

# Efficacy of manual and powered toothbrush in reduction of plaque and gingivitis – A randomized control trial

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## Abstract

**Aim:** To assess the efficacy of power toothbrush and manual toothbrush in reduction of plaque and gingivitis.

**Materials and methods:** A randomized single blind, cross over study was conducted for a period of 7 months to assess the efficacy of manual and powered toothbrush in reduction of plaque and gingivitis. The study population were randomized and allocated to the power toothbrush (PT) and manual toothbrush (MT) groups respectively. The subjects were assessed for plaque and gingival scores using Plaque index (PI) given by and Gingival index (GI). Paired t test and Independent Sample t test were used to analyze the data.

**Results:** In the present study, of the 84 subjects, 76 were females and 08 were males. Comparison between subjects on power toothbrush and manual toothbrush showed a significant ( $p < 0.05$ ) reduction in plaque and gingival scores from baseline to 3 months. ( $p < 0.05$ ). Post Washout period of 1 month, Cross Over was carried out, Interestingly, Comparison between subjects on power toothbrush and manual toothbrush showed no significant ( $p > 0.05$ ) reduction in plaque and gingival scores from baseline to 3 months.

**Conclusion:** Subjects in both the groups showed reduction in plaque and gingival scores. However, a comparison of the mean differences within the groups, from baseline to post brushing, revealed that the Oral B Cross Action power tooth brush was superior in reduction of plaque and gingival scores than the Oral B Ultra Clean manual toothbrush.

**Key words:** Manual Toothbrush, Power Toothbrush, Plaque, Gingivitis, Randomized control trial

## INTRODUCTION:

Maintenance of oral hygiene has been an objective of man since dawn of civilization. The chewing stick became the tooth brush, via tooth cleaning attempts with sponge and rubbing cloths. Most historians trace the development of the first toothbrushes (hog bristles set in ox bone) to 1498 C.E in China, although there is evidence that the Chinese used ivory brush handles and bristles made of hair from a horse's mane as early as 1000 C.E. The Bristle brush was reinvented in the late 18<sup>th</sup> and early 19<sup>th</sup> century. In the first part of the 20<sup>th</sup> century in the United States, a family tooth brush was common tooth cleansing aid. In the late 1930's, nylon filaments began to replace natural bristles, and wood and plastic replaced bone handles [1, 2].

During the past 30 years oral hygiene has improved, and in industrialized countries 80% to 90% of the population brushes their teeth 1 or 2 times a day [1, 3]. Since the experimental gingivitis study by Loe et al (1965), thorough plaque control has been considered an essential factor in the prevention and treatment of gingival and periodontal diseases [4, 5].

Mechanical plaque removal with a manual toothbrush remains the primary method of maintaining good oral hygiene for the majority 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, and as early as 1855 the Swedish clockmaker Frederick Wilhelm Tomberg patented a mechanical toothbrush. The first electric toothbrushes came much later, and were first introduced in the 1960's., over time such devices have

become established as a valuable alternative to manual methods of tooth brushing [1].

Attempts have been made to determine differences in tooth cleaning ability (plaque removal) between electric toothbrushes and hand toothbrushes. Consistent significant differences have not been demonstrated. Occasional discrepancies in plaque and gingivitis improvement have been noted in small, short-term clinical studies [6]. Several toothbrushes both manual and powered claiming to be effective in plaque removal are promoted and sold in market. Studies conducted over the years to compare manual and powered toothbrush have shown results that array from claiming manual toothbrush as superior in comparison to powered toothbrush and vice versa, some studies have gone on to show no difference between the two. Hence aim of the study was to assess the efficacy of power toothbrush and manual toothbrush in the reduction of plaque and gingivitis. The efficacy was assessed under the following objectives 1) To collect the baseline data of plaque and gingival status of the study subjects using plaque index given by Silness J and Loe H and gingival index given by Loe H and Silness J. 2) To know the efficacy of power brush and manual brush in the reduction of plaque from baseline using plaque index given by Silness J and Loe H and reduction of gingivitis from baseline using gingival index given by Loe H and Silness J. 3) To compare the efficacy of powered and manual toothbrush in the reduction of plaque and gingivitis.

