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The plaque-removing efficacy of a finger brush (I-Brush®)

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Abstract

Objective: The purpose of the present study was to test the effectiveness of a finger toothbrush (I-Brush®) in removing plaque compared with a flat-trimmed manual toothbrush.

Material and methods: For this study, 37 subjects were selected, without previous experience of the use of the I-Brush®. Each subject received a finger brush (I-Brush®), a manual toothbrush (Butler® GUM 311), two written brushing instructions for both types of brushes, and a brush calendar. Subjects were given a period of 3 weeks to become familiar with the two types of brushes. During this period, the subjects were instructed to use the two types of brushes on alternate days. The brush calendar helped as a reminder and served to ensure compliance. No instructions regarding brushing time or frequency of brushing were given to the subjects, except that they should conform to their usual oral habits. After 3 weeks, all subjects were asked to abstain from oral hygiene procedures for 48 h prior to the experiment. In this experiment, the amount of dental plaque was scored by a trained examiner. The examiner (N.A.M.R.) used the modified Silness & Löe (1964) plaque index at six sites per tooth. After scoring, each subject received a new finger brush and a new manual toothbrush. The subjects brushed according to a split mouth protocol. Two contra-lateral quadrants were chosen randomly and were brushed with one randomly chosen brush and the two opposing contra-lateral quadrants with the alternate brush. The brushing was performed under supervision in front of a mirror. The available time for brushing was 2 min. for the entire dentition. Finally, the remaining plaque was scored again.

Results: The overall reduction in plaque was 79% for the manual toothbrush and 62% for the finger brush. The plaque removing efficacy of the finger brush was poorest at the approximal vestibular surfaces (55% plaque reduction) compared with the manual toothbrush (77% plaque reduction).

Conclusion: The plaque reduction of the finger brush is not an acceptable alternative to the use of a regular manual toothbrush.

Key words: fingerbrush; plaque; toothbrush

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The most important method for controlling dental disease is the control of plaque on the tooth surface. Thorough plaque control has been considered an essential factor in the prevention and treatment of periodontal diseases (Killoy et al. 1989).

In order to maintain health in the oral cavity, various products are available. Most people use a manual toothbrush to control plaque. With proper techniques and products, oral hygiene can be maintained at a level sufficient to prevent gingivitis and periodontal disease. For toothbrushes, the mechanical removal of dental plaque is achieved primarily through direct contact of the toothbrushes with teeth and gingiva together with the scouring action of the toothbrush filaments.

Although improvements have been made in toothbrush type and design, most people when brushing their teeth, only remove approximately 50% of the plaque (Jepsen 1998). For manufacturers, it is highly desirable to design a toothbrush that allows the average person to remove almost all plaque from his or her teeth on a daily basis. As yet, such a toothbrush has not been developed.

Recently, the I-Brush® (I-Brush, Tootec Gesellschaft für Dentalprodukte mbH, Tübingen, Germany) has been introduced. It is a new manual brushing method for people to control the amount of plaque. This brush is mounted on the index finger of the brushing hand. It uses the agility and sensitivity of the finger. Consequently, it could permit a better control over the finger pressure because the finger can actually feel the

tooth and gingival surfaces and help positioning the brush for more effective scrubbing. This would, in effect, allow the brush to reach less accessible tooth and gum surfaces.

The purpose of this study was to evaluate the effectiveness of plaque removal of the I-Brush® in comparison with an ADA-accepted manual toothbrush (Butler Gum 311®; Butler, John O. Butler Company, Chicago, IL, USA).

Material and Methods

Brush design (see Fig. 1)

The I-Brush® is a new approach in toothbrush design and can be compared to an elastic stocking topped by microfibres. This stocking is placed over a finger, preferably the index finger, and acts as a ''finger brush''.

The control brush was a regular flat trimmed manual toothbrush, the Butler Gum 311®. This is a multitufted toothbrush with a brush head measuring 21 mm in length and 6.5 mm in width. The bristle tufts are positioned in three rows, placed perpendicular to the straight handle.

