



ORAL HYGIENE EFFICACY USING MANUAL, CUSTOMISED MANUAL AND ELECTRONIC TOOTH BRUSH IN VISUALLY IMPAIRED CHILDREN - A COMPARATIVE STUDY

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ABSTRACT

Aims: The aim of the study is to compare the efficacy of three toothbrushes (electric tooth brush, manual, customized manual) in visually impaired children. Further to evaluate the oral hygiene effectiveness using customised manual tooth brush in comparison to electric tooth brush.

Materials and Methods: 60 visually impaired children of age 6-15 years from a professional education centre were included in the study. 60 samples are then divided into 3 groups of 20 participants each (**Group A:** Electronic tooth brush, **Group B:** Manual tooth brush and **Group C:** Customised manual tooth brush). Instructions for brushing were provided to the children using Braille script. The assessment of oral hygiene status was done using Quigley Hein plaque index (QHI) and Løe-Silness gingival index at 1 week, 3 week and 6 week interval.

Results: Electronic tooth brush showed greater reduction in plaque score and gingival score from base line to 6 weeks which was statistically significant. Electronic tooth brush had plaque score of 0.4 at end of 6 weeks less than 1 which is considered to be good. Similarly customized manual plaquescore at 6 weeks was 1.5 which is more than 1. But by manual method plaque score at 6 weeks was 3.2 which is much more than 1.

Conclusion: In the present study, plaque removal efficacy of electronic tooth brush was superior followed by customized manual tooth brush. Manual tooth brushes showed slightest plaque removing efficacy. Gingival scores were reduced to greater level in electronic and customized manual than compared to manual tooth brush. However, extensive long term studies should be carried out to evaluate the usefulness of these brushes on continuation of oral hygiene.

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INTRODUCTION

The oral health of disabled people may be neglected because of a focus on their disabling condition, other major disease(s) or limited access to oral health care. It has been reported that "dental treatment is the greatest unattended health need of the disabled".¹

The patients handicapped by defective vision presents a special challenge to the dental health care team. Providing comprehensive dental care for the visually impaired children is not only rewarding but also a community service that health care providers are obligated to fulfil.²

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Visual impairment is one of the most frequently occurring disabilities and oral hygiene is not adequately maintained. Older studies have clearly stated that manual brushing is not effective to maintain oral hygiene in blind children.²

The mechanical method is the most widely accepted method of plaque control. Unfortunately, effective mechanical methods of plaque control are relatively tedious, time-consuming and, for many individuals like blind children, difficult to master. Studies have suggested that an average person removes only about 50% of the plaque present on teeth.³

Currently, powered toothbrushes have oscillating and rotating motions. Literature seems to indicate that electric toothbrushes are superior to manual brushes in terms of removing plaque and improving gingival health. However few studies showed a

continuing controversy about whether it is more effective than a manual toothbrush or equally effective.³

In the present study manual tooth brush (customized manual) will be modified to make it cost effective and to take advantage of tactile sensation and evaluate its efficacy. Thus the aim of the study is to compare the efficacy of three toothbrushes (electric tooth brush, manual, customized manual) in visually impaired children. Further to evaluate the oral hygiene effectiveness using customised manual tooth brush in comparison to electric tooth brush.

MATERIAL AND METHODS

Subjects

60 visually impaired children of age 6-15 years from a professional education centre were included in the study. 60 samples are then divided into 3 groups of 20 participants each. Three different colour chits (20 yellow, 20 red, 20 green) were put in a box and children were randomly asked to pick the chit. Chit yellow were grouped under Group A. Chit Red were grouped under group B. Chit green were grouped under Group C.

Group A: Electronic tooth brush (JSB: brush head made of Dupont nylon, changeable head, oscillates at 6000 circles per minute)

Group B: Manual tooth brush. (Quest soft bristle brush)

Group C: Customised manual tooth brush (Quest soft bristle brush) where the handles of tooth brush were modified by acrylic finger holding handle for ease to orient the brush and use.

Inclusion criteria

We chose an institutionalised school for Blind. The reason for this was to eliminate other confounding factors that would alter the results of study. All children in age of 6-15 years who had similar healthy diet with understanding verbal command were selected. All were asked to brush with paste given by us and to avoid any other hygiene. Importantly it was easy to monitor their brushing as there was personal instructor who was taking care of them (if the children were at home that brushing may not be monitored).

