brushed longer than those utilizing a manual toothbrush and were increasingly agreeable with twice-every day 2-minute brushing meetings than members utilizing a manual toothbrush. Improving consistence is especially notable for the youthful orthodontic populace since inquire about has uncovered that unsatisfactory oral cleanliness in adolescents is common even without the additional weight of deterrent to tooth surfaces created from wires and brackets (McMurray, 2004). Combining oral cleanliness helps with innovation based highlights that resound with the teenager segment is a novel method to support consistence with toothbrushing. The power begins in the information that young people, in created and rising nations the same, are high clients of portable innovation and acclimatize it into numerous parts of day by day life, including the utilization of advanced smartphones applications ("apps"). Health and fitness applications are progressively famous these days.

In 2015 the Pew Research Center revealed that 62% of surveyed smartphone owners reported using their phone to investigate health conditions in the previous year. Consistent with these trends, an oscillating-rotating power brush has been linked to wireless Bluetooth technology to provide real-time feedback to help improve brushing habits. The 2-way communication between the smartphone-connected mobile app and the power toothbrush means the user gets instant information about variables such as session length and excessive brushing power, and personalized reminders to focus on preselected areas of special concern as identified by their dental professional. Other features, such as access to a newsfeed and calendar while brushing, are intended to increase engagement with toothbrushing.

Specific objectives or hypotheses: The objectives of this study were to evaluate (1) the plaque removal efficacy and (2) the motivation assessment with the use of an interactive power toothbrush versus a regular manual brush in an adolescent population with orthodontic fixed appliances.

METHODOLOGY

The study was carried out at the Department of Periodontics in collaboration with Department of Orthodontics. Sixty teenager subjects with fixed orthodontic appliances (0.2200 slot; Roth Prescription) in both well aligned arches were randomized to test groups in this examiner-blind study. All subjects were required to be in good systemic health, be routinely using manual toothbrush and satisfying other inclusion criteria at the screening visit: at least 16 natural teeth (excluding third molars) with facial and lingual scorable surfaces; at least 1, but not more than 6, "focus care areas" (defined in Experimental Protocol below); a whole-mouth average screening Turesky Modified Quigley-Hein Plaque Index (TMQHPI) plaque score of ≥ 1.75 ; familiarity with smartphone use; no severe or untreated caries, severe gingivitis, or active or advanced periodontitis requiring treatment; no smoking or any other type of tobacco use; no

antibiotics or chlorhexidine mouth rinse use within the 2 weeks before screening; and no dental prophylaxis within the 4 weeks before screening. In accordance with the ethical standards established in the 1964 Declaration of Helsinki and its later amendments, the Institutional Ethical Review Board reviewed and approved the study protocol and the subject consent form before study inception. Each subject and guardian provided written and informed consent before participation.

Interventions: Efficacy of two different toothbrushes in plaque removal were studied and compared over a 6-week period: (1) the interactive power brush with Bluetooth technology, consisting of an Oral-B Professional Care 6000 rechargeable power brush with Oral-B Precision Clean brush head, charger, and smartphone equipped with Oral-B Application v2.1 and (2) the manual brush control, Oral-B Indicator 35 soft manual toothbrush. Participants used the test products assigned to them at home without any supervision for the study duration, brushing twice daily—morning and evening—for 2 minutes with dentifrice either in their customary manner (manual brush group) or according to the manufacturer's instructions, including use of the Oral-B phone application (interactive power brush group). All subjects were directed to brush each individual focus care area for an additional 10 seconds after the overall brushing. For each subject, areas in the dentition showing considerable dental plaque accumulation and thus indicating the need for oral hygiene improvement were identified by the clinical examiner (C.E.) at the screening visit and recorded as focus care areas. For the interactive power brush group, the Oral-B application was programmed with the individually designated focus care areas, and operated like an interactive reminder, prompting subjects via pictograms regarding the additional brushing time needed. Designated focus care areas were communicated to the manual control group via verbal instruction, in customary clinician-patient interactions. At the final visit, focus care areas were again chosen by the clinical examiner in the same manner as at screening to ascertain whether the quantity and location of these special need areas had changed.

