How effective is a chewable brush in removing plaque in children? A pilot study

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ABSTRACT

The aim of this pilot study was to evaluate the plaque removal efficiency of a chewable toothbrush (CB) in children. A total of 20 patients aged 10-12 years who attended to the Department of Pediatric Dentistry were enrolled in the study. This was a single-blinded crossover study which examined plaque removal efficiency of a CB compared to a manual toothbrush (MB) following a consecutive use. After professional prophylaxis had been given, participants refrained from brushing and chewing for 48 h. Supragingival plaque was examined using the Turesky modification of the Quigley-Hein Index (TQHI) and the simplified oral hygiene index (OHI-S). For statistical comparison, the difference (prebrushing minus postbrushing) in average scores was calculated. Data were evaluated by Mann-Whitney U-test, with a $P < 0.05$ considered to be statistically significant. The mean plaque reduction score with TQHI for CB and MB were 1.91 ± 0.54 and 1.96 ± 0.52, respectively. The mean plaque reduction score with OHI-S for CB and MB were 1.31 ± 0.288 and 1.34 ± 0.403, respectively. Differences in scores between the two brushes were not statistically significant ($P > 0.05$). Within the limits of this study, the experimental chewable brush was found to be as effective as a manual brush in removing plaque. The chewable brush may be an appropriate oral hygiene adjunct for school children, including children with disabilities.

Key words: Chewable Toothbrush, Manual Toothbrush, Randomized Study, Simplified Oral Hygiene Index, Turesky Modification of the Quigley-Hein Index

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INTRODUCTION

Dental plaque is defined as the biofilm adhering to tooth surfaces that is formed by soft deposits in the oral cavity. Good plaque control facilitates good gingival and periodontal health, prevents tooth decay, and preserves oral health.[1,2] Of the various chemical and mechanical methods that have been advocated for plaque removal, toothbrushing has been cited as the most commonly used effective method as well as the safest.[3]

A technically adequate brush and patient compliance are both required for effective toothbrushing. Effective handbrushing also requires a certain degree of manual dexterity, which varies among individuals and increases with age.[4-6] Powered toothbrushes were introduced to facilitate tooth cleaning in children[7-10] however, various studies have found manual toothbrushes (MBs) to be equally effective.[11-13] Moreover, due to the low cost, ready availability, and ease of use, MB continues to be the primary method of maintaining good oral hygiene for the majority of the population.[3,9]

The chewable toothbrush (CB) (Fuzzy brush, Fuzzy Brush Ltd, London, UK) is a recent innovation in oral hygiene. This disposable, all-in-one brush is comprised of xylitol, flavoring, aqua, and polydextrose. Myoken *et al.*[14] investigated the effectiveness of the CB in a care-dependent elderly population and concluded that chewing the brush resulted in the removal of a significant amount of plaque. However, to date, no study has been published on the effectiveness of the CB for plaque removal in children. Therefore; the aim of this pilot study was to evaluate and compare the use of a CB and an MB for plaque removal in children.

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MATERIALS AND METHODS

This study was approved by the Faculty of Dentistry's Institutional Review Board. The study population was comprised of 20 children between the ages of 10 and 12 attending the Department of Pediatric Dentistry Clinic. The sample size was calculated as the minimum required to detect a significant difference between the two brushes tested.

Inclusion criteria consisted of good general and oral health and the presence of at least 20 teeth. Children who regularly used antibiotics or other drugs as well as children with oral soft-tissue lesions, 3 or more carious lesions requiring treatment, a severe malocclusion or orthodontic appliances were excluded from the study.