Exclusion criteria

- Poor manual dexterity
- Use of drugs that could affect the state of the gingival tissues
- Current orthodontic therapy
- Muco-gingival problems
- Five or more carious teeth requiring immediate treatment
- Use of any other supplemental plaque control measures, such as interdental cleansing aids or mouthwashes.
- Abscessed teeth/major treatment
- Children with systemic illness.
- Children taking antibiotics/recurrent infections.

Study protocol

A proforma was prepared for the study, so as to have a systematic and methodical recording of all observations and information. The subjects were informed about the study, and

their consent to take part in the study was obtained in a prescribed form and study was approved by institutional ethical committee.

To obtain a plaque-free condition at baseline, professional tooth cleaning was performed on all participants. Other standardisation was also done to eliminate confounding factors. Colgate tooth paste was given for all children and was refrained from using any other oral hygiene aids like dental floss or mouthwash; all the children were taking institutionalised healthy diet. Baseline readings were taken after two week after professional tooth cleaning.

Instructions for brushing were provided to the children using Braille script. The assessment of oral hygiene status was done using Quigley Hein plaque index (QHI) and Løe-Silnessgingival index at 1 week, 3 week and 6 week interval.

Quigley Hein plaque index was measured after application of disclosing agent. All teeth (deciduous and permanent present in individual were scored and divided by number of surface present). Gingival index was evaluated on index tooth 16,12,24,36, 32, 44 (Analogous deciduous tooth or adjacent tooth were considered if the index tooth was not present. Ex-16 was not fully erupted 55 was taken, 12→52, 24→64, 36→75, 32→72, 44→84).

Evaluation and indices were recorded by single blinded examiner. Examiner was trained for recording of indices (Examiner recorded indices for normal children visiting the Dept of Pedodontics).

Statistical analysis

Data was analyzed using SPSS v16.0 software package. Descriptive statistics such as mean, standard deviation, and percentage were used. Association was evaluated using Post-hoc Tukey's test and ANOVA. Any *p* value less than 0.05 was considered as significant.

RESULTS

Mean plaque score at baseline in group A was 4.48 which were higher as compared to plaque score at 1 week (1.79), 3 week (1.65) & 6 weeks (0.40). Repeated measures ANOVA test revealed statistically significant reduction in plaque scores from baseline to 6 weeks (*p*<0.001). Post-hoc Tukey's test showed significant reduction in plaque scores at all time points except between 1 week & 3 weeks (Table 1).

Table 1 Comparison of Plaque scores at follow-up visits in Group A

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Plaque score at baseline	4.4800	0.26675	<0.001	BL>(1wk=3wk)>6wk
plaque score at 1wk	1.7950	0.20894		
plaque score at 3wk	1.6500	0.22361		
plaque score at 6wk	.4050	0.26453		

* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Mean Gingival score at baseline was 2.75 which were higher as compared to score at 1 week (1.7), 3 week (1.1) and 6 week (0.4). There was statistically significant reduction in plaque score from baseline to 6 weeks (Table 2).

Table 2 Comparison of Gingival scores at follow-up visits in Group A

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Gingival score at baseline	2.7550	0.19050		BL>1wk>3wk>6wk
Gingival score at 1wk	1.7000	0.00000	<0.001	
Gingival score at 3wk	1.1100	0.19708		
Gingival score at 6wk	.4650	0.27582		

* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Mean Plaque score at baseline was 4.46 which were higher as compared to score at 1 week (3.8), 3 week (3.3) and 6 week (3.2). There was statistically significant reduction in plaque score from baseline to 6 weeks (Table 3).

Table 3 Comparison of Plaque scores at follow-up visits in Group B

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Plaque score at baseline	4.4650	.35135		BL>1wk>3wk>6wk
plaque score at 1wk	3.8900	.33388	<0.001	
plaque score at 3wk	3.3800	.46747		
plaque score at 6wk	3.2600	.43698		

* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Mean Gingival score at baseline was 2.79 which were higher as compared to score at 1 week (2.4), 3 week (2.1) and 6 week (1.9). There was statistically significant reduction in plaque score from baseline to 6 weeks (Table 4).

Table 4 Comparison of Gingival scores at follow-up visits in Group B

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Gingival score at baseline	2.7900	0.03078	<0.001	BL>1wk>3wk>6wk
Gingival score at 1wk	2.4200	0.23306		
Gingival score at 3wk	2.1800	0.20157		
Gingival score at 6wk	1.9050	0.19861		

* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Mean Plaque score at baseline was 4.5 which were higher as compared to score at 1 week (2.8), 3 week (2.2) and 6 week (1.5). There was statistically significant reduction in plaque score from baseline to 6 weeks (Table 5).

