International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Comparison of Power versus Manual Toothbrush in Reducing Gingivitis

Nandita Gautam[1], Prasanjeet Kumar[2], Lubna Shoaib[3], Arjun Singh[2], Siddhant Singh[3], Himashu Kashyap[4]

[1]Department of Dentistry, Varun Arjun Medical College and Rohilkhand Hospital, Banthara
[2]Department of Public Health Dentistry
[3]Department of Periodontology
[2, 3, 4]Institute of Dental Sciences, Bareilly
Uttar Pradesh, India

Abstract

Introduction: Dental plaque is a bacterial biofilm consisting of complex communities of bacterial species.

Materials and Methods: The study was a single-blind, parallel arm, randomized, controlled interventional trial. Total 46 male and female subjects (32 female and 16 males) with a mean age of 26 years were enrolled according to the admission criteria and accepted into this study. The subjects were assigned to either the powered brush or the manual brush based on levels of inflammation (% BOP, MGI-52), and plaque levels (53, 54, 55) using screening data.

Results: BOP decreased from baseline 22% to 17% at 2 weeks and 16% at 4 weeks for Power users (Group A). For Manual users (Group B), BOP decreased from baseline 27% to 21% at 2 weeks and 19% at 4 weeks; so both groups had a reduction in BOP but there was no statistical significance for either group.

Conclusion: Both groups demonstrated a reduction in signs of gingivitis (BOP and GI) in this non-flossing population after being repeatedly trained in toothbrush use over a 4-week period. Both toothbrushes were equally effective in reducing overnight plaque as a single use exercise after initial professional training.

Keywords: Dental Plaque, Power Versus, Manual Toothbrush, Gingivitis

Introduction

Dental plaque is a bacterial biofilm consisting of complex communities of bacterial species [1]. Plaque can be supragingival or subgingival and can be adherent or non-adherent to teeth or tissue. In addition, the microbial composition of plaque varies from person to person and site to site within the same mouth [2]. Maintenance of effective plaque control is the cornerstone of any attempt to prevent and control periodontal disease. Natural self-cleansing mechanisms include tongue movements on the oral and

vestibular aspects of the teeth as well as mastication of food. These natural mechanisms, however, are not sufficient to control plaque buildup. Therefore, to maintain oral health, regular personal plaque removal measures must be undertaken. The most widespread means of removing plaque is tooth brushing.

Most historian's trace the development of the first toothbrushes in China, which were ivory brush handles with bristles. The bristle brush was reinvented in the late 18th and early 19th centuries, but due to the high price of hog bristles, brushes did not become widely used until the end of the 19th century. ln, the late 1930s, nylon filaments began to replace natural bristles, and wood and plastic replaced bone handles. This made toothbrushes inexpensive enough and more affordable and so they dominated the oral care market in mechanical plaque control. During the past 30 years, oral hygiene has improved, and in industrialized countries, 80 to 90% of population brush their teeth 1 or 2 times a day [3]. Mechanical plaque removal with a manual toothbrush remains the primary method of maintaining oral hygiene for most of the population. When performed well for an adequate duration of time, manual brushing is highly effective. However, for most patients, neither of these criteria is fulfilled. One possible way to overcome the limitations associated with manual brushing was to develop a mechanical brushing device.

In 1961 the first electric toothbrush was launched which mimicked the back-and-forth motion commonly used with a manual toothbrush. When first introduced there were many reports of the effectiveness of such devices. However, an early authoritative report reviewed the research on both manual and electric toothbrushes and stated that they were equally effective in removing plaque [4]. Because of the lack of superiority, powered toothbrushes fell out of favor, and during the late 1960s, they gradually disappeared from the market. However, powered brushes continued to be recommended for the handicapped and for persons with reduced manual dexterity.

