

Do really parents brush their children's teeth better?



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Abstract

Aim Plaque removal from first permanent molar teeth was evaluated when conventional and a new silicone tooth and gum brush was used. Also, the effectiveness of parents' brushing was compared with childrens'.

Materials and methods Study design: This crossover clinical study was conducted with 9 children aged 5 to 7 years, with 18 mandibular first permanent molar teeth which were partially erupted. Four appointments were planned at one-week intervals and at every appointment, dental plaque on teeth was disclosed first. At their first appointment, the children were given a conventional toothbrush, and at their second appointment they were given a silicone tooth and gum brush. Then, at the third appointment, parents performed brushing with a conventional toothbrush, and then brushed with a silicone tooth & gum brush at the fourth appointment. Before and after brushing, photographs were taken for baseline and final plaque scores to determine Occlusal Plaque Index with Image Analysis Software Program. Statistics: Anova was used for comparison of groups with $p < 0.05$ considered to be significant.

Results There was statistically significant difference between baseline and final plaque scores among all of the groups ($p < 0.05$) but, there was not statistically significant difference between the groups ($p > 0.05$).

Conclusions Children under the age of nine are usually believed to lack the developmental skills needed to brush their own teeth, and as a result, the silicone tooth & gum brush might be recommended instead of brushing with parents.

Introduction

Occlusal surfaces of permanent molar teeth are the most caries prone sites during mixed and permanent dentition stages [Chestnutt et al., 1996; Ekstrand et al., 2000]. Complex morphology of pit and fissures of the first permanent molar teeth make mechanical cleaning difficult, favouring food retention. Also, morphology of teeth acts as an inhibiting factor for fluoride to penetrate deeply in order to eliminate caries progression or slow the existing lesions [Pearce et al., 1999]. This fact makes the occlusal surfaces of molar teeth to be a vulnerable site for caries formation and hence 85% of the caries-affected areas are occlusal surfaces of molar teeth [Hicks and Flaitz, 1993; Waggoner and Siegal, 1996].

Plaque accumulation and formation of caries peaks during the eruption stages of the first permanent molar teeth. During the first 12–18 months of the eruption process, risk for caries development is at its highest and it diminishes over time as tooth erupts into occlusion [Carvalho et al., 1989; Carvalho et al., 1992; Carvalho et al., 2009]. The reason behind this is thought to be the fact that eruption period takes a long time and that during this process occlusal surfaces are covered with partial gingiva and cannot be adequately brushed with conventional brushing methods or toothbrushes [Carvalho et al., 1989]. Preventing caries formation by controlling plaque during the eruption period of the first permanent molar teeth is an important key factor for maintaining the oral health of children throughout life [Carvalho et al., 1989; Carvalho et al., 1992].

General belief about brushing is that, since children aged 3 to 6 years lack the developmental skills to brush their own teeth, brushing with parents should be recommended [AAPD, 2012; Dean and Hughes, 2014; Manchanda et al., 2014; Freeman, 2015; Chang et al., 2018]. As for children aged between 6 to 12 years, it is important for parents to be involved as well, and it is especially necessary for parents to help brushing maxillary and mandibular molar regions [AAPD, 2012; Manchanda et al., 2014; Chang et al., 2018]. However, the development of motor skills may vary from child to child and it is generally advised that children are able to brush by themselves when they can tie their own shoelaces. Until then, they should be under parental supervision and guidance [Carvalho et al., 1989; Carvalho et al., 1992; Carvalho et al., 2009].

Tooth brushing skill is notoriously inconsistent in children due to their developing dexterity as well as difficulty in effectively navigating a toothbrush around the both primary and erupting permanent teeth, which are characteristics of a

KEYWORDS Children; Plaque index; Plaque removal; Oral hygiene; Toothbrush.

mixed dentition. Children may lack the foresight to envision the long-term consequences of chronic insufficient oral hygiene. These factors raises the propensity for dental plaque build-up, especially in harder to access areas where the caries and gingival inflammatory processes arise [Davidovich et al., 2017; Shaghaghian et al., 2017]. For appropriate oral hygiene, dental flossing, tooth brushing, regular dental visits, and preventive dental procedures such as fissure sealant and fluoride therapy are recommended. AAPD Guideline [2016] suggests that parents brush their children's teeth twice a day with a soft toothbrush of appropriate size along with fluoridated toothpaste.