## MATERIALS AND METHODS:

A randomized, single blind, cross-over study was conducted to assess the efficacy of manual and powered toothbrush in reduction of plaque and gingivitis. The study

protocol was reviewed and ethical clearance was provided by the "Ethical Committee" of Yenopoya University, Mangalore.

#### Study population:

The study population consisted of 86 school teachers from the 5 private schools, these schools are adopted by the Department of Public Health Dentistry, Yenopoya Dental College, Mangalore. All the 86 school teachers who participated in the study met the following inclusion and exclusion criteria. Inclusion criteria included subjects consenting to participate in the study who were aged between 20 to 60 years and with a minimum of 18 score able teeth (not including third molars, teeth with orthodontic appliances, bridges, crowns or implants. Subjects with any physical limitations that might preclude normal oral hygiene procedures (i.e tooth brushing etc), evidence of major hard and soft tissue lesions or trauma at baseline, any history of allergy to toothpaste, subjects under medication with drugs such as anti-inflammatory, antiepileptic and anti-hypertensive, medically compromised patients (systemic diseases such as diabetes, heart disease etc) were excluded from the study, currently or have recently (within the last 30 days) participated in any other oral hygiene clinical study and subjects consuming tobacco in any form.

#### Study design

Among the 86 school teachers who participated in the study 43 each were allocated randomly by lottery method in to the power tooth brush (A) and manual toothbrush (B) groups respectively.

**Visit 1:** Baseline data was collected, the subjects were assessed for plaque and gingival scores using Plaque index (PI) given by Silness J and Loe H (1964) and Gingival index (GI) given by Loe H and Silness J (1963). The subjects were instructed to brush their teeth twice daily for 2 to 3 minutes each with the standard toothpaste (Colgate, strong teeth) and toothbrush (Oral B Cross Action power brush oral B Ultra Clean manual brush) provided by the investigator.

**Visit 2:** After 3 months visit was paid to the school. Assessment of plaque and gingival scores were done during the visit. Toothpastes were supplied; queries by the subjects were answered. This was followed by a washout period of 1 month the subjects were instructed to return to their usual oral hygiene practices.

**Visit 3:** Post washout period plaque and gingival scores were recorded cross over design was carried out so as to make each subject serve as his or her own control. Those who were on power brush for the first 3 months of the study were given the manual brush, and vice versa. Visit 4: at the end of 7 months study period plaque and gingival scores were recorded

#### Training and calibration of the examiner:

The clinical examination of all the subjects was done by a single investigator. Before commencing with the study, the investigator examined 10 subjects in Department of Public Health Dentistry, Yenopoya Dental College, Mangalore, under the guidance of Professor and Guide, for calibration

and to intra examiner variability. The results so obtained were subjected to Kappa statistics. The Kappa Co-efficient was found to be 0.8.

#### Clinical examination:

Type III clinical examination as recommended by American Dental Association was followed throughout the study.

#### Method of statistical Analysis:

Data was entered in Microsoft Excel sheet and analyzed using SPSS package (Version 18: Raleigh, NC, USA). Paired t test, Independent sample t test analysis was carried

### RESULTS

At the end of the study period, 84 subjects remained, two having withdrawn because of noncompliance. Of the 84 subjects, 76 were females and 08 were males with the mean age of  $33 \pm 0.8$  years.

Comparison between the Power toothbrush (Group A) and Manual toothbrush (Group B) at baseline, showed the mean baseline plaque scores were  $0.70 \pm 0.20$  and  $0.82 \pm 0.22$  for group A and Group B respectively. The mean plaque scores at baseline showed statistical significance ( $p=0.026$ ). The mean gingival scores at baseline were  $0.68 \pm 0.26$  and  $0.79 \pm 0.36$  for Group A and Group B respectively. The mean gingival scores at baseline showed no statistical significance. Interestingly, both the groups improved on their plaque and gingival scores at subsequent observation after 3 months, plaque scores compared between the groups showed statistical significance ( $p<0.0005$ ). The mean plaque score for the power brush group (Group A) was  $0.53 \pm 0.18$  were as the manual brush group had a mean plaque score of  $0.75 \pm 0.21$ . Similarly, gingival scores compared between the groups showed statistical significance ( $p<0.05$ ). The mean gingival score for the power toothbrush (Group A) was  $0.51 \pm 0.19$  were as the manual toothbrush group (Group B) had a mean gingival score of  $0.71 \pm 0.29$  (Table 1).