At the World Workshop in 1966, the consensus from the research reports on tooth brushing stated that in non-dentally oriented persons, in persons not highly motivated to oral health care, or in those who have difficulty in mastering suitable hand brushing technique, the use of an electric brush may result in more frequent and better cleansing of the teeth.

Since then, tremendous advances have been made in the technology of electrically powered toothbrushes with the development of oscillating-rotating brushes which move at high frequency back and forth from a center point and does not rotate in full circles [4]. Rotary action single tuft brush (Rotadent) with small bristles that reach one surface per tooth comes with three different brush heads in different shapes to improve access in areas hard to reach in the oral cavity. The next innovation was the Interplak electric toothbrush which has a rectangular brush head with 6 to 8 bristle tufts which individually counter-rotate. Further innovations resulted in the launch of an oscillating rotating toothbrush by Braun (Oral-B). Oral-B plaque remover D5 oscillates at a speed of 2800 oscillating rotations per minute. Further development of this brush resulted in Oral-B Ultra-Plaque Remover which has a frequency of 3600 oscillation rotations per minute. Philips introduced another oscillating rotating brush the HP 510 similar to Oral-B, but which has, in addition, an active tip at the end of the brush head which makes a small sweeping motion. Another development in technology was the Sonicare electric toothbrush introduced in 1993 which has a rectangular brush head with bristles arranged in a saw-tooth design. Philips has different

versions of the Sonicare brush. The mechanism of the Sonicare model is side-to-side movement at a high frequency of 262 Hz [5]. In sonic toothbrushes, the vibration results in cavitation and acoustic streaming which generate fluid movement and may provide cleaning slightly away from the tip. Numerous clinical studies have been done to compare the efficacy of manual to power toothbrushes and between differently powered toothbrushes. The purpose of the present 4-week, parallel-arm, single-blinded, clinical study is to investigate the efficacy and safety of a new power toothbrush in comparison with a standard flat trim ADA approved manual brush. The primary objective of this study is to evaluate the efficacy of power toothbrush on gingivitis reduction compared to a manual toothbrush in a well-trained population of non-flossers. This is a self-administered procedure to control gingivitis without the confounding effects of interdental cleaning or use of topical antiseptic rinses over a short time period. The patients participating in the study receive repeated professional training and instructions to control brushing time and frequency. Secondary objectives of this study are to evaluate the effectiveness of plaque removal.

Materials and Methods

The study was conducted at Department of Dentistry at Varun Arjun Medical College and Rohilkhand Hospital Banthara, Shahjanpur which was a single-blind, parallel arm, randomized, controlled interventional trial. Total 46 male and female subjects (32 female and 16 males) with a mean age of 26 years were enrolled according to the admission criteria and accepted into this study. The subjects were assigned to either the powered brush or the manual brush based on the levels of inflammation (% BOP, MGI-52), and plaque levels (53, 54, 55) using screening data. Brush assignment was randomized after screening, and only the PI and the Study coordinator had access to the randomization key.

The test group was assigned to a new power toothbrush while the control group was assigned the ADA approved manual flat trim soft bristle toothbrush. For the duration of the 4-week home use trial. Both groups agreed to refrain from the regular use of mouthwash and any interdental device, such as floss, floss picks, toothpicks, water flossing device, interdental brush or chewing gum during the length of the study. Written instructions on brushing and professional brushing demonstration were provided at the outset of the study and repeated at 2- and 4-weeks. Brushes or brush heads were replaced at 4 weeks. Before each visit, subjects had at least 7 hours, but no more than 12 hours of accumulated, non-brushed, undisturbed plaque/debris.

Oral cavity examination for safety assessments included evaluation of the lips, tongue, hard and soft palate, gingiva, all mucobuccal fold areas, the inner surface of the cheeks and sublingual areas, tooth surfaces and restoration surfaces. All areas were assessed and reported as normal or abnormal with an explanation of any abnormality by one of the calibrated study examiners.