A growing body of clinical research studying the efficacy of power toothbrushes in adults has established a significant advantage in plaque removal effectiveness over manual toothbrushes [Klukowska et al., 2012; Kurtz et al., 2016]. The class of power toothbrushes employing the oscillating and rotating mode of action has been uniquely singled out in systematic reviews as producing statistically significant, superior plaque control relative to standard manual toothbrushes [Yaacob et al., 2014]. In contrast to oral hygiene research in adults, less scientific studies have been focused on plaque removal and self-care in children, including the relative merits of differing toothbrush types in paediatric patients [Silverman et al., 2004; Davidovich et al., 2017].

Plaque indices and brushing techniques basically measure the plaque accumulation on buccal-lingual or proximal surfaces and overlook the occlusal surfaces, where the most carious lesions occur. Plaque indices are essentially based on a subjective assessment of the thickness of the plaque, assessing tooth area covered by plaque or presence and absence of plaque on tooth surface or tooth sites. All of these rely on the clinician's ability to visually estimate or score the areas of disclosed plaque, which leads to inter- or intra-examiner errors and a low or absent reproducibility. Thus, scoring systems which take photographic images and calculate absolute or proportional number of dental plaque units might yield an even higher degree of precision [Smith et al., 2001; Splieth and Nourallah, 2006; Cinar et al., 2013].

The first aim of this crossover clinical study was to compare the effectiveness of plaque removal in the first permanent molar teeth that have not fully erupted when a conventional and a new silicone tooth and gum brush is used. The secondary aim was to compare parents' and children's effectiveness on plaque removal. The hypothesis was that parents would brush better with conventional toothbrush, and that there would be no difference when the silicone tooth and gum brush is used.

Materials and methods

This crossover clinical study was approved by University Institutional Review Board and Ethics Committee (Project no: D-KA 15/23) and supported by University Research Fund. Sample size calculation revealed that differences could be detected at 16 teeth at power of 0.8 with $\alpha:0.05$. Thus, this study was conducted with 18 mandibular first permanent molar teeth from nine children aged five to seven years old, who were referred to the University, Department of Pediatric Dentistry clinic for routine control. Inclusion criteria were: mandibular first permanent molar teeth below the occlusal plane, but without gingival coverage. The included teeth were free from cavities, fillings or sealants and the patients were healthy. For all of the participating children, informed consents

were obtained from their parents'. However, the participants were blind about the fact that partially erupted molar teeth would be examined and they were informed on oral hygiene control in general.

A crossover study design was chosen so that the groups would be identical and bias could be eliminated. Four appointments at one-week intervals were set for children's and parents' brushing, alternating a conventional toothbrush and a silicone tooth and gum brush. Each child was examined twice at each appointment to investigate the baseline and final plaque status. For all appointments, the teeth were isolated with cotton rolls and the plaque on occlusal surfaces of all teeth was disclosed with dental plaque disclosing agent (Mira-2-tone, Hager andWerken, Duisburg, Germany).

Appointment 1: Patients were instructed to abstain from any oral hygiene for a 24 hours. Demonstration on how to brush using cross-tooth brushing technique was shown using a demonstration model, since Modified Stillman technique was preferred as brushing technique. After application of the disclosing solution for 10 seconds, the tooth was rinsed and then photographed with a digital camera (Canon EOS 600D, Canon Corporation, Tokio, Japan) for evaluating the baseline plaque scores. Following the baseline photograph, children were given a conventional toothbrush with nylon bristles (Fig. 1A) (Jack N' Jill Bio Toothbrush, Melbourne, Australia), a standard toothpaste (Fig. 1A) (Jack N' Jill Natural Toothpaste, Melbourne, Australia) and were asked to brush for two minutes. Following the brushing, plaque on the tooth was colored and photographed again to evaluate the final plaque scores.

