International Journal of Medical and Health Research
ISSN: 2454-9142
www.medicalsciencejournal.com
Volume 4; Issue 9; September 2018; Page No. 51-55

Comparative evaluation of plaque removal efficiency of manual, electric and chewable toothbrush in children: A pilot study

Dr. Athira Aravind[1], Dr. Faizal C Peedikayil[2*], Dr. Chandru TP[3], Dr. Soni Kottayi[4]
[1,] PG Student, Department of Pedodontics, Kannur Dental College, Kannur, Kerala, India
[2] Professor and Head, Department of Pedodontics, Kannur Dental College, Kannur, Kerala, India
[3] Professor, Department of Pedodontics, Kannur Dental College, Kannur, Kerala, India
[4] Reader, Department of Pedodontics, Kannur Dental College, Kannur, Kerala, India

Abstract
Introduction: Dental plaque is a serious precursor to a multitude of dental and periodontal ailments. Therefore plaque control is a serious consideration in prevention of these ailments. Tooth brushing is the most popular mode of plaque control with different types of brushes used worldwide. The aim of this study is evaluate and compare the efficacy of a manual tooth brush, chewable tooth brush and electrical tooth brush for plaque removal in children of age 8-14years.
Materials and methods: The study population comprised of 30 children aged between 8 to 14 years, who were divided into 3 groups according to the type of toothbrush assigned to them namely Group A: electric toothbrush(N & M Electric Toothbrush), Group B: manual toothbrush(Colgate Sensitive Toothbrush) and Group C: chewable toothbrush (Fuzzy Toothbrush). The children were assessed for plaque buildup under their normal brushing routine and their assigned tooth brushes respectively for consecutive weeks. The plaque buildup was noted using OHI-S and TQHI indices.
Results: Chewable toothbrush showed a final value of 2.70 in OHI-S and in3.32 TQHI. Electric toothbrush showed a final value of 2.702.36 and 2.76 in OHI-S and TQHI respectively. Manual toothbrush showed a final value of 3.08in OHI-S and in 3.69 TQHI
Conclusion: The electric toothbrush was noted to have the most efficiency in plaque removal followed by manual toothbrush and chewable toothbrush.

Keywords: manual toothbrush, chewable toothbrush, electric toothbrush, plaque

Introduction

Dental plaque is defined as the soft deposits that form the biofilm adhering to the tooth surface or other hard surfaces in the oral cavity, including removable and fixed restorations [1]. precursor to a multitude of problems in the oral cavity like dental caries, gingivitis, periodontitis due to its composition of microorganisms like Streptococcus mutans and other anaerobes, like fusobacterium and action bacteria [1, 2].

An effective way of reducing incidence of oral diseases is by plaque control for which mechanical and chemical methods are employed. Tooth brushing is one of the most effective means of removal of accumulated plaque biofilm and also prevention of plaque accumulation on tooth [1, 3]. Control of plaque by tooth brushing involves a wide range of methods prescribed and researched to attain proper plaque removal [4]. Unfortunately, effective mechanical methods of plaque control are relatively tedious, time-consuming and, for many individuals, difficult to master [5].

A technically adequate brush and patient compliance are both required for effective tooth brushing. Effective hand brushing also requires a certain degree of manual dexterity, which varies among individuals and increases with age [6, 4]. An electric toothbrush may have the potential to simplify self-performed oral hygiene in comparison to a manual toothbrush and attain equal if not more plaque removal than a properly administered manual brushing method [7]. An electric toothbrush operates by rotating, oscillating or vibrating without requiring any action on your part other than to turn it on. The movements of a manual toothbrush depend on actions you perform. The determining factor lies more in method than on the type of toothbrush [8]. The chewable toothbrush is a recent innovation in oral hygiene. This disposable, all-in-one brush is comprised of xylitol, flavoring, aqua, and polydextrose [2] manufacturers and prior researches imply the significance of plaque removal by chewable toothbrush in comparison to manual tooth brushing [2, 5] Despite various studies being done to compare the plaque removal efficiency of manual toothbrushes to chewable or electric toothbrush it has been noticed that a comparative analysis of all three has never been performed before.

Therefore, this pilot study aims to have a comparative study between the three different types of toothbrushes. The study aims to evaluate and compare the efficacy of a manual tooth brush, chewable tooth brush and electrical tooth brush for plaque removal in children of age 8-14 years.

