Original Research

Efficacy of Manual Toothbrushes and Powered Toothbrushes in Gingivitis: A Comparative Study

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***ABSTRACT*:**
Introduction: Mechanical plaque removal with a manual toothbrush remains the primary method of maintaining oral hygiene for most of the population. However, powered brushes continued to be recommended for the handicapped and for persons with reduced manual dexterity. **Materials & Methods:** The study was a single-blinded parallel arm randomized controlled interventional trial. Forty-six male and female subjects with gingivitis (32 female and 16 males) with a mean age of 26 years were enrolled but only 44 completed 4-week visit. The subjects were assigned to either of the two different groups (powered brush and manual brush). The test group was assigned to a new power toothbrush while the control group was assigned manual flat trim soft bristle toothbrush for the duration of the 4-week home use trial. Written instructions on brushing and professional brushing demonstration were provided at the outset of the study and repeated at 2- and 4-weeks. Before each visit, subjects had at least 7 hours, but no more than 12 hours of accumulated, non-brushed, undisturbed plaque/debris. **Results:** The site level reduction was statistically significant in both Manual (Group B) and Powered brush (Group A for facial sites compared to interproximal sites in percentage BOP (bleeding on probing), MGI (modified gingival index), and PI (plaque index). In group B more reduction in BOP was seen at 2 weeks inter-proximally compared to facial sites whereas the reduction in both facial and interproximal aspects is similar in Group A. At 4 weeks BOP in both groups A and B was significantly reduced in facial sites compared to proximal sites. The patient level analysis showed a trend toward reductions in signs of gingivitis over this short time frame but did not show any statistically significant reductions in % BOP, MGI, or PI. **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 tooth brushes were equally effective in reducing overnight plaque as a single use exercise after initial professional training. In the short term, subjects well-trained in the use of either an oscillating-rotating power brush or a manual toothbrush can demonstrate reductions in plaque and gingivitis, but the reductions were not statistically significant.
Keywords: Toothbrush, Powered toothbrush, Comparative analysis, Bleeding on probing, Modified gingival index, Plaque index.

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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.

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 (3). 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.

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 manual brush. The primary objective of this study is to evaluate the efficacy of powered toothbrush on gingivitis reduction compared to a manual toothbrush. Secondary objectives of this study are to evaluate the effectiveness of plaque removal.

MATERIALS & METHODS:

The study was a single-blind, parallel arm, randomized, controlled interventional trial. Forty-six (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. 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 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.

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.

RESULTS:

Table 1 shows the distribution of the study participants.

Table 1: Distribution of study participants under Group A and Group B:

	Group A (Power brush users)	Group B (Manual brush users)
Number of subjects	24	22
Number of females	18	14
Number of males	6	8
Average age (years)	26.7	25.5

Gingivitis measures over time were assessed using mean BOP and MGI scores. For patient-level analysis T-tests were conducted.

Table 2 shows the Mean Bleeding on Probing (BOP) over time.

Table 2: 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%

Table 3 shows difference in BOP between Week 2 –Baseline.

Table 3: Difference in BOP between Week 2 –Baseline

Brush type	N	Mean	Std Dev	Minimum	Maximum	P value
Power	26	-0.05	0.09	-0.29	0.11	0.6061
Manual	23	-0.06	0.12	-0.34	0.17	

Table 4 shows difference in BOP between Week 4 –Baseline.

Table 4: Difference in BOP between 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	

Figure 1 shows the change in Bleeding on Probing (BOP) over time.

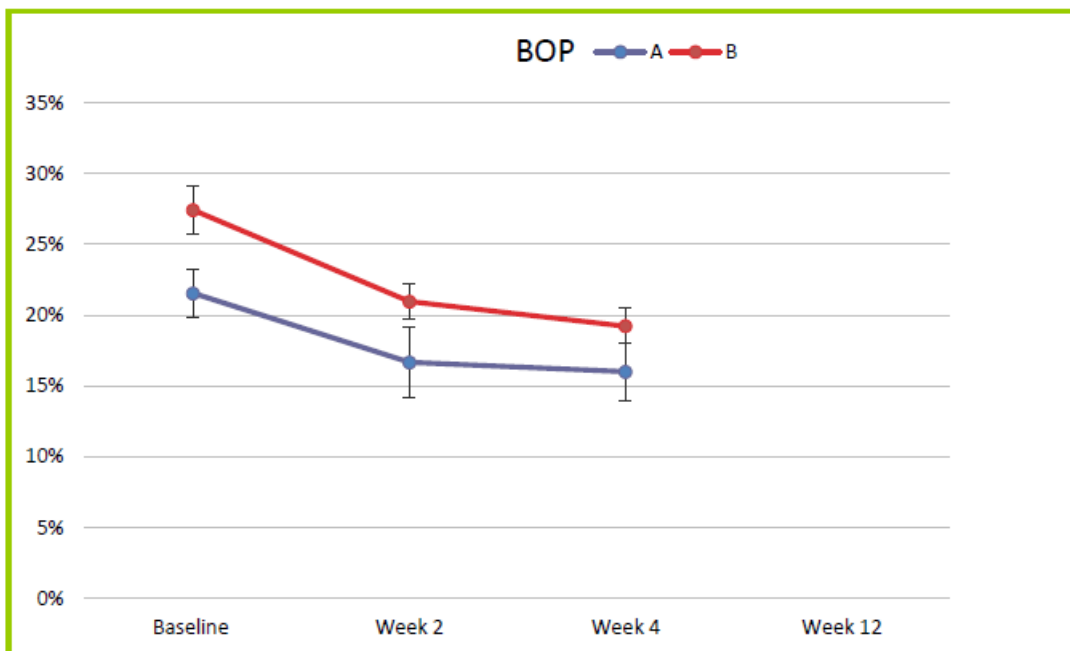**Figure 1: Bleeding on Probing Change over Time**

Table 5 shows difference in Modified Gingival Index (MGI) between Week 2 –Baseline.