Appointment 2: The same steps were followed as the first appointment, but a different toothbrush was used, and demonstration of how to use the toothbrush was shown on a demonstration model at the beginning of the appointment. Children were given a silicone tooth and gum brush (Fig. 1A) (Silicone Tooth and Gum Brush, Jack N' Jill, Australia) which has double sided soft silicone bristles (Fig. 1B) and were asked to brush for two minutes. Subjects were taught to use the silicone tooth and gum brush with chewing movements, different than conventional brushing. toothbrush. Subsequently, plaque on the tooth was coloured and photographed again.

Appointment 3: Brushing was performed by parents with conventional toothbrush, otherwise same procedures were followed as the first appointment.

Appointment 4: Brushing was performed by parents with



FIG. 1 Photograph of the silicone tooth and gum brush, the conventional toothbrush and toothpaste (A); detail of double sided soft silicone bristles of silicone tooth and gum brush (B).



FIG. 2 Intraoral photographs with (A) outlined occlusal surface and (B, C) outlined marked plaque areas with Image Software Analysis Program.

a silicone tooth and gum brush, otherwise same procedures were followed as the second appointment.

The analysis of the occlusal plaque score was conducted similarly as the method described by Nourullah and Splieth [2004]. According to the method, all images of occlusal surfaces were transformed to an open-source Image Analysis Software Program (V.1.42, National Institutes of Health, Bethesda, MD, USA). Then, borders of occlusal surfaces (Fig. 2A) and plaque areas at the occlusal surface (Fig. 2B, 2C) were hand-marked using a computer mouse by one examiner. This procedure was repeated for each tooth three times in the same sitting, and was repeated by the same examiner a second time after two weeks. The mean value of these measurements was used for analysis. Sum of the marked plaque areas and occlusal surfaces were calculated in pixels. Then, Occlusal Plaque Index was calculated as the number of pixels in marked plaque area/occlusal surface.

Data analysis was performed using IBM SPSS Statistics Version 22 (IBM Corporation, Armonk, NY, USA) and normal distribution of variables were analysed with Shapiro Wilk's test. Following that T-paired test used for baseline and final evaluations of matched groups and ANOVA for group comparisons and p-value was determined as 0.05 for the level of significance.

Results

The participants of the present study were nine children with an average age of 6.2 years, and 55.5% of them were boys. Baseline and final occlusal plaque index scores in pixels and significances between them are shown in Table 1. According to the results of the T-paired test, there was

significant difference between baseline and final occlusal plaque index scores for all of the groups ($p < 0.05$). The occlusal plaque scores for both children and their parents decreased statistically while using both toothbrushes ($p < 0.05$) (Fig. 3).

Table 2 shows the change between mean baseline and final occlusal plaque index scores in pixels while comparing four different groups. Although there was not any significance between the groups ($p > 0.05$), the results showed that using silicone tooth and gum brush with children or with parent had decreased occlusal plaque index scores more than conventional toothbrushes.

Discussion

The eruption period of first permanent molar teeth is considered the most risky for caries onset due to the factors related to patients and their teeth [Dean and Hughes, 2004; AAPD, 2012; Manchanda et al. 2014; Chang et al., 2018]. Therefore, for children aged 5 to 7 years it is usually recommended to perform tooth brushing with parents. Due to the difficult plaque elimination at these ages, there are some studies evaluating different brushing and teaching techniques such as the use of a demonstration model or watching videos. Although there was no statistical difference between plaque elimination of different brushing and teaching techniques, authors stated that showing brushing technique on a demonstration model increases plaque elimination, so it might improve oral health [Ceyhan et al., 2018; Salama et al., 2016].

The present study investigated whether there would be any difference in plaque elimination for erupting first permanent molar teeth between parents and children while using a conventional and a new silicone tooth and gum brush. Results

		n	Plaque condition in pixels					T-paired Test	
			Mean	Median	Minimum	Maximum	SD	t	p
Children with silicone tooth & gum brush	Baseline	18	6.880	6.503	3.088	11.872	2.782	7.4	0.0001
	Final	18	3.771	3.595	1.051	7.655	1.903		
Parents with silicone tooth & gum brush	Baseline	18	7.730	7.433	1.756	14.871	3.754	6.7	0.0001
	Final	18	4.130	3.912	1.648	7.872	1.495		
Children with conventional toothbrush	Baseline	18	6.204	6.368	2.318	10.002	2.083	10.6	0.0001
	Final	18	3.850	3.669	1.392	7.769	1.917		
Parents with conventional toothbrush	Baseline	18	5.870	5.314	3.093	9.731	1.897	9.2	0.0001
	Final	18	3.622	3.477	1.668	6.174	1.480		

n: Number of teeth, SD: Standard deviation, * $p < 0.05$

TABLE 1 Baseline and final occlusal plaque index scores for the first permanent molar teeth.