Lobene Modification of the Loe & Silness Gingival Index

The study also has an extended component, up to 12 weeks, to determine the longer term effect and to see patient motivation when there is no oral hygiene instruction or supervised brushing between 4 to 12 weeks. The results for the 12 weeks, however will be analyzed as a different paper.

0 = Absence of inflammation.

1 = Mild inflammation; a slight change in color, little change in the texture of any portion of but not the entire marginal or papillary gingival unit.
2 = Mild inflammation; criteria as above but involving the entire marginal or papillary gingival unit.
3 = Moderate inflammation; glazing, redness, edema, and or hypertrophy of the marginal or papillary gingival unit.
4 = Severe inflammation; marked redness, edema and or hypertrophy of the marginal or papillary gingival unit, spontaneous bleeding, congestion, or ulceration.

Lobene Modification of Turesky Plaque Index

0 = No plaque.
1 = Separate flecks of plaque at the cervical margin of the tooth.
2 = A thin continuous band of plaque (up to 1 mm) at the cervical margin of the tooth.
3 = A band of plaque wider than one mm but covering less than one-third of the crown of the tooth.
4 = Plaque covering at least one-third but less than two-thirds of the crown of the tooth.
5 = Plaque covering two-thirds or more of the crown of the tooth.

Probing Pocket Depth

Full-mouth Probing Pocket Depth (PPD) was measured at six locations of each tooth (mesial-buccal, buccal, distal-buccal, mesial-lingual, lingual, distal-lingual) using a periodontal probe and recorded to track probing depth changes over time.

Bleeding on Probing Index

The Bleeding on Probing index (BOP) was recorded from the gingival sulci of all teeth after periodontal probing at all six locations per tooth. The presence of any bleeding within 30 seconds of gentle probing was considered a positive response and given a score of 1. Sites which did not bleed on probing were be scored as 0.

Randomization blocks

List 1: Low PI ($\leq$ 2.0) and Low GI ($\leq$ 1.33)
List 2: Low PI ($\leq$ 2.0) and Medium GI (> 1.33 to $\leq$ 2.67)
List 3: Low PI ($\leq$ 2.0) and High GI (> 2.67)
List 4: High PI (> 2.0) and Low GI ($\geq$ 1.33)
List 5: High PI (> 2.0) and Medium GI (> 1.33 to <= 2.67)
List 6: High PI (> 2.0) and High GI (> 2.67)

Examiner Calibration

Intra-examiner Reliability

Examiner	Time point	Sites	Kappa Statistics
1	Screening 2	64	0.5 for GI
2	Screening 1	464	0.4 for MGI, 0.34 for PI
3	Screening 1	464	0.5 for PI
2	Screening 2	64	0.47 for GI
1	Screening 3	72	0.49 for GI
2	Screening 3	72	0.5 for GI
3	Screening 3	72	0.42 for PI

Inter-examiner reliability for examiner 1 and 2 for gingival index was 0.37 for 64 sites at second screening.

In our study subjects with age between 18-65 yrs, routine manual toothbrush user and who agrees to use assigned toothbrush and refrain from inter-dental cleaning/ mouth rinsing. Mild to moderate gingivitis as defined by Modified Gingival index above 1.2, and/or Bleeding on probing of at least 20% but not more than 50%, probing pocket depth of 4mm or lower at least 20 natural teeth were included in our research. While current electric toothbrush user Professional prophylaxis within one month. Use of antibiotic within one month, Signs of moderate to severe periodontitis participated in oral care study in the last 90 days pregnant or lactating women, history of cardiovascular disease, diabetes, cancer, aids or organ impairment history of rheumatic fever, kidney or liver disease, and limited use of NSAIDs Current smoker (last 3 months) were excluded.

