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Tooth-brushing behaviour in 6–12 year olds

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Background. A common clinical finding is that many schoolchildren display a nonacceptable oral hygiene.

Aim. To evaluate the tooth-brushing behaviour in children aged 6–12 years.

Design. The study used a cross-sectional descriptive design. Children aged 6, 8, 10, and 12 years in an elementary school in a middle class area in Umeå, a city in northern Sweden, were invited and 82 (82%) consented. Visible plaque on buccal surfaces of incisors and canines was recorded from photographs of the participant's teeth before and after brushing using the scores of the Green and Vermillion Oral Hygiene Index. Brushing technique was recorded with a video camera. A questionnaire was used to collect data about oral hygiene habits at home.

Results. The ratio between the sum of plaque scores after and before brushing was statistically significantly higher in the 6-year-old group compared with the 10-year olds, ($P < 0.05$). There was a negative correlation between time spent for brushing and the ratio between the sum of plaque scores after and before brushing ($r = -0.31$, $P < 0.01$). The lowest correlation was displayed in the youngest age group ($r = 0.07$, $P > 0.05$). Six-year olds spent statistically significantly less time for brushing than older children ($P < 0.05$).

Conclusion. Plaque removal from buccal surfaces from brushing was poor and averaged 19% for 6-year olds and 30% for older children. The results of brushing for children aged 8–12 years could benefit from increasing tooth-brushing time. Children could be given an increasing responsibility from 7 to 8 year of age but parental help is motivated up to 10 years of age.

Introduction

Dental caries still has a comparatively high prevalence in children in spite of intensive efforts with preventive strategies. In school-ages, 60–90% and a majority of adults have caries[1] The most important risk factors for caries are associated with attitudes and behaviours. Strategies to control caries include effective oral hygiene practices to reduce biofilm development, and adoption of a low-sugar diet to restrict periods of acidic challenge to teeth[2,3]. For the outcome in plaque removal from tooth-brushing, motor skills are essential and during pre-school ages parents are instructed to brush their children's teeth. The skill to perform tooth-brushing develops from early ages up to adolescence, and from the age around six children often are given an increasing responsibility for their tooth-brushing. A common clinical finding is that many schoolchildren display a nonacceptable oral hygiene. It is, however, not known if the reason for this finding is lack of motivation, forgetfulness to brush the teeth, or lack of skills. Hattne *et al.*[4] showed in a qualitative study on attitudes to oral health among adolescents 15–19 years of age with high caries risk that forgetfulness and lack of time were the main reason for not brushing, but tooth-brushing emerged as the most important determinant of oral health in this group of children. In a Finish study on 11–13 year-olds tooth-brushing habits, it was shown that almost all participants needed to improve their frequency of brushing or the brushing technique[5]. It can be difficult to change established dental health behaviour during adolescence, and we lack knowledge at what age children can take the full responsibility for their brushing. It was therefore considered of interest to study the brushing behaviour in different age groups of children. The aim of this study was therefore

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to evaluate how children aged 6–12 years brush their teeth and measure the result of their tooth-brushing on the buccal surfaces of upper and lower incisors and canines. The null hypothesis was that there were no differences between the age groups.

Materials and methods

The study was performed with a descriptive cross-sectional study design. The parents of all children in preparatory class and class 2, 4, and 6 (6, 8, 10, and 12 year olds) in a public elementary school in Umeå were provided with a letter with information about the study and their child was offered to participate in the project. Parents of 82 children (82%), 31 boys and 51 girls agreed to their children's participation (Table 1). The participating children were asked to avoid tooth-brushing in the evening and the morning before the clinical examinations and registrations. At the clinical procedure, the children's teeth were stained with a colour tablet (Dia-Plaque, AstraZeneca, Södertälje, Sweden) and thereafter they were asked to rinse their mouth twice with tap water. Then, a mouth-guard (OptraGate, Ivoclar Vivadent, Solna, Sweden), junior size, was applied to keep away their cheeks and lips and to facilitate the view during photographing. After staining the teeth, for each child a set of three intra-oral photographs were exposed with a digital camera (Canon EOS 400D; with lens Canon Macro ET 1:2.8 USM and flash light MR-14EX, Canon, Tokyo, Japan). Thereafter, each child was given a toothbrush (Sensodyne Pro-emalj soft, GlaxoSmithKline, Hamburg, Germany), asked to spread toothpaste and to brush their teeth as they used to do at home. The tooth-brushing procedure was recorded with a video camera (Panasonic NV-65280 3CCD, Panasonic, Tokyo, Japan). Time spent for the brushing procedure was recorded and noted on a sheet form. After brushing, the mouth guard was applied again and new intraoral photos were taken. Thereafter, the child were asked eight standardized questions in a questionnaire about oral hygiene habits, use of fluorides, and who had taught them how to brush the teeth. When the clinical procedure was finalized each child was instructed in how to brush their teeth using the BASS method.