When comparison of plaque and gingival scores within the power brush (Group A) and Manual brush (Group B) was done, subjects on power brush (Group A) showed a significant reduction in plaque scores (mean difference =  $-0.18$ ) ( $p<0.05$ ) and gingival scores (mean difference =  $-0.17$ ) ( $P<0.05$ ) respectively, from baseline to 3 months. Similarly subjects on manual brush (Group B) showed a significant reduction in plaque scores (Mean diff =  $0.07$ ) ( $p<0.05$ ) and gingival scores (Mean difference =  $0.07$ ) ( $p<0.05$ ) from baseline to 3 months (Table 2). When these mean differences are compared higher reduction of plaque and gingival scores is observed in the power brush group (Group A) (Table 2).

Post wash out period, cross over was carried out, baseline and 3 months scores were compared within the groups as well as between the groups. Comparison of plaque scores from baseline to 3 months in Power brush (Group B<sup>1</sup>) and manual brush (Group A<sup>1</sup>) showed that the subjects on power brush (Group B<sup>1</sup>) had significant reduction in

plaque scores ( mean diff = 0.17) ( $p < 0.05$ ). Similarly subjects on manual brush (Group A<sup>1</sup>) showed a significant reduction in plaque scores (mean difference = 0.04), ( $p < 0.05$ ) (Table 3).

Comparison of gingival scores from baseline to 3 months in Power brush (Group B<sup>1</sup>) and manual brush (Group A<sup>1</sup>) showed that the subjects on power brush (Group B<sup>1</sup>) had significant reduction in gingival scores (Mean difference = 0.17) ( $p < 0.05$ ). Similarly subjects on manual brush (Group A<sup>1</sup>) showed a significant reduction in plaque scores (Mean difference=0.04) ( $p < 0.0005$ ) (Table 4). When these mean differences are compared higher reduction of plaque and gingival scores is observed in the power brush group (Group B<sup>1</sup>) (Table4).

Comparison of plaque and gingival scores between power brush (Group B<sup>1</sup>) and manual brush (Group A<sup>1</sup>) at baseline and 3 months showed that, the mean plaque scores at baseline was  $0.64 \pm 0.18$  and  $0.79 \pm 0.23$  for Group A and

Group B respectively. The mean plaque scores at baseline showed statistical significance ( $p = 0.002$ ). The mean gingival score at baseline was  $0.60 \pm 0.22$  and  $0.78 \pm 0.33$  for Group A and Group B respectively. The mean gingival scores at baseline showed statistical significance ( $p = 0.008$ ). Both the groups improved their plaque and gingival scores at subsequent observation after 3 months. Interestingly, plaque scores compared between the groups showed no statistical significance ( $p > 0.05$ ). The mean plaque score for the power brush group (Group B<sup>1</sup>) was  $0.62 \pm 0.18$  were as the manual brush group (Group A<sup>1</sup>) had a mean plaque score of  $0.60 \pm 0.17$ . Gingival scores compared between the groups showed no statistical significance ( $p > 0.05$ ). The mean gingival score for the power brush group (Group B<sup>1</sup>) was  $0.61 \pm 0.26$  were as the manual brush group (Group A<sup>1</sup>) had a mean gingival score of  $0.56 \pm 0.19$  (Table 5).