Results

Bleeding on Probing

Mean BOP (+/- SD) over Time

Time	Power Brush Mean BOP	(+/- SD)	Manual Brush Mean BOP	(+/- SD)
Baseline	22%	2%	27%	2%
2 Week	17%	1%	21%	2%
4 Week	16%	1%	19%	2%

Difference Week 2 - Baseline

Brush Type	N	Mean	Std. Dev.	Minimum	Maximum	P Value
A (Power)	26	-0.05	0.09	-0.29	0.11	0.6061
B (Manual)	23	-0.06	0.12	-0.34	0.17	

Difference Week 4 - Baseline

Brush Type	N	Mean	Std. Dev.	Minimum	Maximum	P Value
A (Power)	24	-0.05	0.08	-0.23	0.14	0.2680
B (Manual)	22	-0.08	0.10	-0.29	0.10	

Results

BOP decreased from baseline 22% to 17% at 2 weeks and 16% at 4 weeks for Power users (Group A). For Manual users (Group B), BOP decreased from baseline 27% to 21% at 2 weeks, and 19% at 4 weeks; so both groups had a reduction in BOP but there was no statistical significance for either group.

Modified Gingival Index

Brush Type	N	Mean	Std. Dev.	Std. Err.	Minimum	Maximum	P Value
A	27	-0.17	0.29	0.06	-0.84	0.51	0.6683
B	22	-0.13	0.30	0.06	-0.78	0.46	

Gingival index for Power users (Group A) decreased from 1.65 at baseline to 1.48 at 2 weeks, and 1.36 at 4 weeks; and for Manual users (Group B), Gingival Index at baseline was 1.69 and 1.56 at 2 weeks, 1.46 at 4 weeks. There was no statistical significance for either group.

Difference Week 4 - Baseline

Brush Type	N	Mean	Std. Dev.	Std. Err.	Minimum	Maximum	P Value
A	25	-0.27	0.33	0.07	-1.00	0.46	0.7211
B	21	-0.24	0.28	0.06	-0.62	0.46	

Gingival index for Power users (Group A) decreased from 1.65 at baseline to 1.48 at 2 weeks, and 1.36 at 4 weeks; and for Manual users (Group B), Gingival Index at baseline was 1.69, 1.56 at 2 weeks, and 1.46 at 4 weeks. There was no statistical significance for either group.

Plaque Index

Difference Week 2 - Baseline

Brush Type	N	Mean	Std. Dev.	Std. Err.	Minimum	Maximum	P Value
A	26	-0.3307	0.4595	0.0901	-2.0577	0.3214	0.4205
B	22	-0.2274	0.4131	0.0881	-0.8869	0.5417	

Difference Week 4 - Baseline

Brush Type	N	Mean	Std. Dev.	Std. Err.	Minimum	Maximum	P Value
A	24	-0.1985	0.4701	0.096	-1.4231	0.6667	0.4031
B	20	-0.314	0.4286	0.0958	-1.0833	0.4103	

Plaque index for Power users (Group A) at baseline was 2, and dropped to 1.6 at 2 weeks, and was 1.8 at 4 weeks. For manual brush users (Group B), was 1.93 at baseline, and dropped to 1.7 at 2 weeks, and 1.6 at 4 weeks. There was no statistical significance in plaque reduction for either brush although there was a slight downward trend over all.

For site level assessment of BOP over time, ANOVA was carried out.

Bleeding on Probing

Both Brushes showed a downward trend from baseline to 4 weeks, but there was no statistical significance in any of the measures. In both groups there was, however, a statistically significant reduction in BOP at facial sites compared to proximal sites over four weeks.

Discussion

Lazarescu et al. [6] evaluated habitual plaque levels and removal of 24 hours undisturbed plaque by supervised brushing for 3 minutes at baseline, 3 weeks, 6 weeks, 12 weeks and 18 weeks. They found a significant reduction in habitual plaque in the manual brushes starting from 3 weeks whereas, for the electric toothbrush users, a significant reduction was not found until 12 weeks. This suggests that subjects more easily trained on the manual brush compared to the electric brush.

