USING PARENTS TO MAINTAIN IMPROVED DENTAL FLOSSING SKILLS IN CHILDREN

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An experimenter-administered intervention involving prompts, self-monitoring, permanent product collection, rewards for plaque reduction, and corrective feedback was used to improve the flossing skills of four 7- to 11-year-old children. Parents were subsequently trained in the reward and feedback procedures to facilitate maintenance. In a multiple baseline across subjects design, all four subjects showed improvement in plaque between teeth during experimenter-administered intervention. Three subjects maintained low plaque levels during the 3- to 4-month parent-administered rewards and feedback follow-up condition. Improved plaque levels on nontargeted tooth surfaces also were observed. Pediatric dentistry applications are discussed.

DESCRIPTORS: behavioral medicine, compliance, dental hygiene, health-related behaviors, oral hygiene

Periodontal disease has been described as the major cause of tooth loss in adults over the age of 35. Although significant decreases in tooth decay can be achieved through community water fluoridation, prevention of periodontal disease remains "largely dependent on individual home self-care procedures, such as daily flossing" (Ayer, 1984, p. 890). Yet, flossing compliance remains a relatively neglected area of behavioral medicine.

Iwata and Becksfort (1981) demonstrated that providing fee reductions for criterion levels of plaque in addition to education in toothbrushing and flossing techniques resulted in lower plaque scores in adult patients than did education alone. Claerhout and Lutzker (1981) used home-based contingency management programs to increase the frequency of brushing and flossing in four 7- to 9-year-old children. They reported superior increases in reported frequency of brushing and floss-

ing, lower overall plaque scores, and improved Snyder's test levels of lactobacilli during reinforcement conditions as compared with baseline or education-only conditions. However, it was not possible to determine from the global oral hygiene measures used in the above studies whether the reported improvements were due to flossing or to brushing, or to both behaviors.

Dahlquist et al. (1985) specifically focused on flossing in a home-based intervention with three 9-year-old children. They found no improvements in plaque between teeth following instruction in proper flossing technique. Prompts, self-monitoring, permanent product collection, and rewards for daily flossing resulted in small but nonoptimal improvements in interproximal (between teeth) plaque in two subjects. However, the addition of rewards for criterion levels of interproximal plaque reduction and repeated corrective feedback on flossing effectiveness resulted in clinically significant reductions in interproximal plaque. Generalization to tooth surfaces considered to be primarily affected by tooth brushing also was demonstrated. However, maintenance of flossing was not assessed.

The purpose of this study was to test the effectiveness of a condensed version of the Dahlquist et al. (1985) intervention program. Prompts, self-monitoring, rewards for criterion levels of

The authors wish to thank Carol Buffington, Tama Franko, Wendy Grimm, Mark Grubb, Bruce Howerton, George Johnson, Lin May, and Bill Zerick for their help in data collection.

Portions of this paper were presented at the Association for the Advancement of Behavior Therapy meeting in Philadelphia, Pennsylvania, in November 1984.

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interproximal plaque reduction, and corrective feedback were introduced immediately following training in correct flossing technique. An additional objective was to demonstrate that parents can learn to reliably assess their child's interproximal plaque levels, reward low plaque levels, and provide corrective feedback on flossing effectiveness. We hypothesized that parental involvement would facilitate maintenance of flossing and improved oral hygiene in the absence of direct professional involvement with the child.

METHOD

Subjects and Setting

Requests for participants were announced in graduate dentistry and psychology classes. Referred participants were contacted by an experimenter and informed consent was obtained independently from both the child and the parent. A 9-year-old girl (Subject 1), an 11-year-old boy (Subject 2), a 7-year-old girl (Subject 3), and an 11-year-old girl (Subject 4) participated in the study. None of the subjects previously had been taught to floss. All experimental procedures were conducted in the child's home.

Procedure

Plaque assessment. The modified Personal Hygiene Performance Index (PHP-M) (Martens & Meskin, 1972) was used to assess plaque. This scoring technique divides the fronts and backs of six selected teeth into the following five surfaces: (a) the top, middle, and bottom thirds of the broad outer section of the tooth, which are called "facial/lingual" surfaces, and (b) the two side sections of the tooth near adjacent teeth, or "interproximal" surfaces. Each surface is scored for presence or absence of plaque. The maximum possible plaque score for a single tooth is 10 (6 facial/lingual and 4 interproximal surfaces). By computing the percentage of total surfaces evidencing plaque separately for facial/lingual and interproximal surfaces, one can differentiate between facial/lingual plaque, which is affected primarily by tooth brushing, and

interproximal plaque, which is affected primarily by flossing.

Experimenters were trained in the use of the PHP-M by an experienced dental hygienist through multiple observations of simulated plaque on models and actual plaque on volunteers. Training was terminated when experimenters reached a criterion of 85% agreement with the hygienist out of all possible agreements plus disagreements.