Table 5 Comparison of Plaque scores at follow-up visits in Group C

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Plaque score at baseline	4.5650	.21343	<0.001	BL>1wk>3wk>6wk
plaque score at 1wk	2.8750	.47559		
plaque score at 3wk	2.2700	.48024		
plaque score at 6wk	1.5900	.48221		

* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Mean Gingival score at baseline was 2.79 which were higher as compared to score at 1 week (2.1), 3 week (1.3) and 6 week (0.8). There was statistically significant reduction in plaque score from baseline to 6 weeks (Table 6).

Table 6 Comparison of Gingival scores at follow-up visits in Group C

	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Gingival score at baseline	2.7900	.03078	<0.001	BL>1wk>3wk>6wk
Gingival score at 1wk	2.1800	.26872		
Gingival score at 3wk	1.3250	.20229		
Gingival score at 6wk	.8000	.13765		

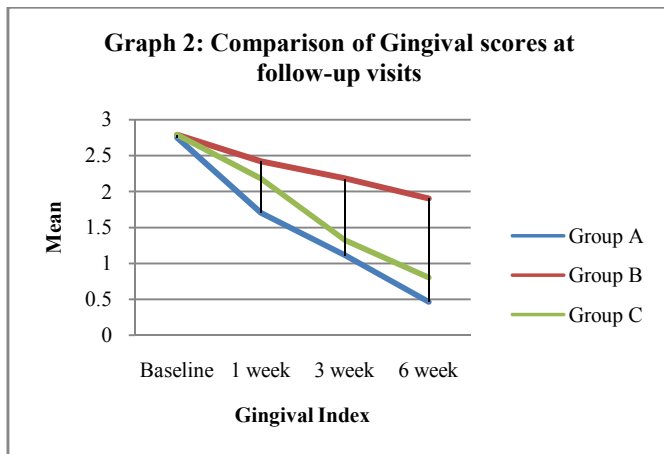
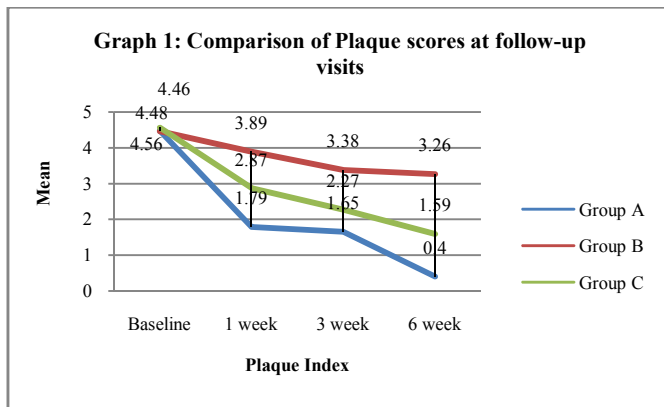
* - Repeated measures ANOVA test # - Post-hoc Tukey's test

Group A (electronic tooth brush) showed greater reduction in plaque score and gingival score from base line to 6 weeks which was statistically significant. Plaque removal of efficacy of electronic tooth brush was superior to both modified manual and manual brushes. Manual brushes showed least plaque removal compared to others. However statistically all three brushing methods showed statistical significant reduction in scores from baseline to 6 weeks. Data when correlated clinically Group A (electronic tooth brush) had plaque score of 0.4 at end of 6 weeks (according to Quigley Hein index plaque score less than 1 is considered to be good). Similarly Group C (modified manual) plaque score at 6 weeks was 1.5 (more than 1). But Group B (manual) plaque score at 6 weeks was 3.2 (much more than 1). Correlating Gingival score at 6 weeks were 0.4, 1.9, 0.8 for group A, Group B and Group C respectively. Group A and B scores are in range 0.1-1 considered as mild gingivitis. Group C score 1.9 considered as moderate gingivitis (Table 7, Graph 1 & 2).