showed that both parents and children were able to eliminate plaque on the occlusal surface of teeth, however there were no differences among the type of toothbrush and who performed the brushing. So, our null hypothesis is partly rejected since there was no statistically significant difference between parents and children for the conventional toothbrush either.

The results of the present study showed that regardless of the person performing the brushing and the toothbrush used, plaque elimination was significant for all groups. According to these results, we could say that the silicone tooth and gum brush was found to be compatible for five to seven year old children for brushing permanent molar teeth, although the brush was manufactured for children aged 2 to 5 years old. This result can be achieved due to the length and wideness of the brush and the effectiveness of double-sided, soft silicone bristles' during brushing. The results might have been different if the brushing was performed at home and/or for a longer period of time, and may also be associated with motivation since performing in a dental office would be likely to enhance the brushing for all subjects.

Tooth brushing technique normally comprises strong horizontal, vertical and/or circular movements and also has a very important role in maintaining oral health, as well as other factors, such as the developmental skills of patient, brushing time, or toothbrush and toothpaste. The modified Stillman technique was the preferred tooth brushing method in this study, which incorporates a rolling stroke, minimises gingival trauma and increases the efficiency of biofilm removal from tooth surfaces [Sharma et al., 2012]. However, the silicone tooth and gum brush is different than the conventional toothbrush, and the children and their parents do not need to know or perform the modified Stillman technique for an effective

brushing. This technique permits cleaning of teeth and gums together with only the chewing movements and the double-sided, soft silicone bristles make the brushing effective and easy. So, according to the results, there was no significant difference between the occlusal plaque index scores for the different types of toothbrushes and children could use silicon tooth and gum brushes instead of conventional toothbrushes.

Also, proper oral hygiene is important for the general health of a child. The ingredients of toothbrushes and toothpastes should be harmless for children and ecological for the environment. The toothpaste was standard for each group in the present study in order to prevent differences between the occlusal plaque index scores of different toothbrushes. The toothpaste was rich in xylitol, which has caries preventive effects and is especially recommended by dentists. Also, the silicone tooth and gum brush was made of 100% medical food-grade silicone and did not include bisphenol-A (BPA) and polyvinyl chloride (PVC). The conventional toothbrush had nylon rounded bristles, which provide soft brushing as recommended by the AAPD and an ergonomic handle made from 100% cornstarch that was not from genetically modified crops (GMO). Also, it was BPA- and PVC-free just like the silicone tooth and gum brush. (<https://au.jackandjillkids.com/>. Accessed 18 January 2019.) So, we should accept that oral hygiene is an important factor for general health, but it is also important that the properties and ingredients of the products are not harmful for children and nature.

Toothbrushes during brushing can lead to adverse events, such as gingival traumatic injury and lesions, as well as more serious adverse events, such as ingestion, impaction and instant trauma. The occurrence of these events can be classified as incidental, as was deduced from case reports. All cases of gingival traumatic injury were related to the excessive use of a toothbrush and primarily involved gingiva. Lesions were triggered by manual tooth brushing in 9 of the cases and by a powered toothbrush in one case. The majority of the trauma cases were caused by an accidental fall while brushing the teeth or while just holding the toothbrush in the mouth. Most often, the age of the subjects involved was less than 10 years old [Haytac et al., 2008]. The authors of a review recommended that people should not to walk or run with toothbrushes in their mouths. This is especially true for small children, who must always be supervised by parents or caregivers during the brushing period [Oliveira et al., 2014]. Due to the silicone structure of the tooth and gum brush, it might be preferred for younger children over the manual or powered toothbrushes to prevent these accidental injuries.

