Effective Teaching of Tooth-brushing to Preschool Children

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ABSTRACT

Purpose: The purpose of the present study was to compare artificial tooth-brushing models (**TBM**) and individual modeling regarding their efficacy in teaching the correct brushing movements to younger preschool children.
Methods: A total of 141 30- to 50-month-old preschool children who had not been previously instructed on tooth-brushing were enrolled in the present trial. Four different model types/groups were compared: (1) giant TBM; (2) animal TBM puppet; (3) child him/herself in front of the mirror; (4) another person with the child in the mirror. Parameters of imitational learning were investigated by means of single-person monitoring on the basis of a standardized observational method. The subjects were randomly assigned to 4 experimental groups, which were comparable regarding gender and age. Statistical analysis was performed using the chi-square test.
Results: This study demonstrated that behavioral modeling types 3 and 4 were more suitable as a methodological basis than TBM. Correct tooth-brushing position and movement were correlated with the attractiveness of the model and its similarity to the child. It was shown that human models achieved greatest learning success.
Conclusion: It is important to find a "helper" and an attractive model person assisting in guiding the brush with a feedback in a mirror.
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Effective dental hygiene is an indispensable prerequisite for the development of a healthy primary dentition. There are undisputed scientific findings regarding frequency, time, and duration of tooth-brushing. Dental research, however, often focuses on material aspects of toothpastes and specific brushing differences.[3,21,22,23,24] Unfortunately, the learning processes of tooth-brushing have been neglected.[5,6,7]

Tooth-brushing is a highly complex motor skill that is difficult to master by very young children who, therefore, need parental assistance from the very first tooth through adolescence. Two-year-old children begin to develop their autonomy and like to do things for themselves. Starting at approximately 2 years old, children are able to recognize themselves in the mirror and to execute first tooth-brushing movements[8,17,22]: Two aspects of the child's development are required for learning tooth-brushing: (1) the development of self regulation; and (2) the recognition of one's own face in the mirror. Together, both conditions mark the starting point of self-controlled tooth-brushing. Adults can help in this process. They should consider the child's age and motivate him/her (eg, via a grip, color, and additional motivational prompts).[7] In addition, adults should demonstrate correct tooth-brushing, which cannot be learned by simple demonstration alone, as it is a complex motor skill.

More complex procedures can only be learned by children when their psychological development is taken into account by instructors, parents, and other persons

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promoting oral hygiene. Thus, instructions as well as controlled and supervised tooth-brushing as well as repetition and training under controlled conditions are needed.[4,15,20]

While thinking and comprehension are developing in childhood, special learning approaches like modeling can be helpful. Oversized tooth-brushing models (TBM) are often used to teach proper tooth-brushing techniques.

Their efficacy however, has not been studied so far. The imitation of demonstrated movements seems to be difficult for younger preschool children, so the learning process must be taught at different levels according to the children's age.[13] In addition, the abstraction level of the models needs to correspond to the child's psychological development. For example, TBMs currently use adult teeth and not the primary dentition, possibly making it difficult for the child to identify with these models.

The purpose of the present study was to compare artificial tooth-brushing models and individual modeling with respect to their efficacy in teaching the correct tooth-brushing movements to younger preschool children.

METHODS

This investigation was approved by the ethical commission of the University of Leipzig. A total of 141 30- to 50-month-old preschool children from 11 day care centers in Leipzig, Germany, who had not been previously instructed on tooth-brushing, were enrolled. Exclusionary criteria included being left-handed as well as hints on previously instructed children (regarding to tooth-brushing automatisms).

Parameters of imitational learning (modeling) were investigated by means of single-person monitoring on the basis of a standardized observational method. The method considers the age-related motor activity and perception of preschool children (Table 1).[5] TBMs and individual modeling were evaluated on the basis of correct tooth-brushing position and movement. Participants who positioned the brush in the mandibular right occlusal areas and performed a horizontal brushing movement were considered correct.

Four different model types/groups were tested, resulting in a 4-group experimental research plan (Table 2):

1. Group 1—giant TBM, which used an oversized tooth model.
2. Group 2—model doll, which used a teeth model in the mouth of an animal puppet.
3. Group 3—tooth-brushing by the child in front of a mirror, with the model being itself the image in the mirror.
4. Group 4—an adult demonstrating tooth brushing for the child as a human model in a parallel sitting position before the mirror.

Subjects were randomly assigned to the 4 experimental groups, which were similar in gender and age. The intervention uniformly consisted of a demonstration of a defined use of the brush by the respective model and the subsequent imitation of a horizontal tooth-brushing movement on the occlusal areas of the right mandible.[5] The investigation was carried out in the morning hours at the Leipzig day care centers. Statistical analysis for intergroup differences was conducted using the chi-square test.