Table 1. Participants and gender distribution in each age group.

Age	*N*	Boys	Girls
6	16	8	8
8	21	10	11
10	23	8	15
12	22	5	17
Total	82	31	51

Registration of plaque before and after brushing and brushing technique

From the intraoral photographs the amount of plaque were scored using the scores for Green and Vermillion Oral Hygiene Index[6] and transferred to a sheet form by one of the authors (AS) who was blinded for age and gender. Nonerupted or missing teeth were also recorded. The amounts of plaque on the buccal surfaces of the upper and lower canines and incisors were recorded using the following scores; 0, absence of plaque or stain; 1, plaque covering not more than one-third of the tooth surface; 2, plaque covering more than one-third, but not more than two-thirds, of the tooth surface; 3, plaque covering more than two-thirds of the tooth surface. For comparison, the scores of the Green and Vermillion index were also dichotomized into absence or presence of plaque. The behaviour during brushing was scored as systematic and not systematic. Systematic brushing was scored when the child brushed consequently either from one side to the other in each jaw or buccal, lingual, and occlusal surfaces from one side to the other. The study was ethically approved by the Ethics Committee at Umeå University (Dnr 08-073M).

Statistical method

All data were computerized into the SPSS software, version 15.0 SPSS software, (SPSS, Inc., Chicago, USA). The sum of plaque scores before and after brushing were compiled for each individual[7] and then ratio between scores after and before brushing were calculated.

Categorical data were analysed with chi-square test and continuous data with ANOVA and Person correlation. Bonferroni *post hoc* test was applied for multiple comparisons. A *P*-value of less than 0.05 was considered as statistically significant.

Results

Plaque before and after brushing

Forty-one teeth were missing. Of these 11, 15, 14, and 1 were missing in 6, 8, 10, and 12-year olds, respectively, and 943 buccal surfaces were examined. After brushing, 3% of the surfaces were totally free from plaque or stain, 53% had score 1, 22% had score 2 and 3. The average reduction in sum of plaque scores were 29%. The ratio between the sum of plaque scores after and before brushing was statistically significantly higher in the 6-year old group compared with the 10-year olds ($P < 0.05$), (Table 2, Fig. 1). No differences in plaque scores could be detected between boys and girls after brushing in any of the age groups ($P > 0.05$).

Time used for brushing and brushing technique

Six-year old children spent statistically significantly less time for brushing than older children, and the difference was statistically significant to all the other age groups (8, 10, and 12-year olds) ($P < 0.05$), (Table 3). Twenty-one per cent of the children spent less than 1 min brushing their teeth, which was 50% of the 6-year olds. Forty-three percent spent between 1 and 2 min and 36% more than 2 min. There was a negative correlation between brushing time and the ratio between the sum of plaque scores after and before brushing ($r = -0.31$, $P < 0.01$). The lowest correlation was displayed in the youngest age group ($r = 0.07$, $P > 0.05$). When 8, 10, and 12-year olds were analysed separately, the ratio between the sum of plaque after and before brushing scores were 0.63 ± 0.18 among children who spent 120 s or more *versus* 0.72 ± 0.17 among those who spent less time ($P < 0.05$), (Fig. 2). There were no differences in time spent for brushing, ratio between the sum of plaque scores after and before brushing according to brushing technique for the whole group or for age groups ($P > 0.05$). Thirty-three per cent of

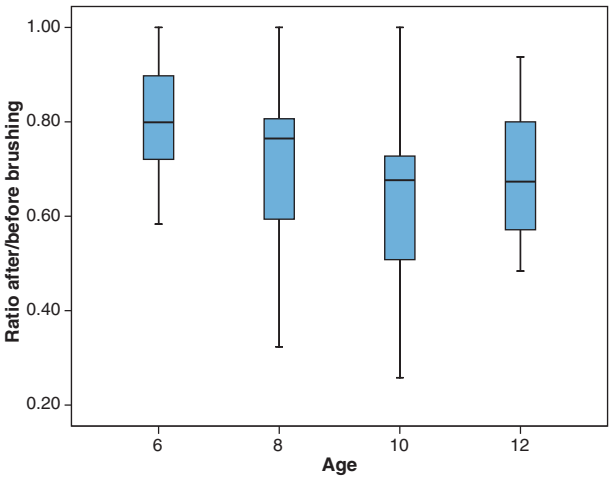

Fig. 1. Box plot with ratio between plaque scores after and before brushing in 6, 8, 10, and 12-year olds. Boxes denote 50% of the children in each age group and lines across the boxes the median values. Whiskers show lowest and highest values.

