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Comparison of plaque removal efficacy of chewable, electronic and conventional tooth brushes in visually impaired children

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Abstract

Background: Maintenance of oral health is an essential part for every individual and is particularly more important for children with special health needs. Teeth related issues are more commonly seen in visually impaired individuals and many studies agree that the visually impaired children have poor oral hygiene compared to the general population. They are generally incapable of obtaining an adequate oral hygiene level by conventional brushing. There is scare literature published on the effectiveness of the chewable and electronic tooth brushes for plaque removal in visually impaired children.

Objectives: The purpose of this study was to evaluate the chewable, conventional and electronic tooth brushes in plaque removal efficacy in visually impaired children.

Methods: Visually impaired children aged between 9 and 15 years who had good general and oral health with at least twenty teeth were included in the study. Fifteen visually impaired children were randomly assigned into chewable toothbrush, conventional toothbrush and electronic toothbrush groups. The oral hygiene status was assessed at baseline, after one week use of respective tooth brushes (phase-1) and again reassessed after one week use of normal brushing (phase-2).

Results: We observed a statistically significant reduction in Oral Hygiene Index-Simplified [0.6 + 0.55; p=0.014] and Turesky Modification of Quigley Hein Index [1.4 + 0.55; p=0.008] scores for the participants using electronic brushes at phase-1 as compared to participants in the other two groups.

Conclusion: The electronic tooth brush showed significant plaque removal efficacy when compared to the chewable and conventional tooth brushes.

Keywords: Oral hygiene, visually impaired, conventional brushing, electronic brushes, chewable brushes, Oral Hygiene Index-Simplified, Turesky Modification of Quigley Hein Index

Introduction

Maintenance of oral health is an essential part for every individual and particularly more important for children with special health needs. Teeth of visually impaired tends to be compromised as they are often unable to perform adequate brushing to control plaque. Dental caries is the most prevalent disease among paediatric population worldwide. Meeting dental care needs is the greatest unattended health need particularly in those with special health needs. Oral health is a vital component of overall fitness, that contributes to each individual's wellbeing and quality of life by positively affecting physical and mental health. Paediatric population with special needs have greater limitations in maintaining oral hygiene due to their potential motor, sensory and intellectual disabilities, thus leading to unhealthy oral cavity. Visually impaired children are usually dependent on parents or guardians for carrying out daily activities including oral care [1].

Teeth related issues are more commonly seen in visually impaired individuals, although the etiology is similar to that of healthy children. However, it is of utmost importance to control and treat dental diseases at an early stage of development, especially for this group. It is known that effective tooth brushing depends on the tooth brush, brushing time, manual dexterity, motivation and ability to follow instructions [2]. Dental plaque is defined as the biofilm adhering to tooth surfaces that is formed by soft deposits in the mouth. If teeth are well maintained it provides better gingival and periodontal health that prevents tooth decay and preserves oral tissues. A technically adequate brush and patient compliance are both required for effective tooth brushing. Effective manual tooth brushing also requires a certain degree of manual dexterity, which varies among individuals and increases with age [3].

Electronic tooth brushes were introduced to simplify tooth cleaning in paediatric population. However, various studies have found conventional tooth brushes to be equally effective. Moreover, due to the low cost, ready availability and ease of use, conventional brush continues to be the primary method of maintaining good oral hygiene for the majority of the people. In order to obtain better compliance with everyday oral hygiene routine, electronic and conventional toothbrushes have been crafted specifically to appeal children with appropriately sized brush heads and features to introduce a fun aspect to tooth brushing. Studies comparing electronic to conventional brush use by children have shown that, while both types of brushes produce significant plaque reductions, the electronic brushes are generally significantly more effective in reducing whole mouth plaque as well as plaque at specific subsets of sites. Studies have also indicated that electronic brushes are often preferred by children because these brushes engage their interest and are more fun to use [4, 5].