Prior to enrollment in the study, informed consent was obtained from parents of all participants. Children and their parents were introduced to the CB [Figure 1], and professional prophylaxis was performed and teeth polished so that all subjects had equally clean teeth at the start of the study. Participants were instructed to refrain from brushing and chewing for 48 h prior to the study.[15]

All appointments were scheduled between 8:30 am and 10:30 am. Disclosing tablets (Mira-2-Ton Tablets, Hager Werken, Duisburg, Germany) were used to aid in identifying plaque. The Turesky modification of the Quigley-Hein Index (TQHI) [Table 1] and the simplified oral hygiene index (OHI-S) [Table 2] were used to assess supragingival plaque.[16,17] TQHI scores were obtained for the buccal and lingual surfaces of all gradable teeth, and the average score was used for each subject. OHI-S index scores were obtained for the buccal surfaces of the upper permanent first molars (16 and 26), the lingual surfaces of the lower permanent first molars (36 and 46) and the labial surfaces of the upper right (11) and lower left (31) central incisors. After recording the individual scores, overall OHI-S Index values were calculated by adding the debris scores and dividing by 6, the number of surfaces.

Figure 1: Chewable brush used in the study

After plaque scores were obtained, children were transferred to a "brushing room" where they were instructed to brush their teeth for 2 min with either a randomly assigned manual brush (Twister Fresh, Colgate-Palmolive Company, Yangzhou, China) and a premeasured quantity of dentifrice (Total Clean Mint, Colgate-Palmolive Company, Yangzhou, China) according to their normal regimen or with the chewable brush in the presence of a supervisor. The randomization was done by flipping a coin (heads: Started with the manual brush, tails: Started with the chewable brush). In line with the manufacturer's recommendation, no dentifrice was used with the CB. Children were told to grip the brush between their teeth, to use their teeth to swivel it from left to right and then to use their tongue to move the brush around their mouth similar to the way one would use chewing gum. Subjects were redisclosed with a disclosing tablet and then transferred to another clinical operatory where they were reexamined, and their plaque indices rerecorded.

Subjects were then instructed to resume their normal oral hygiene routine and brush twice daily for 2 min for the next week, when professional prophylaxis and polishing were performed again. Participants were then instructed to again refrain from brushing and chewing for 48 h. In the final appointment, brushing and scoring procedures described above were repeated for each subject with the toothbrush not previously tested.

All clinical examinations and scoring were performed by the same examiner blinded to both the toothbrush

Table 1: Turesky modification of the Quigley-Hein Index

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

Table 2: OHI-S index

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

OHI-S: Simplified oral hygiene index

used and the previously recorded scores. Intraexaminer reliability was evaluated prior to the study by scoring supragingival plaque in five subjects not enrolled in the main study and then repeating these evaluations in a different randomized order in the same session. Intraexaminer Kappa values were found to be 0.81 for the TQHI and 0.84 for the OHI-S index.

Average pre and postbrushing scores was calculated for statistical comparison. Data were evaluated using the Mann-Whitney U-test, with a $P < 0.05$ considered to be statistically significant.

RESULTS

This was a single-blinded cross-over study in which the examiner was blinded to which brush was used. No adverse clinical signs or symptoms caused by the toothbrushes were noted in any of the study participants ($n = 20$ [11 boys, 9 girls]; mean age: 11.3 years [age range: 10-12 years]).

Turesky modification of the Quigley-Hein Index scores

Turesky modification of the Quigley-Hein Index plaque reduction scores are shown in Table 3. Prebrushing and postbrushing plaque scores for the CB (experimental), and the MB (control) were 3.07 ± 0.38 and 1.91 ± 0.54 and 3.04 ± 0.42 and 1.96 ± 0.52, respectively. Differences in scores between the two brushes were not statistically significant ($P > 0.05$).

Plaque reduction scores for buccal surfaces were higher with the MB (2.09 ± 0.65) than the CB (1.88 ± 0.76), whereas plaque reduction scores for lingual surfaces were higher with the CB (1.92 ± 0.49) than the MB (1.83 ± 0.49). However, again, the differences between the toothbrushes were not statistically significant ($P > 0.05$).

Simplified oral hygiene index scores

Simplified oral hygiene index plaque reduction scores are shown in Table 4. Prebrushing and postbrushing plaque scores for the CB, and the MB were 2.39 ± 0.17 and 1.31 ± 0.29 and 2.50 ± 0.33 and 1.34 ± 0.4, respectively. The differences between the two brushes were not statistically significant ($P > 0.05$).

DISCUSSION

This randomized, blinded study found no differences in plaque removal efficacy between a CB and a conventional MB after a single use.