To determine whether the use of the interactive power and manual control toothbrushes would affect the length of tooth brushing sessions, the number of seconds that subjects brushed under supervision was recorded at the screening visit (subjects using their own at-home manual toothbrush as they normally do) and at the post-treatment 2- and 6-week visits after plaque evaluations. Subjects were told to brush as they normally would with their assigned products while clinical site personnel discreetly recorded the brushing session length. Subject selection criteria allowed for only regular manual brush users who would not have previous experience with the power toothbrush and app, as well as for participants with smartphone familiarity so there would not be a disparate learning arch or novelty factor bias. For validity of the plaque assessments, before each afternoon study visit participants were directed to refrain from toothbrushing and from performing any other oral hygiene procedures after their morning brushing (and no later than 8:00 am). Subjects were also instructed to cease eating, drinking, or chewing gum for 2 hours before their appointment, other than small sips of water up to 45 minutes beforehand. Furthermore, subjects were questioned at all visits to confirm that each study criterion continued to be met, including the nonuse of non-study-assigned oral hygiene products.

Outcomes (primary and secondary): For analysis of motivational aspects related to tooth-brushing with the interactive power toothbrush, subjects in the interactive power brush group responded to queries about their inclination to brush twice daily, and to brush for at least 2 minutes per brushing session at screening and again at study end. Responses were coded as scores 1-5, with 1 indicating highest motivation or agreement, and 5 lowest. To determine whether the subjects understood the home use tooth brushing oral and written instructions, clinical staff supervised all subjects' brushing after their baseline visit plaque assessments and gave reinstruction as necessary.

Sample size calculation: The sample size of 60 randomized subjects (30 per group) was chosen for logistical considerations.

Randomization (random number generation, allocation concealment, implementation): Randomization in 1:1 allocation to the 2 test groups was achieved via a computer-generated program, which also stratified qualified subjects based on gender, base-line whole-mouth TMQHPI-MQH (#3.8 vs .3.8), age (13-14 y vs 15-17 y), and number of focus care areas (#5 vs 6).

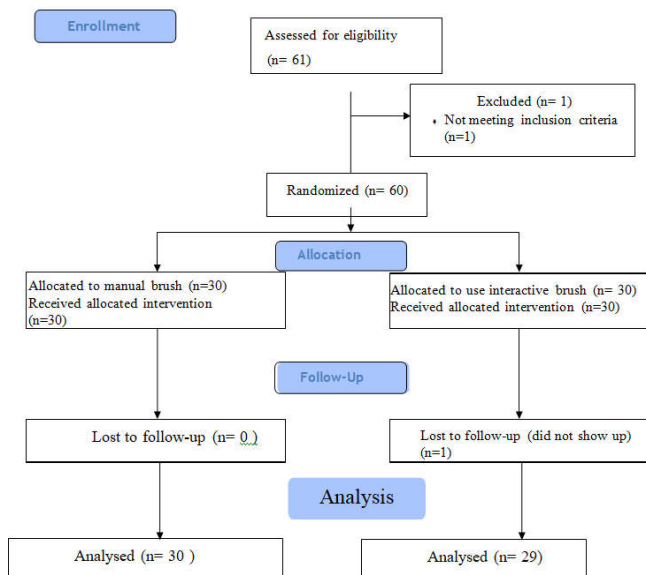
Blinding: Both the assignment process and the test products distribution were conducted in a protected area to ensure examiner blinding to group assignments.

Statistical analyses (primary and secondary outcomes, subgroup analyses): Demographic and baseline variables were summarized by treatment group. The TMQHPI and MQH data were combined into a single dataset representing both fixed orthodontia and orthodontia-free tooth surface scores, and the evaluation results are labeled herein as TMQHPI-MQH. Statistical analyses for plaque efficacy were based on average whole-mouth TMQHPI-MQH change from baseline score. The 2- and 6-week plaque reduction was analyzed separately for treatment differences with the use of an analysis of covariance (ANCOVA) with baseline whole mouth TMQHPI-MQH score as the covariate. Similar analysis was carried out for determining treatment differences in the identified focus care areas. The within-treatment difference from baseline scores for each end point was tested versus zero with the use of a paired t test.