Table 2. Ratio between sum of plaques scores after and before brushing in 6, 8, 10, and 12-year-old children.

Age	Mean	SD	95% confidence interval for mean
6	0.81*	0.11	0.74–0.87
8	0.72	0.18	0.64–0.80
10	0.64	0.20	0.56–0.73
12	0.69	0.14	0.63–0.76
Total	0.71	0.17	0.67–0.75

ANOVA, Bonferroni *post hoc* test.
*$P < 0.05$ for the difference between 6 and 10-year olds.

Table 3. Time spent for tooth-brushing, reported brushing frequency and parental help at home and technique in 6, 8, 10, and 12-year-old children.

Age	Time spent for brushing (s)	Brush two times/day or more (%)	Parental help (%)	Systematic technique (%)
6	65 ± 24*	81	81	19
8	126 ± 90	90	41	19
10	120 ± 45	96	9	52
12	117 ± 49	95	0	32
Total	109 ± 62	91	29	32

ANOVA, Bonferroni *post hoc* test.
*$P < 0.05$ compared with all other age groups.

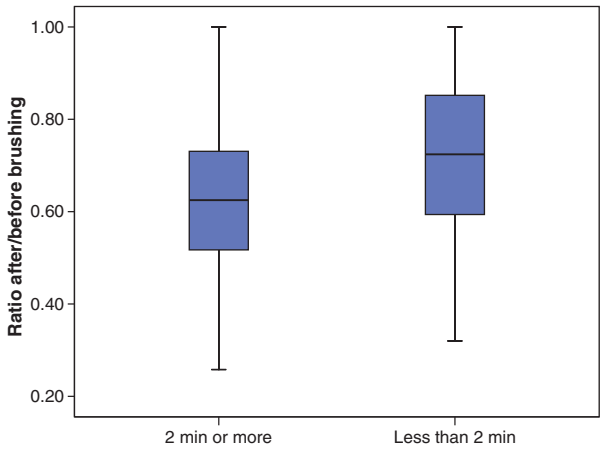

Fig. 2. Box plot with ratio between plaque scores after and before brushing in 8, 10, and 12-year olds who brush less than 2 min and 2 min or more. Boxes denote 50% of children Lines across the boxes show the median values and whiskers show lowest and highest values.

the children were classified as having systematic brushing technique, 26% of the boys and 35% of the girls ($P > 0.05$) (Table 3).

Oral hygiene procedures at home

Ninety-one per cent of the participants answered that their teeth were brushed twice a day or more often. Help with brushing at least once per day were received by 81% of the 6-year olds and 41% of the 8-year olds (Table 3): All stated that they used fluoride tooth paste and 11% also used fluoride tablets and 21% fluoride mouth rinses. There were no statistical significant differences between age groups or between boys and girls ($P > 0.05$). Seventy-seven per cent of the children stated that their parents had taught them how to brush their teeth and 6% had been instructed by their dental team. Half of the 6-year olds answered that they did not know who had instructed them. Five per cent used an electric toothbrush only, while 22% used an electric toothbrush sometimes at home.

Discussion

It is clear from this study that 6-year-old children have a result of tooth-brushing that is statistically significantly different from older age groups and the null hypothesis could be rejected. There was no connection between time spent for brushing and the effect on plaque removal in the youngest age group while the effect of time was clear for older children.

The participating children were recruited from an elementary school in a middle class area in the city of Umeå. More girls than boys participated but as no differences between gender could be displayed data are considered as representative for these age groups; however, as the experimental model included only buccal surfaces of incisors and canines, the results can only be generalized to these surfaces. The brushing procedures were performed under standardized conditions and all the plaque recordings from photographs were made by the same observer who was blinded for age group and gender but due to the different eruption of permanent teeth in different ages, the blinding for age could have been affected. Plaque was scored into four different categories with each step representing an increase of one-third, and the mean ratio of plaque scores after and before brushing was calculated and compared. The experimental situation with video filming may have put some children under pressure but is also obvious from examinations of the films that lack of motor skills may have played a role for some individuals.

To our knowledge, there is no data on when children in general have sufficient motor development to brush their teeth themselves. Generally, it is stated that children need help with tooth-brushing until 10 years of age, which seems to be supported by our findings. Many children are given an increasing responsibility for their brushing from around 6 years of age, which according to the present data is a too low age if it not is accompanied with parental advice and help. Although electric toothbrushes reduce plaque better than manual brushes,[8] there is little evidence that it may help in children with unacceptable oral hygiene. It could be argued that the first step is that the child should have adequate knowledge about manual brushing technique before other facilities are introduced. If the child does not have a motor

or physiological development that permits a good brushing, parental help should be given.

