Comparative Evaluation of Plaque Removal Effectiveness of Manual and Chewable Toothbrushes in Children: A Randomized Clinical Trial

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Abstract

Objective: In children, manual dexterity poses a problem with the use of manual tooth brushes (MB), resulting in inefficient plaque removal. Recently, novel chewable brushes (CB) have been introduced which could overcome this problem but are less researched in children. The objective of this study is to assess and compare the plaque removal effectiveness of CB with that of MB.

Materials and methods: A total of 60 patients aged 8 to 10 years were enrolled in a single-blinded randomized clinical trial. At baseline, disclosing solution was applied and the Turesky modification of the Quigley–Hein index (TQHI) plaque index and Loe and Silness gingival index were recorded. The subjects were randomly divided into two groups as group I (MB) and group II (CB) and they were instructed to use their respective brushes for a period of 1 week. For statistical comparison, the difference (prebrushing minus postbrushing) in average scores was calculated. Data were evaluated by the independent t test and paired t test, with $p < 0.05$.

Results: The overall plaque scores reduced from 1.71 ± 0.4 to 0.79 ± 0.24 when using CB and from 1.64 ± 0.64 to 1.13 ± 0.47 when using MBs. On lingual tooth surfaces, CB showed a plaque reduction of 38.70 ± 11.04 to 12.60 ± 4.79 compared to less reduction from 37.43 ± 14.26 to 28.73 ± 11.37 for MB. The overall gingival scores were also reduced from 0.33 ± 0.51 to 0.09 ± 0.07 when using CB and from 0.30 ± 0.33 to 0.19 ± 0.23 when using MB. Differences in scores between the two brushes were statistically significant ($p = 0.0001$).

Conclusion: It was concluded that the experimental CB was able to remove a significant amount of plaque, particularly on the lingual surfaces, and reduced gingival index scores, thereby improving oral hygiene and gingival health status.

Keywords: Chewable, Dental plaque index, Gingivitis, Oral health, Oral hygiene, Randomized clinical trial.

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Introduction

Good oral hygiene is essential for preventing dental caries and gingivitis, as it was well acknowledged that effective daily removal of plaque biofilms plays a central role in maintaining oral health. Among all the oral hygiene methods available, mechanical plaque removal with a manual toothbrush (MB) due to its ready availability and ease of use still remains the primary mode of maintaining good oral hygiene due to its affordability.[1] Manual tooth brushing is highly effective if performed in a correct manner and specified time.[2] It remains the most efficient long-term means of removing dental plaque in children, while children's ability to use the toothbrush varies greatly according to their age, individual dexterity, and motivation.[3]

Recently, chewable toothbrushes (CB) have been developed as an alternative to MB. These newer brushes are known to help improve motivation during oral hygiene performance, improve plaque removal, and elevate the level of oral hygiene in areas where mechanical access is difficult (especially in lingual surfaces). The Rolly mini CB is a recent innovation that offers an effective, convenient, and desirable alternative to the standard-sized toothbrush in the maintenance of oral hygiene. This is a disposable, all-in-one brush comprised of acacia senegal gum, mint aroma, xylitol, aspartame, sodium monofluorophosphate, limonene, linalool, eugenol, and cinnamal.[4]

Many articles have been published evaluating the effectiveness of plaque removal in adults, persons with disabilities, and children using manual and electric tooth brushes. However, limited research has been performed using CB.[5] Wherein Myoken et al. investigated the effectiveness of the CB in a care-dependent elderly population

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and noticed that chewing the brushes resulted in the removal of a significant amount of plaque.[6] In children, Bezgin et al. conducted a pilot study and found experimental CB to be as effective as a MB in removing dental plaque. More comprehensive studies are needed before this CB could be recommended for use in children.[4]

Therefore, considering the great importance of plaque removal in improving oral health, the aim and objective of this study was to assess and compare the plaque removal effectiveness of a CB with that of a MB, when used by children in the mixed dentition period.