Plaque levels were assessed by the experimenters 3 evenings per week throughout baseline and intervention. The experimenter applied disclosing solution to all of the child's upper teeth with a cotton swab. Using a dental mirror with a penlight flashlight attachment, the experimenter recorded presence or absence of plaque on each of the upper teeth targeted on the PHP-M. The same procedure was repeated for lower teeth. The percentage of facial/lingual and interproximal surfaces evidencing plaque was computed.

A second experimenter was present for approximately 20% of the experimenter-conducted plaque assessments at random intervals throughout all phases of the study. The second observer checked each tooth immediately after the first experimenter. Agreement between the experimenters averaged 92% for interproximal plaque (range, 58%–100%) and 82% for facial/lingual plaque (range, 58%–97%).

Baseline. Prior to intervention, baseline plaque levels were obtained three times per week on all subjects. Subjects were given no information regarding their plaque scores.

Intervention. Flossing training was introduced in a multiple baseline across subjects design. Three intervention sessions were conducted per week. On the first day of treatment, a routine plaque check was conducted. A dental hygienist then instructed subjects in the correct flossing technique employed by Dahlquist et al. (1985). The hygienist then demonstrated flossing on one of the child's back teeth and one front tooth while the child observed in a mirror. The child then flossed one back tooth and one front tooth while the hygienist watched and provided feedback. The demonstration and practice session lasted approximately 30 minutes

and was terminated when plaque was no longer visible on both practice teeth.

Subjects were instructed to floss before bed every night. A roll of unwaxed floss was provided. Prompt cards stating "Remember to Floss" were hung in the child's bedroom. A poster listing the steps involved in flossing was placed in the bathroom. Each child also was asked to record the time of day he or she flossed on a calendar posted in the bathroom. A bag was hung on the bathroom sink to collect used floss.

The experimenter recorded the subject's current interproximal plaque level on a graph composed of several teeth marked off in segments. The experimenter informed the subject that he or she would receive a prize on subsequent visits if the child monitored, saved used floss, and achieved a criterion level of plaque. Criterion was initially set at the lowest baseline level of interproximal plaque and was marked with a star on the next session's tooth graph.

During subsequent home visits, the experimenter conducted a plaque check, collected the used floss, examining it to be sure it appeared used (i.e., flattened, shredded, and discolored), checked the self-monitoring chart, and recorded the interproximal plaque level on the tooth graph. The subject was allowed to select a gift-wrapped prize from a grab bag if he or she met criterion. (Prizes were approximately \$.50 value items selected on the basis of interviews with subjects.) Criterion for the next visit was set two points (approximately 9%) lower than the subject's current score.

If the subject did not meet criterion, a reward was not given and criterion remained the same. If criterion was not met in three consecutive sessions, it was raised to the previously successful level and then lowered after successful attainment. Final criterion for Subject 3 was an interproximal score of 50%; the final goal for the older subjects was 33.3%.

Corrective feedback on flossing technique was provided at the end of each intervention session. The experimenter picked one molar and one incisor with substantial plaque and showed the child how red these two teeth looked. The child was instruct-

ed to floss these teeth while the experimenter praised proper technique and/or suggested corrections in technique. The flossing and feedback procedure continued until the child removed all visible interproximal plaque on these two teeth.

Parent training. Parent training was conducted at the end of the last four sessions of intervention. In the first two parent training sessions, parents were taught a simplified plaque check procedure involving only the interproximal surfaces of three of the six teeth assessed in the PHP-M. They were taught (a) to identify the interproximal tooth surfaces, (b) to apply disclosing solution, and (c) to recognize, record, and graph interproximal plaque. Parents were taught to assess upper teeth in the first session and lower teeth in the second session. The experimenter checked the parents' scoring, noted any errors, and explained correct scoring.

In the last two parent training sessions, the parent conducted a plaque check on "even" or "odd" numbered teeth on the PHP-M. The experimenter conducted an independent plaque check, computed percent agreement with the parent, and then discussed discrepancies in scores. All parents achieved a minimum of 85% agreement with the experimenter, using the agreements divided by agreements plus disagreements method.

Parents also were taught to provide corrective feedback in the last two parent training sessions. The steps in proper flossing were explained. The experimenter then demonstrated corrective feedback for one of the child's teeth while the parent watched. The parent then chose a tooth and provided feedback while the experimenter praised or suggested improvements in the parent's performance. The session was terminated when the child successfully removed all plaque from the tooth.

Follow-up. Parents were instructed to check and graph their child's plaque once a week, provide corrective feedback, and praise and reward the child if he or she achieved the criterion interproximal plaque level. A supply of gift-wrapped prizes was provided. Parents alternated checking "even" or "odd" numbered teeth on the PHP-M each week. The parent of Subject 2 checked his teeth only during the second and third weeks of follow-up,

Figure 1. Experimenter-assessed interproximal and facial/lingual plaque levels across treatment conditions.

and then dropped out of the study. The remaining parents complied with weekly checks and rewards throughout the 3- to 4-month follow-up.