The chewable tooth brush (Fuzzy brush, Fuzzy brush ltd, London, UK) introduced in the UK is a recent innovation in oral hygiene practice. Fuzzy brush contains over 70% xylitol, a natural sweetener which helps to kill bacteria in

the mouth, protect tooth enamel, fight tooth decay. A study conducted by Myoken et al. assessed the effectiveness of the chewable brush in care dependent elderly population and concluded that the chewable brush significantly removed plaque [6].

Many studies agree that the visually impaired children have poor oral hygiene compared to the general population and are generally incapable of obtaining an adequate oral hygiene level by conventional brushing [7]. However, there is limited published literature on the effectiveness of the chewable and electronic tooth brushes for plaque removal in visually impaired children. Therefore, the purpose of this study was to evaluate the chewable, conventional and electronic tooth brushes in plaque removal efficacy in blind children.

Materials and methods

After obtaining the permission and consent from the administrative authorities, this cross-sectional study was conducted at Shree Ramana Maharshi School for blind children. The study was approved by the institutional research and ethics committee of AECS Maaruti College of Dental Sciences and Research Center.

Visually impaired children aged between 9 and 15 years who had good general and oral health with at least twenty teeth were included in the study. We excluded the children with soft tissue oral lesions, multiple carious lesions requiring treatment, severe malocclusion or with orthodontic appliance (because these children usually have poor oral hygiene) and those who regularly use antibiotics. Fifteen visually impaired children were randomly assigned into three study groups namely, chewable toothbrush, conventional toothbrush and electronic toothbrush groups and each group had five students. A thorough oral examination and prophylaxis was performed for all the study subjects and were instructed to refrain from brushing for the next forty-eight hours. A baseline oral hygiene status was assessed after forty-eight hours using Oral Hygiene Index-Simplified [OHIS] (Table 1) and Turesky Modification of Quigley Hein Index [TMQHI] (Table 2) [8, 9]. Each group was then provided with their respective tooth brushes and asked to use the same for one week, following which the oral hygiene status was reassessed (Phase-1). In the last phase of the study, children were instructed to resume their normal brushing for one week and once again the oral hygiene status was reassessed (Phase-2). The oral hygiene index scores at all the three intervals (after forty-eight hours of prophylaxis (Baseline), after the use of respective study group toothbrushes (Phase-1) and routine oral hygiene practices (Phase-2) were compared. Scores were calculated for statistical comparison, data thus obtained evaluated using Freidman test.

Results and discussion

We observed a statistically significant reduction in OHIS and TMQHI scores at phase-1 for the participants using electronic brushes as compared to participants in the other two groups. Electronic toothbrushes produced statistically significant plaque reductions from baseline, when compared to chewable brush and conventional brush. The details are presented in Table 3 and 4. No adverse clinical outcomes were observed among the study participants during the study period. The removal of debris from teeth is a skill that can be mastered only when the individual has the skills to manoeuvre toothbrush and an understanding of the objectives of this activity. It is obvious that many disabled individuals will find the maintenance of their oral hygiene much more difficult than normal individuals because, those with hearing impairment cannot understand and respond to the instructions given and those who are blind, lack the vision to understand and master the technique of oral hygiene practices [10].

Nicolaci & Tesini have shown that oral hygiene can be improved significantly by providing intensified daily brushing by dental personnel, by the development of self-help workshops, by providing effective staff training, or by a combination of all these approaches [11]. Although handicapped (hearing impaired and blind) subjects are entitled to the same standards of oral healthcare as the general population, there is evidence that they experience penurious general and oral health and have unmet health needs and a lower uptake of screening services. Oral health and quality oral health care contribute to holistic health, which should be a right rather than a privilege. Thus, these underserved populations need a special attention by the dentist community.

In India and in many other countries, the academic curriculum does not train dentists to treat these children. Hence, there is a need to make dental personnel and dental students aware of the special problems posed by these handicapped children and to provide suitable training.