Materials and Methods

The single-blinded randomized clinical trial was started after obtaining approval from the Institutional Review Board (IGIDSIEC2016 NRP50PGRSPPD) and Institutional Ethical Committee, Indira Gandhi Institute of Dental Sciences, Puducherry. The study population comprised of 60 children, based on the sample size calculation formula and from previous literature. Children aged 8–10 years with at least 20 teeth were included. They were selected based on clinical examination and inclusion and exclusion criteria from the Bless children home, Puducherry, after obtaining consent. Children who were regularly on antibiotics or other drugs, those who had oral soft tissue lesions, crowding of teeth, carious lesions (>3) and children with special health care needs were excluded from this study.

At baseline, disclosing solution (Alpha Plac, DPI) was applied to all the tooth surfaces to aid in identifying plaque. A total of 60 children were randomly selected and categorized into group I (MB) and group II (CB). Allocation concealment was done by using sealed envelopes, wherein the respective brushes (MB and CB) were randomly allocated by the toss of a coin to 60 children. The Turesky modification of the Quigley–Hein index (TQHI) was used to assess supragingival plaque and Loe and Silness gingival index (Table 1)[4,7] was used to assess gingival health status. TQHI scores were obtained from the buccal and lingual surfaces of all gradable teeth, and the average scores were calculated for each subject. Gingival index scores were obtained from the mesiobuccal, middle, distobuccal, and lingual surfaces of all gradable teeth, and again the average scores were calculated for each subject. After recording the individual scores, children were then transferred to a brushing area where they were instructed to brush their teeth for 2 minutes with either a randomly assigned MB or CB (Rolly Chewable Brush, UK), respectively, in the presence of a supervisor and an investigator. Children were instructed to follow the Fones brushing technique for MB as demonstrated in a model, CB was given to them and according to the manufacturer's instruction, children were told to grip the brush between their teeth, and use their teeth to swivel it from left to right, and then to use their tongue to move the CB around their mouth to brush all surfaces (Fig. 1).

Fig. 1: Chewable brushes (Rolly Chewable Brush, UK) tied with dental floss

The subjects were then instructed to brush their teeth with respective toothbrushes daily for 2 min for the next 7 days. In the final follow-up, they were again redisclosed with a disclosing agent and scoring procedures of both the TQHI and gingival indices as described above were repeated for each subject. All clinical examinations and pre and post index scorings were performed by the examiner blinded to both the toothbrushes. The obtained values were recorded, tabulated, and subjected to statistical analysis. An independent t test was used to determine the intragroup comparison and a paired t test to determine the intergroup comparison.

Results

The clinical study was conducted in 60 children aged 8–10 years old at Bless children residential home, Puducherry to compare and evaluate the plaque removal effectiveness of MB and CB in children. They were categorized into group I (MB) and group II (CB). Before and after intervention, indices were recorded and statistically analyzed.

The comparison of the plaque index and gingival index scores at different time intervals in the MB group was done (Table 2). The mean plaque scores on the labial surface for the children using MB at baseline and after 7 days were 37.83 ± 15.7 and 22.30 ± 11.44, and their differences were statistically significant ($p = 0.0001$). While on the lingual surfaces at baseline and after 7 days the scores were 37.43 ± 14.26 and 28.73 ± 11.37, which were also statistically significant ($p = 0.0001$). The total mean plaque index scores for the children using MB at baseline and after 7 days were 1.64 ± 0.64 and 1.13 ± 0.47 and was found to be statistically significant ($p = 0.0001$). While for the gingival index, the mean gingival index scores for the children using MB at baseline (0.30 ± 0.33) and after 7 days (0.19 ± 0.23) were statistically significant ($p = 0.026$). Thus, from the above results, a gradual improvement in the oral hygiene and gingival health was observed with the use of MB from baseline to 7 days.

Similarly, plaque index and gingival index scores were compared between different time intervals for the CB group (Table 3). On the labial surface of teeth, the mean plaque scores on using CB at baseline and after 7 days were 38.07 ± 9.67 and 23.20 ± 8.47 and the differences were statistically significant ($p = 0.0001$). The mean plaque scores on the lingual surface of teeth in children using CB at baseline (38.70 ± 11.4) and after 7 days were 12.60 ± 4.79, displaying a statistically significant ($p = 0.0001$) value.