Categorised scoring systems are generally used for

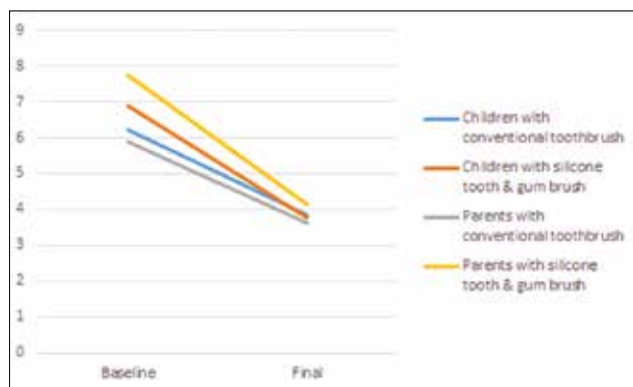


FIG. 3 Baseline and final occlusal plaque index scores for all groups.

	n	Mean	SD	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Anova	
					Lower Bound	Upper Bound			F	p
Children with silicone tooth & gum brush	18	3.1	1.8	0.4	2.2	4.0	0.7	6.5	2.4	0.074
Parents with silicone tooth & gum brush	18	3.6	2.7	0.6	2.3	4.9	0.1	8.1		
Children with conventional toothbrush	18	2.4	0.9	0.2	1.9	2.8	0.9	4.2		
Parents with conventional toothbrush	18	2.2	1.0	0.2	1.7	2.8	1.0	4.5		
Total	72	2.8	1.8	0.2	2.4	3.3	0.1	8.1		

n: Number of teeth, SD: Standard deviation, Std: Standard, * $p < 0.05$

TABLE 2 Mean occlusal plaque index scores for each group.

investigating dental plaque on teeth [Carvalho et al., 1989; Addy et al., 1998; Goncalves et al., 2007; Cinar et al., 2013]. However, these systems depend on the examiners judgement, and therefore are vulnerable to bias. In order to eliminate clinicians' visual estimation, computer-assisted systems were suggested [Splieth and Nourallah, 2006]. This method includes taking photos of the occlusal surfaces and then calculating the occlusal plaque index scores by pixel analysis. This method was found to be sensitive and reproducible for investigating occlusal plaque in erupting molars [Nourallah and Splieth, 2004; Splieth and Nourallah, 2006]. In the present study, occlusal plaque index scores were calculated by pixel analysis in order to eliminate subjective assessments [Smith et al., 2001; Splieth and Nourallah, 2006].

The results of a previous study, comparing manual and powered toothbrushes showed that powered toothbrushes are better for plaque elimination for erupting molars [Nourallah and Splieth, 2004]. Another study comparing different methods and toothbrushes for plaque removal in partially erupted molars also showed that the type of toothbrush plays an important role [Goncalves et al., 2007; Borzekowski et al., 2009]. Our findings may be considered compatible with the mentioned studies. The silicone tooth and gum brush was found to be better in eliminating occlusal plaque in erupting first permanent molar teeth, but this was not statistically significant. However, it should be kept in mind that within the limits of this study, we only tested with two minutes of brushing time with only one interval at the dental office. Further crossover clinical studies with longer follow-up times are needed to gain more clear results.

The findings of this study suggest that children may be able to brush their teeth effectively starting at the age of 5 years old, when detailed information, supervision, and motivation are provided. Both toothbrushes should be tested at home to see if the effectiveness of the brushing decreases for children when they are not at the dental office, where they might feel under pressure to do a good job. A demonstration model was also used in this study to teach parents and children how to brush with both toothbrushes for all teeth. We chose to blind the fact that we would be investigating the plaque specially on first permanent molars in order to imitate daily regular brushing on each tooth and eliminate possible overbrushing of the first permanent molars. For the same reason, we used the plaque disclosing agent on the occlusal surfaces of all teeth, not just the first permanent molars.

Conclusions

Considering the findings from the present study, it can be concluded that it does not matter whether the teeth were brushed by children or by parents. However, the development of children's health and oral health literacy should be achieved through a long path by working with children and their parents. This would allow us to assist them in converting oral health rules into their own oral health practices. Also, due to the complex occlusal surface and location of first permanent molars, patients and their families should be educated about the eruption age, phase, and brushing. Within the limits of this study, we believe that the silicone tooth and gum brush should be recommended instead of conventional toothbrushes during this eruption period.

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