Materials and methods

The study population comprised of 30 children aged between 8 to 14 years, who were the inmates of a residential school in Kannur district. The inclusion criteria consisted of satisfactory general and oral health with no history of any systemic diseases. Children under any form of regular drug therapy

were excluded from the study. The children undertaking the study was required to have all permanent first molars and incisors erupted into their oral cavity and have a maximum of 3 carious lesions in there oral cavity which are not pulpally involved.

Before commencement of the study, informed consent was obtained from the child's parent/guardian. The children and guardians were familiarized with the disclosing agent, chewable toothbrush as well as electric toothbrush before the commencement of the study with the help of videos and demonstrations.

Participants underwent a thorough oral prophylaxis before the commencement of the study. For the next one week the participants continued with their routine plaque control methods. After the gap of exactly one week the children and their guardians were recalled. The children were asked to rinse their mouth and disclosing agent in form of chewable tablet (Trace Disclosing Tablets) were given to the children for better visualization of plaque. A recording of OHI-S index and Turesky modification of Quigley-Hein index were done after this.

After the plaque scores were obtained the children underwent another round of thorough oral prophylaxis. After this the participants were divided into 3 groups each consisting of 10 members randomly assigned to each group via lottery method.

The 3 groups were namely

Group A: electric toothbrush (N & M Electric Toothbrush)
Group B: manual toothbrush (Colgate Sensitive Toothbrush)
Group C: chewable toothbrush (Fuzzy Toothbrush)

The guardian/caregiver and child pair in each group were explained in detail individually about how to use the type of toothbrush they were provided and were given demonstrations. Each child was then advised to follow their normal frequency of brushing under parental observation, but using the toothbrush they were provided with. Following the previous time period, the participants reported back to the department after one week were their OHI-S index and Turesky modification of Quigley-Hein index were recorded.

All clinical examinations and scoring were performed by the same examiner blinded to the toothbrush being used.

The study simple was subjected to analitical and descriptiveanalysis. The normality of data was tested by Shapiro-Wilk test. As the data followed normal distribution, parametric tests were used to analyze the data. The paired t-test and ANOVA test were used to check differences among groups noted apposite. The analysis was done using software SPSS (Statistical Package for Social Sciences) Versión 20.1 (Chicago, USA Inc.)

Results

It was a single blinded cross over study in which the examiner was blinded to which toothbrush each subject was using. The study participants did not display any adverse signs and symptoms in correlation to use of the toothbrushes.

All subjects (n=30) successfully completed the study period of 2 weeks with no loss of subjects for follow up. The participants of this study ranged in the age group of 8-14 years of age [mean age (chewable toothbrush 10.20 ±2.04) (manual toothbrush9.20 ±1.93) (electric toothbrush 10.10 ±2.07)] and consisted of 25 males and 5 females in the pool of subjects. (Table 1)

Chewable toothbrush scores

The initial OHI-S mean values for chewable toothbrush was 2.90 at baseline which reached a mean of 2.70 after the trial period of 1 week ($p < 0.05$). Similarly the TQHI index showed a mean ratio of 3.50 in the chewable brush category which was reached a mean value of 3.32 after the investigation period of a week. (Table 2, Figure 1(a))

Manual toothbrush scores

In a similar variation noted in the manual tooth brush group it was noticed that after an initialmean value of 3.52 in the OHI-S index through the duration of the experiment there was a reduced variation to a value of 3.08.similarly in the TQHI index values the initial mean value of 4.27 wassubdued to a final of 3.69 as by the end of investigation. With a statistically significant p-value of0.024 in relation to OHI-S index and 0.031 in relation toTQHI.(Table 2,Figure 1(b))