Table 1: Plaque (TQHI) index and gingival index (Loe and Silness)

Turesky modification of the Quigley–Hein index		Gingival index (Loe and Silness)
Scores	Criteria	Criteria
0	No plaque	Normal gingiva
1	Isolated areas of plaque at gingival margin	Mild inflammation: slight change in color and slight edema. No bleeding on probing
2	Thin band of plaque at gingival margin (≤1 mm)	Moderate inflammation: Glazing, redness, and slight edema, bleeding on probing
3	Plaque covering up to 1/3 of the tooth surface	Severe inflammation: marked redness and edema, ulceration, tendency to spontaneous bleeding
4	Plaque covering between 1/3 and 2/3 of the tooth surface	
5	Plaque covering ≥2/3 of the tooth surface	

Table 2: Comparison of plaque index and gingival index scores between different time intervals in the MB group

	Baseline	7 days	t	df	p
Plaque labial surface	37.83 ± 15.7	22.30 ± 11.44	10.25	29	0.0001
Plaque lingual surface	37.43 ± 14.26	28.73 ± 11.37	8.66	29	0.0001
Plaque index	1.64 ± 0.64	1.13 ± 0.47	12.57	29	0.0001
Gingival index	0.30 ± 0.33	0.19 ± 0.23	2.34	29	0.026

Table 3: Comparison of plaque index and gingival index scores between different time intervals in the CB group

	Baseline	7 days	t	df	p
Plaque labial surface	38.07 ± 9.67	23.20 ± 8.47	12.25	29	0.0001
Plaque lingual surface	38.70 ± 11.04	12.60 ± 4.79	17.35	29	0.0001
Plaque index	1.71 ± 0.41	0.79 ± 0.24	20.74	29	0.0001
Gingival index	0.33 ± 0.51	0.09 ± 0.07	2.61	29	0.14

Table 4: Comparison of plaque index scores between the MB group and the CB group at baseline and 7 days

	MB N = 30, mean ± SD	CB N = 30, mean ± SD	t	df	p
Baseline plaque labial surface	37.83 ± 15.7	38.07 ± 9.67	0.069	58	0.945
Baseline plaque lingual surface	37.43 ± 14.26	38.70 ± 11.04	0.385	58	0.702
Baseline plaque index	1.64 ± 0.64	1.71 ± 0.41	0.471	58	0.640
7 days plaque labial surface	22.30 ± 11.44	23.20 ± 8.47	0.346	58	0.730
7 days plaque lingual surface	28.73 ± 11.37	12.60 ± 4.79	7.158	58	0.0001
7 days plaque index	1.13 ± 0.47	0.79 ± 0.24	3.489	58	0.0001

Table 5: Comparison of gingival index scores between the MB group and the CB group at baseline and 7 days

	MB N = 30, mean ± SD	CB N = 30, mean ± SD	t	df	p
Baseline gingival index	0.30 ± 0.33	0.33 ± 0.51	0.304	58	0.762
7 days gingival index	0.19 ± 0.23	0.09 ± 0.07	2.37	58	0.021

The total mean plaque index scores for the children using CB at baseline and after 7 days were 1.71 ± 0.41 and 0.79 ± 0.24, which were also found to be significant ($p = 0.0001$). However, the mean gingival index scores for the children using CB at baseline and after 7 days were 0.33 ± 0.51 and 0.09 ± 0.07 and the differences were not statistically significant ($p = 0.14$). Thus, from the above results, an improvement in the plaque scores was observed, while only moderate decrease in the gingival index scores was seen in the CB group.

On comparison of the plaque index scores between group I (MB) and group II (CB) at baseline and after 7 days, the mean baseline plaque index scores on the labial surfaces using MB and CB were 37.83 ± 15.7 and 38.07 ± 9.67 ($p = 0.945$), and for the lingual surface ($p = 0.702$), these p values were statistically insignificant. Also, the mean total baseline plaque index scores for children using MB and CB were not significant statistically ($p = 0.640$). The mean plaque scores after 7 days on the labial surface when using MB and CB were 22.30 ± 11.44 and 23.20 ± 8.47 and the differences were not statistically significant ($p = 0.730$). However, the mean plaque scores after 7 days on the lingual surfaces of teeth in children using MB and CB were 28.73 ± 11.37 and 12.60 ± 4.79, were found to be statistically significant and also the total plaque index scores between the groups after 7 days were statistically significant ($p = 0.0001$). It can be inferred that a statistically significant increase from the baseline to after 7 days of plaque index values in the CB group when compared to MB group was observed on the lingual surfaces than on the labial surfaces of teeth (Table 4).