Table 5: Difference in MGI between week 2 –Baseline

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	

Table 6 shows difference in Modified Gingival Index (MGI) between Week 4 –Baseline.

Table 6: Difference in MGI between 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	

Figure 2 shows the change in Modified Gingival Index (MGI) over time.

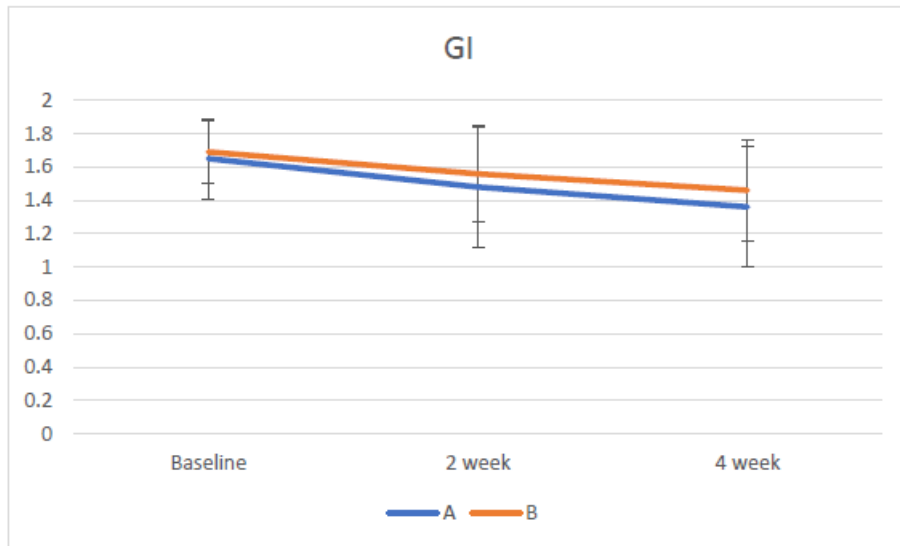**Figure 2: Modified Gingival Index over time**

Table 7 shows difference in Plaque Index (PI) between Week 2 –Baseline.

Table 7: Difference in PI between 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	

Table 8 shows difference in Plaque Index (PI) between Week 4 –Baseline.

Table 8: Difference in PI between 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	

Figure 3 shows the change in Plaque Index (PI) over time.

Figure 3: Change in PI over time
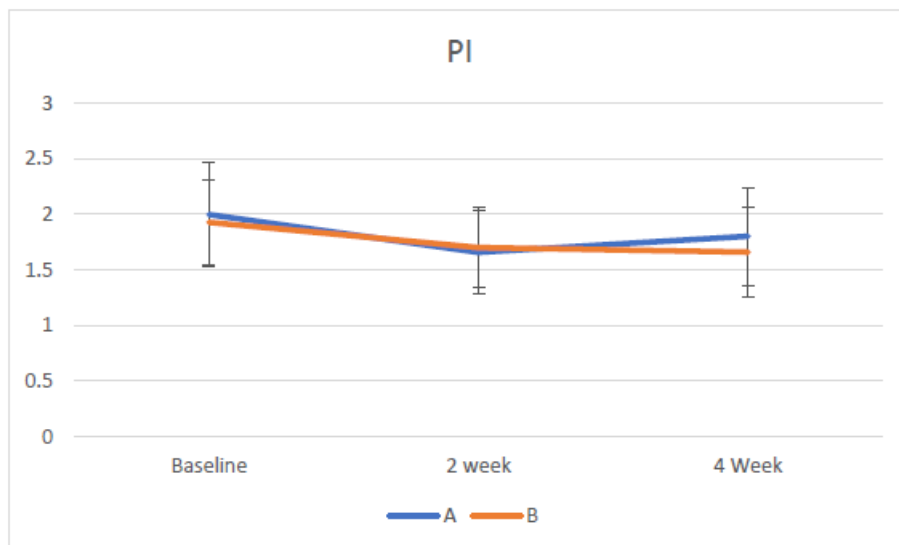
Patient-level analysis

BOP decreased from baseline 22% to 17% at 2weeks and up to 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. 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) baseline is 1.69 and 1.56 at 2 weeks, 1.46 at 4 weeks. There was no statistical significance for either group. Plaque index for Power Users (Group A) at baseline was 2.0, and 1.6 at 2 weeks and 1.8 at 4 weeks, showing a slight increase from a 2-4 week, for Manual Users (Group B) 1.93 at baseline and 1.7 at 2 weeks and 1.6 at 4 weeks. There was again no statistical significance in plaque reduction for either group.

DISCUSSION:

Lazarescu and co-workers (4) 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 (5) 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 (6) 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 (7) 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.

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