Prior to plaque scoring, professional prophylaxis was performed following 48 h of plaque accumulation.[15] Toothbrush effectiveness is typically tested following 24 h (range: 12-48 h) of oral hygiene abstinence.[18] However, plaque-reduction examination can be improved by allowing a solid plaque layer of about 30-50 μm in thickness to develop over a 48 h period.[19,20]

Studies in which new oral hygiene devices are tested at home may be affected by the Hawthorne and Novelty effect, whereby subjects improve an aspect of their behavior not in response to any particular experimental manipulation, but simply in response to the fact that they are being studied. The single-use, postbrushing design of the present study facilitated the exclusion of this effect as well as other patient-related factors such as brushing technique, dexterity, motivation, and handedness.[15,21,22]

The plaque index used in studies comparing toothbrushes should adequately record plaque in the interproximal area.[15] Although the site-related plaque scoring of the TQHI used in the present study makes it well-suited for recording interproximal plaque in children, who have abundant gingival papillae in interproximal areas, the long examination time required makes it difficult to implement the TQHI in children. Therefore, this study also tested brush effectiveness using the OHI-S, a less time-consuming index often used in studies with a large population. The findings of the two indexes were similar.

Table 3: Results of TQHI

Tooth surfaces	Plaque reduction score						Mann-Whitney U		
	n	Mean	Median	Minimum	Maximum	SD	MR*	U	*P*
Buccal surfaces									
Chewable	20	1.88	2.00	0.70	2.90	0.76	18.8	166	0.357
Manual	20	2.09	1.95	1.10	3.20	0.65	22.2		
Lingual surfaces									
Chewable	20	1.92	1.78	1.30	3.40	0.49	22.05	169	0.401
Manual	20	1.83	1.65	1.20	3.10	0.49	18.95		
All surfaces									
Chewable	20	1.91	1.88	1.20	3.20	0.54	19.875	187.5	0.735
Manual	20	1.96	1.73	1.30	2.90	0.52	21.125		

*MR: Mean rank, SD: Standard deviation, TQHI: Turesky modification of the Quigley-Hein Index

Table 4: Results of OHI-S index

Type of toothbrush	*n*	Plaque reduction score					Mann-Whitney U		
		Mean	Median	Minimum	Maximum	SD	MR*	U	*P*
Chewable	20	1.31	1.2	1	2.2	0.288	20.58	198.5	0.966
Manual	20	1.34	1.2	0.8	2.5	0.403	20.43		

*MR: Mean rank, SD: Standard deviation, OHI-S: Simplified oral hygiene index

In order to avoid the risk of swallowing, the manufacturer of the chewable brush does not recommend its use for children under age 6. In addition, as effective handbrushing requires a certain degree of manual dexterity, this study was conducted with a population of healthy children aged 10-12.[4,23]

The study results showed overall plaque scores were significantly reduced with both the chewable and manual brushes and that no statistically significant differences existed between the two brushes. However, the experimental CB was more efficient in removing plaque on lingual surfaces, whereas the MB was more efficient in removing plaque on buccal surfaces. These results are consistent with those of a previous study by Myoken *et al*.,[14] who also found the CB capable of removing a significant amount of plaque, particularly on the lingual surfaces. One possible explanation for the differences in plaque removal between surfaces may be that children spend less time on manual brushing of lingual surfaces than buccal surfaces,[24] whereas children chewing the experimental brush may unconsciously spend more time on brushing lingual surfaces.

The chewable brush used in this study contains xylitol. It has been suggested that daily exposure to xylitol may be beneficial to child dental health by reducing caries and assisting remineralization.[25,26] The similarities in plaque removal found between the two brushes suggest the chewable brush may be an appropriate oral hygiene adjunct for school children, including children with disabilities. However, in order to definitively determine the suitability of the CB for disabled children and children under age 10, additional long-term studies are required.

CONCLUSIONS

- Within the limits of this study, the experimental chewable brush was found to be as effective as a manual brush in removing plaque.
- The chewable brush may be an appropriate oral hygiene adjunct for school children, including children with disabilities.
- More comprehensive studies are needed before the chewable brush can be recommended for use by high-caries-active children.

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