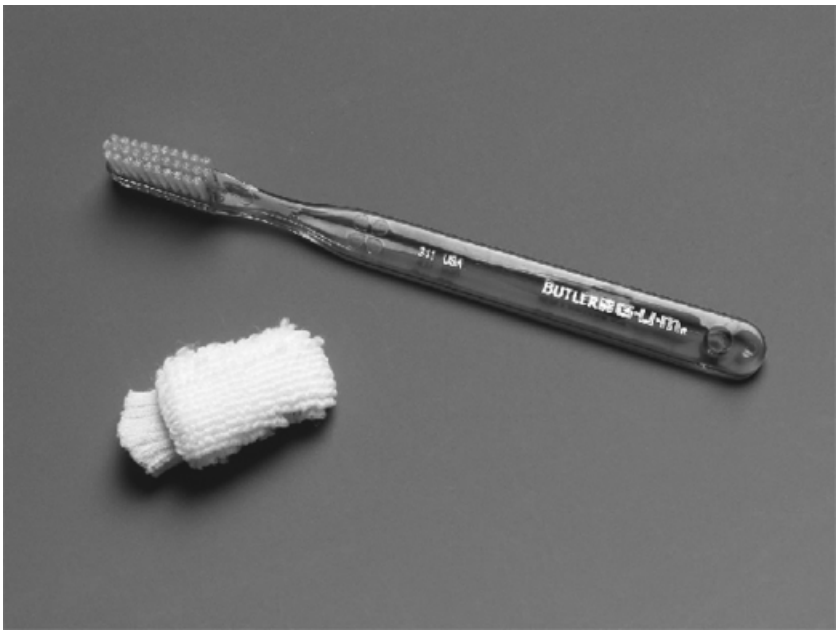

Fig. 1. Butler Gum 311® control brush and the I-Brush® finger toothbrush as a test.

Subjects

For this study, 37 healthy subjects of both sexes (11 male/26 female) with an average age of 24 years were selected. Information for the subjects was provided in a recruitment letter and subsequently at the first appointment. They were given a written explanation of the background of the study, its objectives and their involvement. After screening for their suitability, they were requested to give their written consent prior to enrolment into the study. All of the subjects were without any previous experience with the finger brush and had at least 20 teeth suitable for evaluation. Exclusion criteria were: a history of usage of antibiotics during 3 months prior to the study, signs of untreated caries, presence of acute oral lesions, orthodontic banding, partial dentures and multiple crowns or bridges.

Outline of the study

At the first appointment each subject received one finger brush and one manual (control) brush together with an explanatory letter for both brushes. The subjects received instructions in how to use both brushes properly in front of a mirror. Subjects were also provided with information about the maintenance of the I-Brush®. All participants in this study were given a familiarisation period of 3 weeks in order to achieve optimum dexterity with the brushes. During those 3 weeks the subjects were instructed to use the two brushes on alternate days. To help them remember which brush they had to use, a brush calendar was supplied. No instruction regarding brushing time and frequency of brushing was given, except that the subjects should conform to their usual oral hygiene habits.

The brushing experiment was designed as a split-mouth, single blind, randomised clinical study. After 3 weeks, all 37 subjects were requested to abstain from oral hygiene procedures for 48 h prior to the experiment to ensure enough plaque formation. At the second visit the examiner (N.A.M.R.) scored the plaque according to a modification of the Silness & Löe (1964) plaque index scored at six sites per tooth (Van der Weijden et al. 1993a, Danser et al. 2003). After scoring, the subjects received a new finger brush and a new manual toothbrush. Subsequently, in the absence of the examiner (N.A.M.R.), the subjects brushed in a split mouth order. The first assigned toothbrush, being either the I-Brush® or the Butler® GUM 311, was used in two randomly selected contra-lateral quadrants. In the opposing two contra-lateral quadrants the alternate toothbrush was used. The available time for the brushing procedure was 30 s per quadrant which is 15 s for the buccal and 15 s for the lingual surfaces. With the aid of a stopwatch, a sign was given to the subjects to change brushing from surface and quadrant at 15 s interval. The full-mouth brushing time therefore is representative of 2 min brushing. All toothbrushing took place in the absence of the examiner (N.A.M.R.) to retain blindness of the study. In order to maintain good visibility in front of the mirror, the subjects brushed without toothpaste. After finishing the brushing procedure, the remaining amount of dental plaque was again scored at six sites. All plaque assessments were performed by the same examiner (N.A.M.R.) using the same dental unit and operating lamp. At the time of the examinations, the examiner was unaware of the allocation of the brushes to the quadrants. Due to possible overlap, the central incisors, and when present the third molars, were excluded from recordings.

Statistical analysis

The average index score was determined for each individual. The percentage plaque reduction was calculated by dividing the difference between ''base'' and ''end'' scores by the baseline scores. Exploratory analysis was performed on different regions of interest to explore the origin of possible differences observed between the brushes. Brushes were compared using non-parametric statistics

Table 1. Overall plaque scores and percentage reductions in plaque for the finger brush (I-Brush®) and the manual brush (Butler Gum 311®) (SDs in parentheses)

	Finger brush	Manual brush	Significance**
mean base plaque	1.41 (0.32)	1.44 (0.28)	ns
mean end plaque	0.56 (0.23)	0.31 (0.17)	*
mean plaque reduction	62 (12)	79 (9)	*

*Statistical analysis $p<0.01$. **Tested with the Wilcoxon-test. ns, not significant.

Table 2. Exploratory analysis showing the percentage plaque reductions for different tooth types and surfaces (SDs in parentheses)

	Finger brush	Manual brush	Significance**
Anterior			
mean	69 (15)	84 (12)	*
Premolars			
mean	64 (16)	82 (11)	*
Molars			
mean	54 (13)	72 (14)	*
Surfaces vestibular			
approximal vestibular	55 (15)	77 (10)	*
mid-vestibular	87 (14)	94 (8)	*
all vestibular	64 (13)	82 (8)	*
Surfaces lingual			
approximal lingual	50 (15)	70 (14)	*
mid-lingual	78 (21)	88 (15)	*
all lingual	58 (14)	75 (13)	*

*Statistical analysis $p<0.01$. **Tested with the Wilcoxon test.

where appropriate. Values of $p<0.05$ were accepted as statistically significant.