**Table 1: Comparison of plaque and gingival scores between power brush (group A) and manual brush (group B) at baseline and 3 months**

Group	N	Mean	Std. Deviation	P
PI-SCORE Baseline Group A	42	0.7179	0.20338	0.026
Group B	42	0.8248	0.22855	
GI-SCORE baseline Group A	42	0.6819	0.26472	0.101
Group B	42	0.7964	0.36020	
PI-SCORE 3months Group A	42	0.5371	0.18701	<0.05
Group B	42	0.7595	0.21926	
GI-SCORE 3months Group A	42	0.5129	0.19203	<0.05
Group B	42	0.7186	0.29174	

**Table 2: Comparison of plaque and gingival scores within power brush (group A) and manual brush (group B) at baseline and 3 months**

	N	Mean	Std. Deviation	P
Group A PI-SCORE Baseline	42	0.71	0.20	<0.05
PI-SCORE 3months	42	0.53	0.18	
Group B GI-SCORE baseline	42	0.68	0.26	<0.05
GI-SCORE 3months	42	0.51	0.19	
Group B PI-SCORE Baseline	42	0.82	0.22	<0.05
PI-SCORE 3months	42	0.75	0.21	
Group B GI-SCORE baseline	42	0.79	0.36	<0.05
GI SCORE 3 months	42	0.71	0.291	

**Table 3: Comparison of plaque scores within power brush (group B') and manual brush (group A') at baseline and 3 months post wash out and crossover**

	N	Mean	Std. Deviation	P
PI-SCORE - Group A baseline	42	0.64	0.18	<0.05
PI SCORE Group A' 3months	42	0.60	0.17	
PI-SCORE Group B baseline	42	0.79	0.23	<0.05
PI-SCORE Group B ' 3months	42	0.62	0.18	

**Table 4: Comparison of gingival scores within power brush (group B') and manual brush (group A') at baseline and 3 months - post wash out and crossover**

	N	Mean	Std. Deviation	P
GI-SCORE - Group A baseline	42	0.60	0.22	<.0005
GI SCORE Group A' 3mths	42	0.56	0.19	
GI-SCORE Group B baseline	42	0.78	0.33	<.0005
GI-SCORE Group B ' 3months	42	0.61	0.26	

**Table 5: Comparison of plaque and gingival scores between power brush (group B') and manual brush (group A') at baseline and 3 months - post wash out and crossover**

Group	N	Mean	Std. Deviation	P
PI-SCORE- Baseline Group A	42	0.64	0.18	0.002
Group B	42	0.79	0.23	
GI-SCORE - Baseline Group A	42	0.60	0.22	0.008
Group B	42	0.78	0.33	
PI SCORE 3mths Group B'	42	0.62	0.18	0.592
Group A'	42	0.60	0.17	
GI SCORE 3mths Group B'	42	0.61	0.26	0.389
Group A'	42	0.56	0.19	

**DISCUSSION:**

In the year 1885 Swedish watch maker Fredrick Wilhelm Tom berg was credited with designing the first mechanical tooth brush. New models of powered toothbrushes continue to be developed and marketed and it is important that such devices are assessed, and compared to established powered and manual toothbrushes in independent, controlled clinical trials (Hansen et al 1999) [7]. The tests were conducted under a variety of conditions, and the results often conflicted [8]. During 1986, an international workshop on oral hygiene did not conclude that up to that time powered nor did manual toothbrushes remove significantly more plaque regardless of the brushing method [3].

In the present study a randomized control trial was conducted for a period of 7 months to assess the efficacy of Oral B Cross Action powered toothbrush and Oral B Classic Ultra Clean manual toothbrush in reduction of plaque and gingivitis. Long term studies are generally accepted as necessary for evaluation of any treatment of plaque and gingivitis [9].

Results of the present study demonstrated that the electric tooth brush tested was superior, in controlling plaque and gingivitis compared to a manual tooth brush. The results are in accordance with earlier studies by Terezhalmly, Soparkear and Lobene, in which no professional instruction in oral hygiene was given [10, 11, 12].

It is reasonable to assume that some studies which failed to show difference of efficacy between manual and electric toothbrushes actually through instruction, motivation (Rainey and Ash, Glavind and Zeuner, Walsh et al) and selection of participants e.g dental students as in studies by (Walsh and Glen Wright, Van der Wijden et al, Ainamo et al) eliminated a difference which might well be present in ordinary daily life [13, 14, 15, 16, 17, 18]. Hence in this study specific target group i.e school teachers were chosen as the study participants.

The size of the study population as well as the duration of the study has a significant effect on results; hence for the present study ADA guidelines for sample size and duration of study for a tooth brush trial was followed [19].