Obvious lack of skills to perform tooth-brushing was evident in most children. The plaque removal on buccal surfaces from brushing was poor and averaged 19% for the youngest age group and around 30% for older children. It was clear after examination of the videos that many children focused mainly on brushing occlusal surfaces. No more than 20% of the tooth surfaces with plaque are commonly considered as a good level of oral hygiene[9]. In our study, we displayed no child with this level of oral hygiene on the examined surfaces. Kasila *et al.*[5] concluded that the quality of brushing needed to be improved for around 52% of 11 to 13-year olds. The same study showed that almost all of the participants needed a change in tooth-brushing practices as in frequency, quality, and practice skills, which is in line with our finding.

The association between plaque and caries is varying[10]. There is, however, a common opinion that dental caries is a plaque-mediated disease[2,3,11] and oral hygiene is a strong risk factor when controlling for other common risk factors such as sugar consumption[12,13]. When tooth-brushing twice a day is performed with fluoride toothpaste, it constitutes a caries preventive method with the highest level of evidence[14]. The method is self-administered and it is therefore important that young individuals are taught how to perform a brushing that may prevent oral diseases. Information about the importance of tooth-brushing is stressed in all dental health programmes in Sweden and the message on desired number of daily brushing seems well known as only 9% of the participants reported brushing less than twice per day. These data are lower compared with data from Livny *et al.*[15] who reported that 67.2% of school-children brushed once a day and only 8.2% had been taught by their dental team. Also in this study only a low number of children reported that they had learnt brushing from their dental team and the majority had learnt it from their parents.

The outcome of brushing for children 8–12 years of age was shown to be more dependent on duration of brushing than technique that corroborate with an earlier finding were brushing for 120 s removed 26% more plaque than brushing for 45 s[16]. Oral health care professionals should therefore persuade patients to brush for longer periods of time. Brushing twice a day for a minimum of 2 min seems to be the message but there is little evidence on the outcome on oral health advice including instructions in oral hygiene[17]. The importance of establishing a stable pattern of oral hygiene before adolescence has been pin-pointed[5,18] as it can be difficult to perform life style changes during this period of life. During adolescence, lack of time and forgetfulness are often reported as reasons for unfavourable oral hygiene habits[4]. Personal self-esteem in children was correlated to positive oral health behaviours and it has been suggested that children who are not satisfied with their life and school and who have low self-esteem should be the focus of oral health education[19].

The importance of an early establishment of tooth-brushing and the association to a low approximal caries experience in adolescence has been demonstrated[20]. The context of the family and home environment play a central role in the promotion of oral health[21] and the importance of providing parental guidance to introduce oral hygiene is emphasized[22]. Different strategies can be used were a population strategy seeks to control common causes of caries incidence, whereas a high-risk strategy seeks to protect susceptible individuals[23]. A combination of these two strategies in susceptible ages or groups can be a strategy. Targeted dental health programmes directed to ages with newly erupted teeth may be an approach to give instruction and inform parents about the beneficial effects of tooth-brushing. From 7 to 8 years of age of the child, parents should be informed to instruct children in tooth-brushing and give continuous help and advice up to 10 years with check of brushing with disclosing tablets with regular intervals. Saied-Moallemi *et al.*[24] pointed out that internalizing behavioural norms requires a reflective conversation. Continuous oral health promotion and development of tooth-brushing skills may be better

achieved in the parent–child interaction than in a child–health counsellor relation. The health authority approach may prevent the child from deep and meaningful communication in oral hygiene instructions. Accordingly, very small effects of school children's oral hygiene after discussions with dental hygienists in the traditional model were it was supposed that the information itself and its delivery influenced the individual's behaviour have been displayed[5]. Therefore, the search for effective ways to reach families with attractive and understandable oral health messages is an important task for the dental profession, and oral health promotion should be designed to be a continuous process rather than a short-term intervention[25].

It is concluded that the plaque removal on buccal surfaces from brushing was poor and averaged 19% for 6-year olds and 30% for older children. Many children focused mainly on brushing occlusal surfaces. The results of brushing for children 8–12 years could benefit from increasing tooth-brushing time. Children could be given an increasing responsibility from 7 to 8 years of age, but parental help and advice are motivated up to 10 years of age.

What this paper adds

- Children's oral hygiene could benefit from increasing tooth-brushing time.
- Children could be given an increasing responsibility from 7 to 8 years of age but parental help is motivated up to 10 years of age.

Why this paper is important to paediatric dentists:

- The paper strengthen the opinion that children need parental help with brushing up to 10 years of age
- Tooth-brushing should be performed for a minimum of 2 min.

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