No direct intervention was provided by the experimenters during follow-up. An experimenter visited the child's home at 1- to 2-week intervals, conducted a plaque check in the same manner as in baseline, and collected the parent's weekly records of previous plaque checks. No comments were made to the child regarding his or her progress. Experimenter contact was gradually faded to monthly intervals over the remaining follow-up period.

RESULTS

Significant decreases in interproximal plaque were obtained during intervention (see Figure 1). Mean baseline interproximal plaque levels ranged from 75%–94%. During intervention, the percentage of visits in which criterion was met was

82% for Subject 1, 86% for Subject 2, 84% for Subject 3, and 54% for Subject 4. Average interproximal plaque scores obtained in the final four observations of the intervention phase ranged from 28%–59%.

Low interproximal plaque levels also maintained while experimenter contact was faded during follow-up. Average interproximal plaque levels assessed by the parents were 31.5% for Subject 1 (range, 17%–42%), 41.2% for Subject 2 (range, 33.3%–50%), 38.1% for Subject 3 (range, 25%–50%), and 38.1% for Subject 4 (range, 8%–75%). Average experimenter-assessed interproximal plaque levels during follow-up were 23% for Subject 1, 56% for Subject 2, 43% for Subject 3, and 54% for Subject 4 (see Figure 1).

Plaque reductions also were observed on non-targeted facial/lingual tooth surfaces. During baseline, mean facial/lingual plaque scores ranged from 35%–67%. During the last four observations of the intervention phase, mean facial/lingual plaque levels decreased to 27%–51%, and main-

tained at 22%–47% during follow-up (see Figure 1).

Mean total plaque scores (sum of both interproximal and facial/lingual surfaces) ranged from 51%–80% during baseline. Average total plaque scores decreased to 22%–33% during the last four observations of intervention, and maintained at average levels of 20%–44% during follow-up.

DISCUSSION

Results of this study demonstrate that the intervention package involving instruction in flossing technique, prompts, self-monitoring, permanent product collection, rewards for criterion plaque reduction, and corrective feedback on flossing effectiveness significantly reduced interproximal plaque levels in all subjects. The intervening phase of rewards for flossing frequency used by Dahlquist et al. (1985) does not appear to be necessary. The data also suggest that the need for direct professional contact with the child can be reduced by training parents to assess and reward low plaque levels and provide corrective feedback. Three of the subjects maintained low plaque levels over the 3 to 4 months of follow-up without direct experimenter intervention.

Although flossing is not expected to significantly affect the facial/lingual areas of the PHP-M, improved plaque levels also were obtained for these surfaces. This finding suggests that subjects were brushing their teeth more frequently or more effectively, and further supports the speculation raised by Dahlquist et al. (1985) that it may be more cost-effective to target flossing rather than toothbrushing in oral hygiene intervention programs.

The results also suggest that ongoing parental involvement may be crucial to flossing maintenance in children. When Subject 2's mother did not check his teeth during the first week of follow-up, a return to baseline interproximal plaque level was observed. When she did check plaque, significantly lower plaque scores were obtained. Flossing may be such an intrusive oral hygiene behavior that children will not continue to floss in the absence of external rewards. There are no immediate

negative consequences for failure to floss and there are many competing activities that are more pleasurable than flossing. The consequences of poor flossing compliance usually are not evident until periodontal disease appears in adulthood. Although some adults may floss because of these long-term consequences, it is likely that children need more immediate external contingencies.

Several issues remain to be evaluated, however, before the procedures used in this study can be routinely applied to pediatric dentistry. First, the participants in this study were recruited from acquaintances of graduate students and therefore may represent a sample of parents with greater than average concern about dental health. The generalization of the results to a broader sample of parents and children needs to be assessed.

Second, although the procedures used in this study represent a simplification of the Dahlquist et al. (1985) protocol, the package intervention used here is still complicated and time-consuming. Further study is needed to determine the number and frequency of intervention sessions necessary to achieve low, stable interproximal plaque levels. The feasibility of teaching parents to conduct the entire intervention, and thereby further reduce the need for professional involvement, also should be explored.

Finally, less reactive methods of plaque assessment should be considered in future research. Because the present intervention was conducted in the child's home, it was necessary to schedule experimenter visits in advance. Consequently, experimenter contacts may have served as rewards or prompts for parents to continue plaque checks. Subjects may have flossed differently before experimenter visits. It may be possible to minimize reactivity problems, however, by using gingival inflammation as an index of long-term compliance and by adapting the assessment procedures to other settings, such as classrooms, where unannounced evaluations are more feasible.

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Received July 25, 1985

Final acceptance March 19, 1986