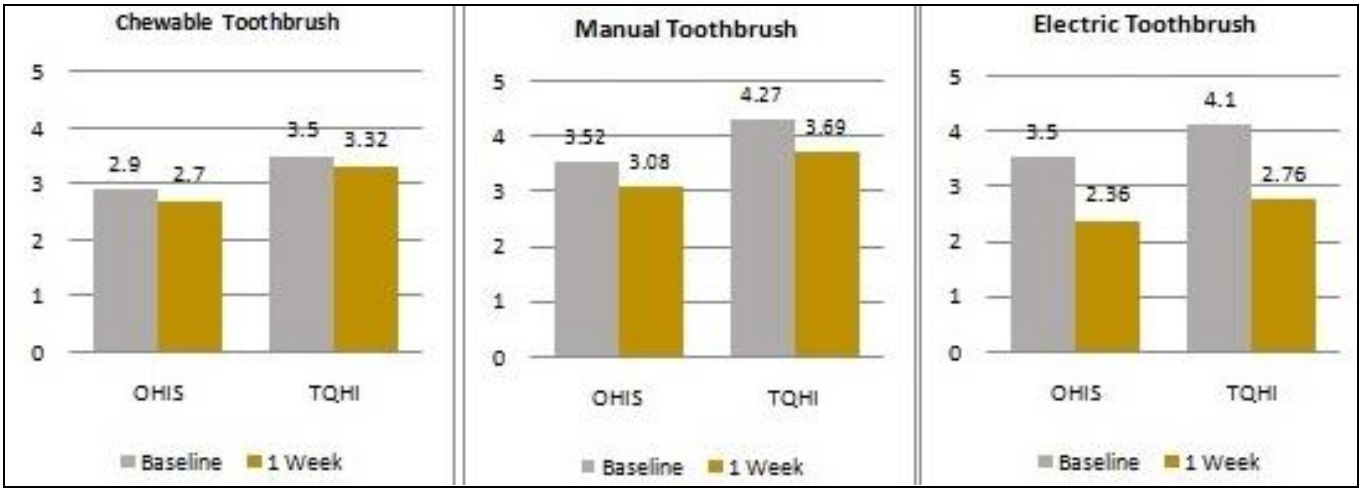
Electric toothbrush scores

In the electric toothbrush using group it was noted that the baseline values of OHI-S index and TQHI index were 3.50 and 4.10 respectively. These values were noted to be 2.36 and 2.76 respectively for OHI-S index and TQHI index after the investigative period of 1 week.The p-value was noted to be at0.001 for OHI-S index and <0.001for TQHI and was highly significant statistically. (Table 2 and Figure 1(c))

Comparison of toothbrush

In a comparative evaluation it can be noticed that the reduction in case of chewable toothbrush is limited to a 0.20 range in OHI-S index and 0.18 In TQHI INDEX. Whereas subjects of manual toothbrush use showed a reduction of 0.24 range in OHI-S index and 0.58 In TQHI.

This was highly surpassed by the results of the electric toothbrush category with arough mean variation ranging at a 1.14 in OHI-S index and 1.34 for TQHI. (Depicted in Table 3& Table 4 and graphs in Figure 2)



(a) **(b)** **(c)**

Fig 1: Comparison Of mean OHI-S TQHI values at baseline and at 1 week Of chewable Tooth brush Manual Toothbrush and electric Tooth Brush

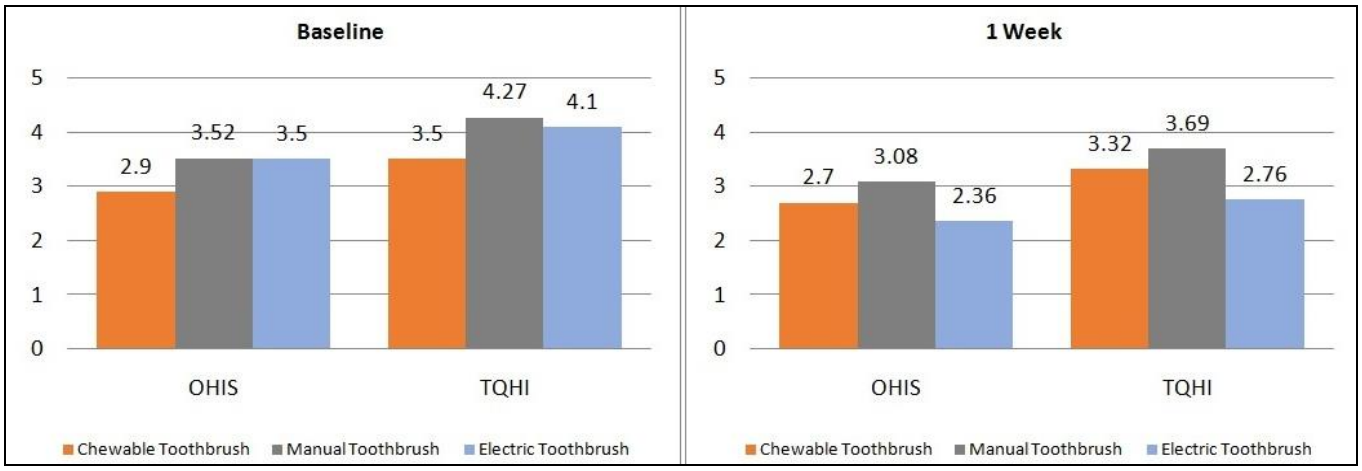


Fig 2: Comparison of mean OHI-S and TQHI and Values among chewable Toothbrush, manual Toothbrush and electric toothbrush At baseline and at 1 week