Table 7 Comparison of Plaque & gingival scores at follow-up visits between three experimental groups

	N	Mean	Std. Deviation	P* Value	Post-hoc test [#]
Plaque score at baseline	A 20	4.4800	.26675		
	B 20	4.4650	.35135	0.48	A=B=C
	C 20	4.5650	.21343		
Plaque score at 1wk	A 20	1.7950	.20894	<0.001	
	B 20	3.8900	.33388		B>C>A
	C 20	2.8750	.47559		
Plaque score at 3wk	A 20	1.6500	.22361	<0.001	
	B 20	3.3800	.46747		B>C>A
	C 20	2.2700	.48024		
Plaque score at 6wk	A 20	.4050	.26453	<0.001	B>C>A
	B 20	3.2600	.43698		
	C 20	1.5900	.48221		
gingival score at baseline	A 20	2.7550	.19050	0.53	A=B=C
	B 20	2.7900	.03078		
	C 20	2.7900	.03078		
gingival score at baseline 1wk	A 20	1.7000	.00000	<0.001	B>C>A
	B 20	2.4200	.23306		
	C 20	2.1800	.26872		
gingival score at baseline 3wk	A 20	1.1100	.19708	<0.001	B>C>A
	B 20	2.1800	.20157		
	C 20	1.3250	.20229		
gingival score at baseline 6wk	A 20	.4650	.27582	<0.001	B>C>A
	B 20	1.9050	.19861		
	C 20	.8000	.13765		

* - One-way ANOVA test # - Post-hoc Tukey's test



DISCUSSION

From the time; electric toothbrush are introduced, many articles have been published evaluating its effectiveness in adults, persons with disabilities, and children undergoing orthodontics.^{4,5} Thus the present study was also carried out to compare the efficacy of three toothbrushes (electric tooth brush, manual, customized manual) in visually impaired children.

In the present study, using conventional clinical indices for plaque and gingival health, a significant reduction in plaque levels and gingival inflammation was apparent in all the three groups after 6 weeks.

Electronic tooth brush showed greater reduction in plaque score and gingival score from base line to 6 weeks which was statistically significant. Electronic tooth brush had plaque score of 0.4 at end of 6 weeks less than 1 which is considered to be good. Similarly customized manual plaque score at 6 weeks was 1.5 which is more than 1. But by manual method plaque score at 6 weeks was 3.2 which is much more than 1.

Electronic tooth brush had gingival score of 0.4 at end of 6 weeks. Similarly customized manual plaque score at 6 weeks was 0.8. But by manual method score at 6 weeks was 1.9.

Electronic brushes are expensive and hence the modification of handle was tried in the present study. The acrylic handle was specifically designed for the study. There is no similar design reported in literature. The main idea of designing this handle was that the handle is re usable, once the bristles are worn off the brush can be detached and new brush can be attached again. The design also consist addition of electronic unit that beeps every 30 seconds but due to technical difficulties and time constrains this component was not possible and hence we

only chose to use the designed handle and timer was given to instructor that beeped every 30 seconds. (If this handle design works the patient need of purchasing expensive electronic tooth brush would be eliminated and the handle can be reused and only normal brush had to be attached). Getting the handle in plastic was not possible and hence we chose to design it using acrylic.

Aass *et al.* in 2000, compared efficacy of two electronic tooth brush (Philips HP555 and Philips Jordan-2) and one manual tooth brush. The results were similar to our study. Electronic tooth brush showed a plaque scores for Philips HP555 and Philips Jordan-21.19 and 1.22 respectively. Manual toothbrush showed plaque score of 2.79.⁶

Sharma *et al.* in 2012 compared three manual toothbrushes with different bristle designs to an electric toothbrush. QHI values obtained with the electric brush were the lowest (0.088 ± 0.051). This study concluded that electric toothbrushes are still the most effective in the visually disabled group.⁷

However, Renton-Harper *et al.* 2001 (4days), Robinson *et al.* 2009 (1 weeks) and Seyedeh-Mahsa *et al.* 2014 (2 weeks) found no significant difference between electronic and manual toothbrush. The drawback of these studies is short study duration of 1 week and 2 weeks.⁸⁻¹⁰

Thus the present study proposes that electronic and customized manual toothbrushes have the ability to improve overall oral hygiene when compared with the manual toothbrush. Thus these two methods have the potentiality for optimal plaque removal and improving gingival health of an individual. Further, this study was conducted on visually disabled children who lack much of manual dexterity or training. This confers that good brushing technique with electronic and customized manual toothbrushes can be used as an alternative to manual toothbrush and proves to be secure, better, and efficient in the improvement of overall gingival health in visually disabled children.

CONCLUSION

In the present study, plaque removal efficacy of electronic tooth brush was superior followed by customized manual tooth brush. Manual tooth brushes showed slightest plaque removing efficacy. Gingival scores were reduced to greater level in electronic and customized manual than compared to manual tooth brush. However, extensive long term studies should be carried out to evaluate the usefulness of these brushes on continuation of oral hygiene.

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