When comparing the gingival index scores between MB and CB groups at baseline and after 7 days (Table 5), the mean gingival index scores for the children using MB and CB at baseline were 0.30 ± 0.33 and 0.33 ± 0.51 and the differences were not statistically significant ($p = 0.762$). However, after 7 days the mean gingival index scores for the children using MB and CB were 0.19 ± 0.23 and 0.09 ± 0.07 and statistically significant ($p = 0.021$). From these results, a significant improvement in the gingival health from baseline to 7 days follow-up was observed with the use of CB when compared to MB.

DISCUSSION

This study was conducted in the population aged 8–10 years as effective handbrushing requires a certain degree of manual dexterity, this tooth brushing skill is usually developed in children aged 8 years and above. However, in our present study, the Fones technique was introduced for the effective removal of plaque. The Fones method brought about a clear advantage in terms of gingivitis and hygiene skills and it was easier to remember after a single training session. Besides, the children enjoyed brushing their teeth with the Fones method and this was in accordance with the studies by Harnacke et al. and Joybell et al.[8,9]

Based on the study of Bezgin et al.,[4] the sample size was calculated as the minimum sample of 60 was required to detect a significant difference between the two brushes tested and also using the sample size formula. Residential home was selected in order to standardize the diet, oral hygiene practices, and to monitor the children for a week during the trial.

The MB are considered to be principal devices for home care plaque removal.

However, evidence from more recent studies indicates that bristle wear of toothbrushes may not impede the effectiveness of plaque removal, but it might be affected by manual dexterity in children. According to Bezgin et al., a novel and recently innovated CB is more efficient than the MB as a technically adequate brush and patient compliance is required for the effectiveness of MB. In order to avoid the risk of swallowing, the manufacturer of theCB does not recommend its use in children under 6 years.[4] Thus, we tied dental floss in the center of CB for additional safety, although the age group we selected was well beyond the risk.

The plaque index (TQHI) is a site-related plaque scoring method used in the present study for comparing toothbrush efficacy, it was well suited for recording interproximal plaque in children according to Bezgin, those who have abundant gingival papillae in interproximal areas have an advantage of clear objective definitions of each numerical score included in the index.[4] Alse et al.[10] also assessed the oral hygiene status using the TQHI and found it to be effective. For recording the gingival index score, the gingival index system as proposed by Loe and Silness was used, which is entirely confined to qualitative changes in the gingival soft tissues.[7] Plaque disclosing solution was used in identifying the pathogenicity of plaque,[11] which would help in better recording of indices.

The present study results showed that the overall plaque and gingival scores were significantly reduced with both the CB and MB, while statistically significant differences existed between the two brushes. In contrast, Bezgin et al.,[4] within the limitation of his study, found that the experimental CB was found to be as effective as a MB in removing plaque. However, in our study, the experimental CB was more efficient in removing plaque from the lingual surfaces than on the labial surfaces in children. These results are consistent with those of a previous study by Myoken et al.[6] who also found that CB was capable of removing a significant amount of plaque, particularly on the lingual surfaces in care-dependent elderly population. One possible reason for the differences in plaque removal could be that children would spend less time on manual brushing of the lingual surfaces, whereas children chewing the experimental CB may unconsciously spend more time on chewing the CB on the lingual surfaces like a chewing gum.

Many different factors such as frequency, duration, technique, thoroughness of tooth brushing, manual dexterity, motivation, individual pathogenicity of plaque formation, type of dentifrice used, regularity of subjects, and novelty effect might interfere with results. In our study, the better results of CB could have been due to the novelty of the brush, which was needed to be chewed like a chewing gum. Thus, the results of this study demonstrate that CB have great potential to remove plaque, thereby improving the oral hygiene and gingival health efficiently.