Table 1: Demographic data of the study population among the three groups – chewable toothbrush, manual toothbrush and electric toothbrush

Variables	Chewable Toothbrush	Manual Toothbrush	Electric Toothbrush
Age (Mean ±S.D.)	10.20 ±2.04	9.20 ±1.93	10.10±2.07
Male [N (%)]	10 (100.00)	9 (90.0)	6 (60.0)
Female [N (%)]	0 (0.00)	1 (10.0)	4 (40.0)

Table 2: Comparison of mean OHI-S and TQHI values at baseline and at 1 week of chewable toothbrush, manual toothbrush and electric toothbrush

Groups	Index	Timeline	N	Mean	S.D.	M.D.	95% C.I.	t-Value	P-Value*
Chewable	OHI-S	Baseline	10	2.90	0.73	0.20	-0.10-0.50	1.500	0.168
Toothbrush		1 Week	10	2.70	0.59				
	TQHI	Baseline	10	3.50	0.94	0.18	-0.28-0.64	0.881	0.401
		1 Week	10	3.32	0.65				
Manual	OHI-S	Baseline	10	3.52	0.70	0.44	0.07-0.80	2.703	0.024†
Toothbrush		1 Week	10	3.08	1.04				
	TQHI	Baseline	10	4.27	0.64	0.58	0.06-1.09	2.561	0.031†
		1 Week	10	3.69	0.99				
Electric	OHI-S	Baseline	10	3.50	0.70	1.14	0.60-1.67	4.778	0.001†
Toothbrush		1 Week	10	2.36	0.60				
	TQHI	Baseline	10	4.10	0.74	1.34	0.80-1.87	5.706	<0.001†
		1 Week	10	2.76	0.61				

*P-value derived from paired t-test; †significant at $p < 0.05$

Table 3: Comparison of mean OHI-S and TQHI values among chewable toothbrush, manual toothbrush and electric toothbrush at baseline and at 1 week

Timeline	Index	Groups	N	Mean	S.D.	95% C.I.	F-Value	P-Value*
Baseline	OHI-S	Chewable Toothbrush	10	2.90	0.73	2.37-3.42	2.426	0.107
		Manual Toothbrush	10	3.52	0.70	3.01-4.02		
		Electric Toothbrush	10	3.50	0.70	2.99-4.00		
	TQHI	Chewable Toothbrush	10	3.50	0.94	2.82-4.17	2.639	0.090
		Manual Toothbrush	10	4.27	0.64	3.80-4.73		
		Electric Toothbrush	10	4.10	0.74	3.56-4.63		
1 Week	OHI-S	Chewable Toothbrush	10	2.70	0.59	2.27-3.12	2.154	0.136
		Manual Toothbrush	10	3.08	1.04	2.33-3.82		
		Electric Toothbrush	10	2.36	0.60	1.92-2.79		
	TQHI	Chewable Toothbrush	10	3.32	0.65	2.85-3.78	3.652	0.039†
		Manual Toothbrush	10	3.69	0.99	2.97-4.40		
		Electric Toothbrush	10	2.76	0.61	2.32-3.19		

*P-value derived from ANOVA test;†significant at $p < 0.05$

Table 4: Pair wise comparison of mean TQHI values at 1 week among chewable toothbrush, manual toothbrush and electric toothbrush

Pairs	M.D.	95% C.I.	P-Value*
Chewable Toothbrush v/s Manual Toothbrush	-0.37	-1.22-0.48	0.542
Chewable Toothbrush v/s Electric Toothbrush	0.56	-0.29-1.41	0.256
Manual Toothbrush v/s Electric Toothbrush	0.93	0.07-1.78	0.032†

Discussion

This study was conducted to assess the plaque removal potential of three different types of toothbrushes. In this randomized, single blinded study a significant decrease was found in the plaque removal efficiency of electric toothbrush and manual toothbrush in comparison to chewable toothbrush.

The plaque indexes used were the OHI-S INDEX and the Turesky modified Quigley-Hein index. OHI-S INDEX was utilized as the significant gold standard of plaque index. The Turesky modified Quigley-Hein index was utilized due to its ability to better assess the plaque buildup due to the use of disclosing agents as well as the assessment of interproximal areas for plaque [2]. Concerns on the non-brushing period for plaque deposition leading to discomfort for the children dictated continuation of the normal oral hygiene habits for the time period of 7 days.