The brushing times (in seconds) collected at screening, week 2 and week 6 were summarized, and the changes from screening-visit brushing times were analyzed for treatment group differences with the use of the Wilcoxon rank sum test because the data were determined to be non-normally distributed. The distribution of the number (and percentage) of subjects in each focus care area was computed at the screening and week 6 visits. In addition, the mean change (from screening) in number of focus care areas at week 6 was analyzed with the use of a nonparametric ANCOVA analysis because the data were determined to be non-normally distributed. The mean changes in toothbrushing motivation after treatment compared with baseline were analyzed with the use of a 1-sample t test based on the difference between post-treatment and baseline values, with no correction for multiple testing. All treatment comparisons were 2 sided with $\alpha=0.05$ significance level.

RESULTS

Participant flow: Sixty adolescent subjects 13-17 years of age (mean 14.5 years) with fixed orthodontic appliances in both arches were randomized in a 1:1 allocation to test groups in this single-blind study, with 59 participants completing all study visits (Fig 1).



Median brushing times (126 and 118 seconds for the force and manual brushes, individually) were comparative at screening ($P = 0.411$). At week 2 (177 s for power and 130 s for manual) and week 6 (181 s for power and 114 s for manual), power brush clients brushed significantly more ($P \leq 0.002$) than manual brush clients.

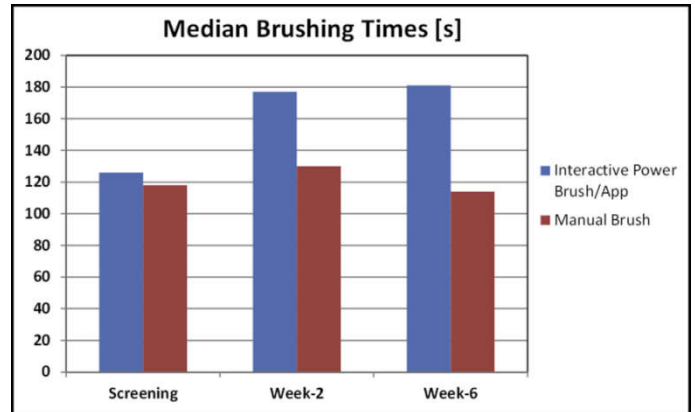


Fig. 1: Median brushing times

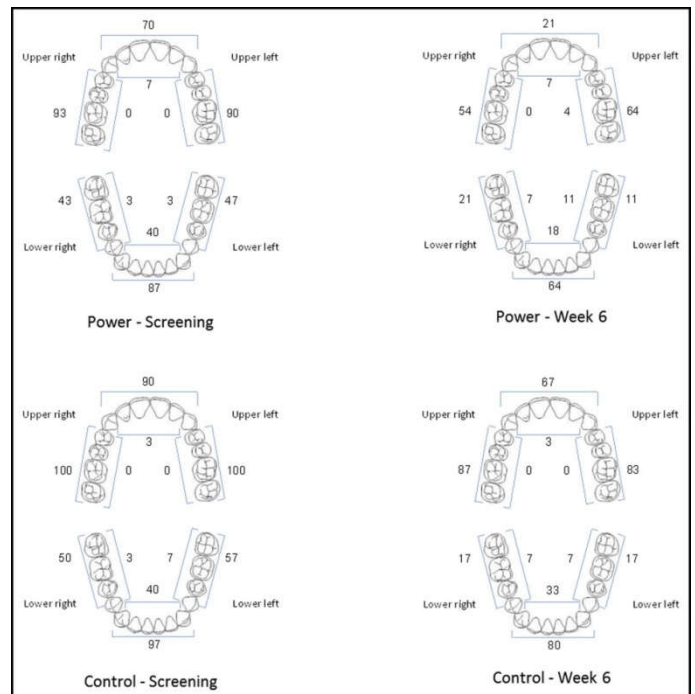


Fig 2. Percentage of subjects with focus care areas: interactive power brush group (top) and control (bottom).