Results

During this 3-week clinical trial, no adverse effects were found or reported for both brushes.

The overall means with respect to plaque removal are presented in Table 1. This provides the base- and end plaque scores for the finger brush and the manual toothbrush as well as the plaque reduction in terms of percentages. The mean base plaque score for the finger brush was 1.41 and 1.44 for the manual toothbrush. The mean end plaque score for the finger brush was 0.56 and 0.31 for the manual toothbrush. The manual toothbrush removed more plaque (mean plaque reduction of 79%) compared with the finger brush (mean plaque reduction of 62%).

In Table 2 the plaque reduction in terms of percentages for different tooth types and surfaces are presented. The reduction in plaque scores was higher for the manual brush than for the finger brush on all teeth and surfaces scored. Exploratory analysis showed that the origin of the difference between the two brushes is mainly attributable to a higher efficacy of the manual (control) brush on the approximal surfaces. It appeared that the highest difference in plaque reduction was found on the approximal vestibular aspect. On approximal vestibular surfaces the finger toothbrush had a 55% plaque reduction and the manual toothbrush had a 77% plaque reduction (Table 2). Thus the manual toothbrush removed 22% more plaque than the finger brush. On the approximal lingual aspect, the plaque reduction of the manual toothbrush was 20% higher as compared with the finger brush.

Discussion

There are a few studies that report on finger brushing but these describe the effect in relation to caries incidence (Warnakulasuriya 1988, Kaimenyi et al. 1993, Kane et al. 2001). No controlled studies were found, which compare finger brushing to a regular manual toothbrush with regard to plaque removal. There are, however, a few ''foam brush'' studies published over the years, which is the only brush design that has some resemblance with the I-Brush®. These brushes resemble a disposable soft sponge on a stick and have been dispensed to hospital patients for intra-oral cleansing and refreshing as early as the 1970s (Pearson & Hutton 2002). They are particularly used for oral care in medically compromised and immune compromised patients, to reduce the risk of oral and systemic infection.

Lefkoff et al. (1995) studied the effectiveness of such a disposable foam brush on plaque. In this study the regular manual toothbrush was found to be significantly more effective in retarding the accumulation of plaque from a plaque-free baseline on both facial and lingual surfaces. The foam brush did, however, show some plaque-preventive capabilities by maintaining plaque formation below 2 mm at the cervical margin of the tooth. Nevertheless, according to most authors, foam brushes should not be considered as a substitute for the regular toothbrush (Addems et al. 1992, Kambhu & Levy 1993, Lefkoff et al. 1995, Ransier et al. 1995).

In a study by Ransier et al. (1995) foam brushes were saturated with a chlorhexidine solution. Chlorhexidine has been shown to posses a broad spectrum of topical antimicrobial activity (Seymour & Heasman 1992). They found that the foam brush that had been soaked in chlorhexidine to be as effective as a regular toothbrush in controlling plaque and gingivitis levels. Therefore, if a toothbrush cannot be used in hospitalised patients, an alternative may be the use of chlorhexidine applied with a foam brush (Epstein et al. 1994).

The interdental gingiva fills the embrasure between two teeth, apical to their contact point. This is a protected area when teeth are in normal position. Most gingival diseases start in this interdental area (Löe 1979). The main reason for the difficulty in removing approximal plaque is that people have difficulty in allowing the bristles to make a proper scouring action across tooth and gingival surfaces. Foam swabs have been found to be particularly ineffective in removing plaque, which had accumulated in areas between teeth (Pearson & Hutton 2002). In the present study, the greatest difference in plaque reduction between both types of brushes was also found at these ''sheltered'' approximal sites. Therefore, the finger brush is not an acceptable alternative to a regular toothbrush. The question may then arise, whether the finger brush was designed as a replacement for the toothbrush. It could also be used as possible adjunct to oral hygiene, particularly when the necessary facilities for toothbrushing with tooth paste are not avail-

able, for example whilst travelling. This is particularly the case, when considering the frequent finding that toothbrushes remove only 50% of accumulated plaque, even after 2 min brushing (Jepsen 1998). In this study the finger brush actually removed 62% of the total plaque. However, this may reflect the dexterity of the volunteer group, where the manual brush removed 79% of the accumulated plaque.

Summary and Conclusion

During this 3-week clinical trial, no adverse effects were found or reported for both brushes. But both brushes were not comparably effective in controlling the amount of dental plaque. The results show that the finger brush removed less plaque than a regular manual toothbrush. In particular the approximal plaque reduction was poor in comparison with the manual toothbrush. Based on these results, it is concluded that there is no beneficial effect of the finger brush in comparison with a regular manual toothbrush.

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