The duration of the study could be an important criterion, which could affect the results, especially when applied to children. According to Bastiaan, plaque control improves when periods of brushing increases.[12] However, within the limitations of our study, 1 week follow-up was done as Zimmer et al.[13] and Wolff et al.[14] stated that 1 week was enough to assess the plaque removal efficacy because it is a matter of only hours before visible plaque reappears even on professionally cleaned teeth.[15] Therefore, further long-term studies are recommended before this CB could be recommended for children.

CONCLUSION

The chewable brush was able to remove a significant amount of plaque, particularly on the lingual surfaces, demonstrating its effectiveness for plaque removal, thereby improving the oral hygiene and gingival health status.

More additional long-term studies are needed before this CB could be recommended as an adjunct for use in high caries active children.

CLINICAL RELEVANCE

- Considering this, a pediatric dentist can use the chewable brush as an alternative for the control of dental plaque and gingivitis.
- It also helps to motivate and elevate interest in brushing in children.

REFERENCES

1. Malekafzali B, Biria M, et al. Plaque removal by manual and electric toothbrushing among children. EMHJ 2011;17(2):115–120.
2. Costa CC, Filho C, et al. Plaque removal by manual and electric toothbrushing among children. Pesqui Odontol Bras 2001;15(4):296–301. DOI: 10.1590/S1517-74912001000400005.
3. Das UM, Singhal P. Tooth brushing skills for the children aged 3–11 years. J Indian Soc Pedod Prevent Dent 2009;27(2):104–107. DOI: 10.4103/0970-4388.55335.
4. Bezgin T, Dag C, et al. How effective is a chewable brush in removing plaque in children? A pilot study. J Pediatr Dent 2015;3:41–45. DOI: 10.4103/2321-6646.155557.
5. Silverman J, Rosivack G, et al. Comparison of Powered and Manual Toothbrushes for Plaque Removal by 4- to 5-year-old Children. Pediatr Dent 2004;26:225–230.
6. Myoken Y, Yamane Y, et al. 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;16:83–86.
7. Damle SG, Patil A, et al. Effectiveness of supervised toothbrushing and oral health education in improving oral hygiene status and practices of urban and rural school children: a comparative study. J Int Soc Prevent Communit Dent 2014;4:175–181. DOI: 10.4103/2231-0762.142021.
8. Joybell C, Krishnan R, et al. Comparison of Two Brushing Methods-Fone's vs Modified Bass Method in Visually Impaired Children Using the Audio Tactile Performance (ATP) Technique. JCDR 2015;9(3):19–22. DOI: 10.7860/JCDR/2015/11307.5651.
9. Harnacke D, Mitter S, et al. Improving oral hygiene skills by computer-based training: a randomized controlled comparison of the modified Bass and the Fones techniques. PLoS One 2012;7(5):1–7. DOI: 10.1371/journal.pone.0037072.
10. Alse ASS, Anandkrishna L, et al. Educational intervention on the plaque score among hearing impaired children. J Adv Clin Res Insights 2015;1:1–5. DOI: 10.15713/ins.jcri.37.
11. Jayanthi M, Shilpapriya M, et al. Efficacy of three-tone disclosing agent as an adjunct in caries risk assessment. Contemp Clin Dent 2015;6:358–363. DOI: 10.4103/0976-237X.161887.
12. Bastiaan RJ. The cleaning efficiency of different toothbrushes in children. J Clin Periodontol 1986;13:837–840. DOI: 10.1111/j.1600-051X.1986.tb02239.x.
13. Zimmer S, Dider B, et al. Clinical study on the plaque removing ability of a new triple headed toothbrush. J Clin Periodontol 1999;26:281–285. DOI: 10.1034/j.1600-051X.1999.260503.x.
14. Wolff D, Pioch T, et al. Effect of a crossover design on the 24-hour plaque regrowth. Int Poster J Dent Oral Med 2005;3:279.
15. Sharma A, Arora R, et al. Clinical evaluation of the Plaque removing Ability of Four Different Toothbrushes in Visually Impaired Children. Oral Health Prev Dent 2012;10:1–6.