This randomized blinded study found differences in plaque removal efficacy between chewable tooth brush, electronic tooth brush and conventional tooth brush. These findings are in agreement with the study reports of Jain *et al*. in India and Brown et al in Saudi Arabia revealing a high need for dental care among handicapped children [12, 13]. Prior to plaque scoring a professional prophylaxis was performed following 48-hours of plaque accumulation. However, plaque reduction examination can be improved by allowing a solid layer of about 30-50 micrometre thickness to develop over a 48-hour period. The plaque index used in studies comparing toothbrushes should adequately record plaque in the interproximal areas. Although the site-related plaque scoring of the TMQHI used in the study makes it well suited for recording interproximal plaque in the children who have abundant gingival plaque in interproximal areas, the long examination time required makes it difficult to implement in children. Therefore, this study also tested brush effectiveness using the OHIS; a less time-consuming index often in the studies with a large population. The findings of the two indexes were similar. In order to avoid the risk of swallowing, the manufacturer of the chewable brush does not recommend its use for the children under the age of six years. In addition, as effective hand brushing requires a certain degree of manual dexterity, this study was conducted with a population of blind children aged between 9 and15 years since these children have poor oral hygiene when compared to general population because of decreased manual dexterity.

Our study has shown that the children who used electronic toothbrushes produced statistically significant plaque reductions from baseline. These results were consistent with those of previously reported studies. Myoken *et al* investigated the effectiveness of the chewable brush in care dependent elderly population and it was observed that the chewing brush resulted in the removal of a significant plaque [6]. In another study conducted by Sharma *et al* it was observed that the electronic tooth brush resulted in the removal of a significant plaque in children, which is consistent with the observations of our study [14]. Bezgin *et al* also observed a statistically significant plaque removal by both chewable and conventional tooth brush in children in their study [15].

It has been suggested that daily exposure to xylitol (in chewable brushes) may be beneficial to the child dental health by reducing caries and remineralisation. Though it was not proved statistically in our study, the similarities in plaque removal found in chewable and electronic tooth brushes suggests that the chewable brush may be an appropriate oral hygiene aid adjunct for school children, including children with disabilities. However, in order to definitively determine the suitability of the chewable

brush for disabled children and children under age ten years, additional long-term studies are required.

Table 1: Oral Hygiene Index-Simplified (OHIS) [8]

Criteria	Scores
No debris or stain	0
Soft debris covering not more than one third of the tooth surfaces or presence of extrinsic stains without other debris regardless of surface area covered	1
Soft debris covering more than one third but not more than two-third of the exposed tooth surface	2
Soft debris covering more than two-third of the exposed tooth surface	3

Table 2: Turesky Modification of Quigley Hein Index (TMQHI) [9]

Criteria	Scores
No plaque	0
Isolated areas of plaque at gingival margin	1
Thin band of plaque at gingival margin (less than 1mm)	2
Plaque covering up to 1/3 of the tooth surface	3
Plaque covering up to 1/3 of the tooth surface and less than 2/3 of the tooth surface	4
Plaque covering>2/3 of the tooth surface	5

Table 3: OHIS scores of the study participants.

Study group	OHIS scores (± SD)			*p* value†
	Baseline	Phase-1	Phase-2	
Chewable brush (n=5)	2.4 ±0.55	1.8 ± 0.45	2.4 ± 0.55	0.105
Electronic Brush (n=5)	2.8 ± 0.45	0.6 ± 0.55	2 ±0.71	0.014*
Conventional Brush (n=5)	2.4 ±0.55	2.8 ±0.45	2 ±0.71	0.21

†Friedman test; **p* value <0.05 is statistically significant

Table 4: TMQHI scores of the study participants.

Study group	TMQHI scores (± SD)			*p* value†
	Baseline	Phase-1	Phase-2	
Chewable brush (n=5)	3.4 ± 0.89	2.6±0.55	2.8±0.84	0.165
Electronic Brush (n=5)	4.8±0.45	1.4±0.55	3.4±0.55	0.008*
Conventional Brush (n=5)	4±0.7	3.6±0.89	3.4±0.54	0.368

†Friedman test; **p* value <0.05 is statistically significant

Conclusion

The electronic tooth brush showed significant plaque removal efficacy when compared to the chewable and conventional tooth brush. Within the limits of this study, the experimental chewable brush was found to be as effective as an electronic brush in removing plaque. Chewable tooth brush can also be used as an alternative in children with disabilities.

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