DISCUSSION

Young people might be among the most imposing populations in which to impact change in regards to oral hygiene. In a past also structured preliminary of shorter term with German teenagers who didn't have fixed orthodontics, the intelligentpower brush gave significant 34% and 38% mean decreases versus benchmark in entire mouth and center consideration region plaque, individually, at week 2. The consequences of the current preliminary in a comparable to age gathering yet with fixed orthodontic apparatuses equal those findings, with significant week 2 entire mouth and center zone mean post-treatment plaque decreases of 36% and 38%, individually, for the intelligent power brush clients. In this manner, considerably under all the more requesting cleaning conditions inalienable to orthodontics wearers, unaided brushing with this interactivepower brush yielded significantly more prominent plaque decreases than brushing with a standard manual brush, with results as generous as those seen when subjects were not wearing fixed apparatuses after only 2 weeks. Besides, the more extended term of the current examination at about a

month and a half uncovered that the TMQHPI-MQH plaque decrease benefits contrasted and standard became bigger with proceeded with utilization of the intelligent power brush, as did the size of the between-bunch execution hole.

Indeed, even without orthodontics, regions of the dentition that are more difficult to access during tooth-brushing are at more serious hazard for gum disease and caries incidence. Brackets, arch wires, and other fixed orthodontic segments can be reproducing reason for caught nourishment and flotsam and jetsam and undisturbed plaque development, especially in young people who may need cleanliness insight and inspiration. The idea of center consideration territories recognizes that specific locales of the dentition may require additional brushing time and consideration inferable from testing access, hindrance with orthodontics, or other patient-specific constraints (e.g. smoothness) that incline to extreme plaque develop. At the point when these destinations can be identified by the dental expert, the patient would then be able to work collaboratively to center extra time where expected to remove more plaque and decrease infection hazard. In the current preliminary, subjects in the interactivepower brush bunch saw more prominent decreases than the manual brush bunch in both the general number of center consideration regions and the percentage of high-recurrence intraoral locales with center consideration territories. This proposes the power brush subjects were in reality reacting to application suggestions to pay extra attention to these issue zones, while the manual brush gathering would have expected to recall their verbal instructions. In real clinical-quiet connections, where a 6-month review interim is run of the mill, all things considered, just the profoundly energetic patient will make sure to finish at each brushing without a novel system advancing more noteworthy responsibility, for example, the application updates.

Plaque has a built up relationship with gum disease and caries, and a few investigations show young people have a lot shorter than suggested normal brushing times, so the requirement for viable oral cleanliness apparatuses that will be utilized by adolescents and improve their propensities is paramount. In the current preliminary, following 2 and a month and a half of unaided brushing, there was no significant gain in mean brushing time in the manual brush gathering, and, truth be told, the mean was marginally lower at about a month and a half than at 2 weeks and benchmark. Conversely, the interactivepower brush bunch was brushing 55 seconds longer on normal contrasted and benchmark by study end. This surpasses the 34-second increment seen for power brush clients in the past comparative trial. The possible clarification for the expansion in brushing time for the power brush bunch with no comparative gains in the manual brush bunch is owing to the interactive arrangement and customized suggestions to brush for 2 minutes. Eminently, the clinical site-recorded brushing time gains were upheld by reactions to the subject-evaluated questions at week 6: The interactivepower brush subjects' view of their brushing inspiration changed well throughout the preliminary, with significant gains in the extent of subjects who were persuaded to brush twice every day and brush for 2 minutes or increasingly after the investigation contrasted and before they had utilized the intelligent power brush. These results, which show efficacy and compliance benefits for the intelligent power toothbrush, are clinically significant.

The patient populace—juvenile patients with fixed orthodontics and significant levels of plaque—speak to an enormous portion of patients in an ordinary orthodontic practice. The efficacy out-comes, including a 46% plaque removal benefit, have positive ramifications for gingival wellbeing. At long last, the in-wrinkle in brushing time of almost 1 moment and the improvement in inspiration are clinically important, on the grounds that consistence is one of the essential impediments to successful oral cleanliness. The pertinence and immersion of individual remote technology utilization right now cannot be exaggerated. Cell phones progressively work as helpful entries for moment remote openness to applications, with applications that both engage and teach. In the class of information boosting applications, the clinical, wellbeing, and condition-following classification is developing exponentially to satisfy the need for individualized wellbeing advancement.

Conclusion

In light of this randomized preliminary, an interactivepower toothbrush produced increased brushing times and significantly more prominent plaque removal generally speaking and in center consideration zones versus a manual toothbrush. Young people are regularly conflicting at oral cleanliness, yet their remote versatile innovation use can be bridled to improve brushing inspiration and cleaning.

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