In the present study the duration of tooth brushing was standardized by instructing the patients to brush for 2 minutes as suggested by Walsh and Glenwright, Baab and Johnson [16,20]. According to Hawkin et al 1986, the duration of tooth brushing has almost linear monotonic effect on the plaque reduction. Therefore, if in the

evaluation of the plaque removing efficacy, the brushing time is not standardized, the brushing time will vary between subjects [21]. As a consequence possible differences between brushes may be obscured. Our results are consistent with those of previous short and long term studies which have found powered toothbrushes to be more effective in removing plaque than manual brushes Van der Weijden, Terezhalmly et al, Quirynen et al, Stolze and Bay [4, 10, 22, 23].

In the present study plaque index described by Silness J and Loe H (1964) was used to record plaque levels as in studies conducted by Vander Weijden, Walsh and Glen Wright et al [4,16, 24]. Results demonstrated a significant reduction of plaque score from baseline to the end of 3 months for both powered toothbrush (Group A) (mean difference = 0.18) and manual tooth brush (Group B) (mean difference=0.7). A positive change in the behavior of a subject as a result of special attention and status received from participation in an investigation (the "Hawthorne effect") is often observed Robertson et al 1989 [9, 23]. These facts may explain the possible effect of the manual toothbrush (Group B) in reducing the plaque. Plaque scores compared between the powered brush group (Group A) and the manual brush group (Group B) showed statistical significance with means of  $0.53\pm 0.18$  and  $0.75\pm 0.21$  respectively.

Interestingly post cross over though there was reduction in plaque scores from baseline (3 months) within the power toothbrush group (B<sup>1</sup>) (mean difference =0.17) and manual tooth brush group (A<sup>1</sup>) (mean difference =0.4), the plaque scores did not show statistical significance between the groups ( $p>0.05$ ). The possible explanation for this would be due to the carry over effect, indicating that the plaque reduction score for a given treatment was influenced by the treatment that came immediately before. The carry over effect was not estimated in the present study.

In the present study gingival index described by Loe H and Silness J (1963) was used to record the gingival scores as in studies conducted by Walsh M et al, Stolze and Bay, Terezhalmly et al [15, 23, 25]. Results showed a similar trend in the gingival scores too. There was a significant reduction of gingival scores from baseline to the end of 3 months for powered tooth brush (Group A) (mean difference = 0.17) and manual tooth brush (Group B) (mean difference = 0.09). The reduction of gingival scores from baseline to 3 months in the manual group too can be attributed for the possible "Hawthorne effect". Gingival

scores compared between the powered tooth brush group (Group A) and the manual tooth brush group (Group B) showed statistical significance with means of  $0.51 \pm 0.19$  and  $0.71 \pm 0.29$  respectively.

Interestingly, post cross over though there was a reduction in gingival scores from base line to 3 months within the power tooth brush (group B<sup>1</sup>) (mean difference=0.17) and manual tooth brush (group A<sup>1</sup>) (mean difference =0.04). The gingival scores did not show statistical significance between the groups ( $p > 0.05$ ). The 'carry over' effect as observed in plaque scores too, may be the possible reason behind such result. It was evident in the present study that plaque and gingival scores of subjects improved significantly in both the groups, but a comparison of mean differences showed power toothbrush was more effective in reduction of plaque and gingivitis. One drawback of the cross over design is the carry over effect which is seen in the treatment groups, this is evident in our study since post crossover comparison between the power toothbrush group and manual toothbrush group showed no significance.

#### CONCLUSION:

A randomized, controlled, cross over trial was conducted for a period of 7 months, to assess the efficacy of Power toothbrush (PT) and Manual toothbrush (MT) in the reduction of plaque and gingivitis. Subjects in both the groups showed a significant reduction in plaque and gingival scores. However, a comparison of the mean differences within the groups, from baseline to post brushing, revealed that the Oral B Cross Action power tooth brush was superior in reduction of plaque and gingival scores than the Oral B Ultra Clean manual tooth brush. Cross over effect needs to be assessed along with longer wash out period while considering future research on the topic, to conclusively indicate superiority among the two tooth brushes.

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