The chewable toothbrush manufacturers prescribe an age range of 6 years and above so as to decrease incidence of ingestion [2, 6]. hence an age group of 8-14 years was selected also keeping in light better operator control over the toothbrush to facilitate better plaque removal and to avoid accidental ingestion. The children were allowed to carry their oral hygiene habits under parental presence and guidance in relation to the experiment, as the results are still considered significant, despite the Hawthorne and Novelty Effect [9, 10].

An electric toothbrush operates by rotating, oscillating or vibrating and has a higher range of plaque removal compared to the plaque removal efficiency of manual tooth brushes [1, 9, 10]. In better senses the work is cut out for the person using the brush as the implications of operator expertise is reduced to a limit. This may be supportive of our study results which shows a maximum plaque removal efficiency in case of electric toothbrushes

The manual tooth brush shows a pronounced reduction in plaque buildup in our study which correlates to studies by Bezgin *et al*. [2] Myoken *et al* [5]. hence it can be stated that the plaque removal efficiency of a manual toothbrush is majorly based on the operator technique rather than the type of brush [3, 4]

The chewable toothbrush group was noticed to have a comparatively less efficient plaque removal efficiency. This may be due to the use of tongue and teeth rather the external force from the hand to attain plaque removal. Though noted to be less effective mode of plaque removal in conjugation to the present study, chewable toothbrushes were considered a method equally efficient to manual tooth brushing. Study by Myoken *et al*. states it as a reliable method of brushing among care dependent elderly population [5]. Also, Govindaraju *et al*. and Tugba *et al.* reports it is an effective mode of plaque removal among children [2, 7] Hence it can be highly effective in bed ridden persons and in differently abled children as a high rate of success in case of manual toothbrush depends on operator technique [2, 5]. also the incorporation of xylitol crystals which are sugersubstitutes with added benefits of plaque buildup and caries prevention adds to the beneficial aspects of chewable toothbrushes. However operator control over brush is a primary concern in this case and hence care should be taken to avoid use by individuals with reduced motor abilities.

Conclusions

Through the results obtained from the experimental study held within its limitations we can attain an opinion that plaque removal efficiency of electric toothbrush is the highest with manual toothbrush and chewable toothbrush in succession respectively.

Better detailed and precise results can be obtained after extensive studies in the same subject as this study has been conducted amidst multiple limitations like a minimal sample size and no direct professional observation.

Reference

1. Newman, Michael G, Takei HH, Klokkevold PR, Carranza FA. Carranza's clinical periodontology. Print, 2015.
2. Bezgin T, Dag C, Özalp N. How effective is achewable brush in removing plaque in children? A pilot study. J Pediatr Dent. 2015; 3:41-5.
3. Noble SL. Clinical Textbook of Dental Hygiene and Therapy, 2nd ed. West Sussex, Wiley-Blackwell, 2012.
4. Sobanpeter. Essentials of preventive and community dentistry 4th edition. Arya (medi) publishers, 2013.
5. Myoken Y, Yamane Y, Myoken Y, Nishida T. Plaque removal with an experimental chewable toothbrush and a control manual toothbrush in a care-dependent elderly population: A pilot study. J Clin Dent. 2005; 16:83-6.
6. Pujar P, Subbareddy VV. Evaluation of the tooth brushing skills inchildren aged 6-12 years. Eur Arch Paediatr Dent. 2013; 14:213-9.
7. Govindaraju L, Gurunathan D. Effectiveness of chewable toothbrush in children-a prospective study. JCDR, 2O17: VIL-11(3), ZC31-ZC34
8. Mascarenhas AK, Soparkar P, Al-Mutawaa S, Udani TM. Plaque removal using a battery-powered toothbrush compared to a manual toothbrush. JClin Dent. 2005; 16:23-5.
9. Feil PH, Grauer JS, Gadbury-Amyot CC, Kula K, McCunniff MD. Intentional use of the Hawthorne effect to improve oral hygiene compliance in orthodontic patients. J Dent Educ. 2002; 66:1129-35.
10. McCarney R, Warner J, Iliffe S, van Haselen R, Griffin M, Fisher P. The Hawthorne Effect: A randomised, controlled trial. BMC Med Res Methodol. 2007; 7:30.