Table 1. Standardized Single-expert-observation of Tooth-brushing*[5]

Technique	Horizontal	Rotation	Red-white-technique
Row order	Occlusion area Ri/d ri/u le/d le/u	Vestibular area Ri le fr	Oral area Ri/d ri/u le/d le/u fr/d fr/u
Skills development	1 2 3 4	5 6 7	8 9 10 11 12 13

** Ri=right; le=left; d=down; u=upper; fr=front; row=row order and completeness of brushed areas, according to the child's development of motor skills; column=proof of the level of automatization of behavior, assuming that equal row order means a high level of automatization.*

RESULTS

The investigation revealed differences between the 4 modeling types. Correct tooth-brushing position and movement were correlated with the attractiveness of the model and the similarity to the child. Seventy-five percent of the group 4 children (adult model person) met the criteria placement of the brush and brushing movement. Approximately 6% of the children were incorrect in both criteria. In this group, the number of children who put the brush into the correct position without exercising any tooth-brushing movements was highest (Table 3).

The results for groups 1 and 2 vs groups 3 and 4 differed significantly regarding the "correct brushing movement" criterion. Groups 1 and 2 showed the lowest

Table 2. Study Plan

	Group 1: Giant tooth-brushing model	Group 2: Animal puppet with teeth	Group 3: Child itself in the mirror	Group 4: Another person with child in the mirror
N	37	32	36	36
Age (mos)	40	41	40.5	43
Age range (mos)	30-50	29-52	27-51	29-49
Sex: males/females	26/11	15/17	17/19	17/19

** No statistically significant differences were observed for age and gender among the groups.*

Table 3. Results of Imaginational Learning Procedure of Tooth-brushing in Preschool Children*

Observational criterion	Group 1: Giant tooth-brushing method	Group 2: Animal puppet with teeth	Group 3: Child looking in the mirror	Group 4: Another person with child in front of the mirror	Number of children
Right place and right tooth-brushing move N (%)	2 (5)	4 (13)	23 (64)*	27 (75)*	56
False place and false tooth-brushing move N (%)	29 (78)	26 (81)	3 (8)	2 (6)	60
Right place no tooth-brushing move N (%)	3 (8)	2 (6)	0 (0)	6 (17)	11
False place and right tooth-brushing move N (%)	3 (8)	0 (0)	10 (28)	1 (3)	14
Total	**37**	**32**	**36**	**36**	**141**

** Significant differences were observed between the groups using chi-square tests (P<.05).*

imitation rates, according to the criteria of right position and right brushing movement. Results were notably similar between groups 1 and 2 and between groups 3 and 4. In group 1, 8% of the children used only the right position and thus met one of the criteria (static factor of modeling). In group 3, children tended to make right brush movements more often (28%), but not at the right place, indicating perhaps that right-handed children find it easier to brush their teeth on the left side of their mouths.

DISCUSSION

The present study's results suggest that children identify less with a model that corresponds less to the real image. The effectiveness of the model was found to be greatest when there was the highest similarity between the model and the learning children. The more a child recognizes him/herself in a model and identifies with this, the more likely he/she will be able to successfully imitate taught movements.

The precondition for learning by a model, in addition to its attractiveness, social status, and popularity, is typically the similarity between the model and the learner.[1] This means that simple brushing movements, adapted to the motor activity development of the young preschool child, have to be demonstrated by a model that is attractive to the child (eg, parents, kindergarten teachers, older siblings). This also explains why the results in groups 1 and 2 did not differ significantly. Whether the TBM is fitted into an occlusion simulator (group 1) or the head of an animal doll (group 2) seems to be relatively unimportant. Children seemed to be impressed only by the opening and closing movement of the giant model. The better modeling results in groups 3 and 4 differ significantly. The best modeling results in group 4 demonstrate the importance of: attractiveness and similarity of the models; parallel sided demonstration; and mirror feedback for development of self-control of motor skills. Group 3 children did not really perform an observation because each child's brushing hand was brought into the "correct position" by a helper. The simultaneous countermovement of the child did not contribute to the development of a kinesthetic adaptation to the toothbrush.[5,6,10,16,18]

In addition to repetition of model movements, the preschool child's intellectual and perceptual performance was decisive for imitation learning. Group 4's significantly better results vs groups 1 and 2 point to the importance of a parallel-sided demonstration as well as feedback regarding the child's movement in front of a mirror. This study is supported by the essential elements of the social-cognitive learning theory, as described by Bandura,[1,2] regarding acquisition and performance phases.

Children younger than 4-years-old are in an egocentric development phase of thinking. They are unable to put themselves in another person's place or comprehend their own perception of a subject as one possibility among many.[14,17] Therefore, imitational learning by tooth-brushing demonstrations using oversized TBM was shown to be important. A combination of well-mixed, assisted tooth-brushing and simultaneous demonstration in front of a mirror appears to be the most promising approach with the best effectiveness in modeling. The result also showed that children of this age can better imagine, and thus imitate, situations than processes.[11,12] This study suggested that, in this age group, behavioral modeling fit better as a methodological basis than cognitive behavioral modeling.[2,19]

CONCLUSIONS

1. The present study's results showed that younger preschool children cannot learn tooth-brushing via widely used, oversized models.
2. It is important for the learning process to find a "helper", and an attractive adult model person who can help with tooth-brushing and provide feedback in front of a mirror.
3. This study has contributed to resolving inconsistencies between technical and behavioral approaches in oral health promotion.

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