Heasman et al. [7] showed that difference in plaque index reduction achieved statistical significance at interproximal surfaces for powered brushes at 6 weeks. They found a significant reduction in plaque index at interproximal sites at 6 weeks and did not find a significant difference from baseline for the gingival index.

Jain et al. [8] compared a manual to the oscillating-rotating power brush after providing instructions to dental students, and found there was a significant reduction in the gingival index at 2 weeks in power brush group which is in contrast to our current study. Together these observations may suggest that with the general population there is a learning curve associated with the oscillating-rotating power brushes.

In an 8 month study, Van der Weijden [9] compared an oscillating rotating toothbrush to a manual toothbrush for reductions in plaque and gingivitis in a college population. The subjects in both groups were given timers and written instructions. After 4 weeks they received toothbrush specific professional instruction by a hygienist. By five months and eight months, they showed significant reductions in Plaque and Gingival indices for both groups. These data suggest that when subjects are well trained it may be difficult to see clear differences in the efficacy of a well-used manual brush and a oscillating-rotating toothbrush. In our short term study this is the most striking observation we can make. It will be interesting to see if after and additional 8 weeks with no further intervention if both brushes continue to show similar measures of inflammation and plaque levels.

The Hawthorne effect also must be taken into consideration in a short term study such as presented in this clinical because both groups of subjects had very explicit instructions at every visit. This effect likely contributed to the reduction in gingivitis for both the groups at both two and four weeks.

Conclusion

Both groups demonstrated a reduction in signs of gingivitis (BOP and GI) in this non-flossing population after being repeatedly trained in toothbrush use over a 4-week period. Both toothbrushes were equally effective in reducing overnight plaque as a single use exercise after initial professional training. Both brushes appeared to be safe in this short term trial. The 12 week data will need to be evaluated to determine if a longer duration of use is helpful in discriminating the effects of either brush in reducing plaque and/ or gingivitis.

References

1. Costerton, J.W., Lewandowski, Z., DeBeer, D., Caldwell, D., Korber, D., & James, G. (1994). Biofilms, the customized microniche. Journal of Bacteriology, 176(8), 2137–2142.
2. Aas, J.A., Paster, B.J., Stokes, L.N., Olsen, I., & Dewhirst, F.E. (2005). Defining the normal bacterial flora of the oral cavity. Journal of Clinical Microbiology, 43(11), 5721–5732.
3. Saxer, U.P & Yankell, S.L. (1997). Impact of improved toothbrushes on dental diseases. I. Quintessence International, 28(8), 513–525.
4. Ash, M.M. (1964). A Review of the Problems and Results of Studies on Manual and Power Toothbrushes.
5. Leah, S.C., Landini, G., Walmsely, A.D. (2004). A novel method for the evaluation of powered tooth brush oscillation characteristics. Am J Dent, 17(5), 307–309.
6. Lazarescu, D., Boccaneala, S., Illiescu,A., De Boever J.A. (2003). Efficacy of plaque removal and learning effect of a powered and a manual tooth brush. Journal of Clinical Periodontology, 30(8), 726–731.
7. Heasman, P.A., Stacey, F., Heasman, L., Sellers, P., Macgregor, I.D., Kelly, P.J. (1999). A comparative study of the Philips HP 735, Braun/Oral B D7 and the Oral B 35 Advantage toothbrushes. Journal of Clinical Periodontology, 26(2), 85–90.
8. Jain Y. (2013). A comparison of the efficacy of powered and manual toothbrushes in controlling plaque and gingivitis: A clinical study. Clinical, Cosmetic and Investigational Dentistry, 5, 3–9.
9. Van der Weijden, G.A., Timmerman, M.F., Reijerse, E., Danser, M.M., Mantel, M.S., Nijboer, A., Van der Velden, U. (1994). The long-term effect of an oscillating/rotating electric toothbrush on gingivitis. An 8-month clinical study. Journal of Clinical Periodontology, 21(2), 139–145.