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Teaching Oral Hygiene Skills to Elementary Students with Visual Impairments

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Abstract: This study investigated the effects of a program that taught oral hygiene skills to students with visual impairments using group instruction and individual coaching. The results showed that the program enhanced the oral hygiene skills of the three participants significantly, and its effectiveness lasted for at least two months after the instruction ended.

Improvements in oral hygiene have been documented in Western countries and in Taiwan over the past few decades (Brown, 1994; Department of Health, 2001). However, some significant subgroups, including children with disabilities, have had higher levels of oral disease (Huang, 1996; Martens, 1997; National Center for Chronic Disease Prevention and Health Promotion, 2000; Randell, Harth, & Seow, 1992; Rodríguez, Garcillán, Rioboo, & Bratos, 2002). This higher level of oral disease among children with disabilities may be due to the fact that teaching students to manage their disability is of major concern among educators, but

oral hygiene is not a priority (O'Donnell & Crosswaite, 1988).

In addition, people with visual impairments may have difficulty maintaining oral hygiene, since they are less able to detect early symptoms of tooth decay that are typically recognized through vision (Schembri & Fiske, 2001). For example, discoloration of teeth suggests tooth decay, and bleeding when brushing is an early sign of gingival inflammation. The observation of these symptoms would remind sighted people to seek dental treatment. However, people with visual impairments can be at a disadvantage with regard to their oral health because they are not in a position to detect or recognize early oral disease visually (Anaise, 1979). Previous studies reported that people with visual impairments, like those with other disabilities, tended to have a larger amount of dental plaque and were at a higher risk for dental diseases than were sighted people (Greeley, Goldstein, & Forrester, 1976; Weddel, Vash, Jones, & Lynch, 1987). Anaise (1979) compared the periodontal status and oral hygiene of a sighted group to one with visual impairments (blindness or low vision) in Israel. He found that the sighted group had better oral health than did the one with visual impairments and that students with low vision had lower rates of periodontal disease than did those who were totally blind. Schembri and Fiske (2001) also pointed out that the degree of periodontal disease was more pronounced in the elderly people with visual impairments whom they studied than in the

sighted elderly group. In addition, some children with visual impairments may have limited eye-hand coordination or manual dexterity, which is necessary to execute adequate oral hygiene skills, such as flossing teeth. Consequently, the acquisition and maintenance of oral hygiene skills remains an important and challenging task for students, as well as older adults, with visual impairments.

Despite the need for students with visual impairments to learn these skills, little research has been conducted on teaching oral hygiene skills to them. Nonetheless, efforts have been made to teach oral hygiene skills to people with other disabilities or to their caretakers. Of the dental research on teaching teeth-cleaning skills, more has been conducted with people with mental retardation than with those with visual impairments. For example, in their study of the teaching of oral hygiene skills to adults with mild mental retardation, Willette and Savage (1978) used group instruction, coupled with one-on-one help. They found that after eight weeks of a supervised oral hygiene routine, the mean average for the dental plaque of the 17 participants dropped from over two-thirds of the teeth to less than one-third. Other examples of such research can be found in the following studies: Faulks and Hennequin (2000); Feldman et al. (1997); Mojon, Rentsch, Budtz-Jorgensen, and Baehni (1998); Mori, Amano, Akiyama, and Morisaki (2000); Shapira and Stabholz (1996); and Vazquez, Garcillán, Rioboo, and Bratos (2002). Other studies have focused on people

with behavioral disorders (Vigild, Brinck, & Hede, 1998) or with multiple disabilities (Adiwoso & Pilot, 1999). However, a thorough search of the Medline database revealed that the majority of dental preventive programs were designed to educate persons without disabilities (Ai-Dlaigan, Shaw, & Smith, 2002; Axelsson, Buischi, Barbosa, Karlsson, & Prado, 1994; Biesbrock, Walters, & Bartizek, 2003; De Abreu, Paixo, Resende, & Pordeus, 2002; Hawkins et al., 2001; Morishita, Sakemi, Tsutsumi, & Gake, 2003; Persson, Persson, Powell, & Kiyak, 1998; Rayner, 1992; Worthington, Hill, Mooney, Hamilton, & Blinkhorn, 2001). Studies in the dental literature on teaching oral hygiene skills to students with visual impairments were rare.

Given that students who are visually impaired need to learn oral hygiene skills, as do all children, dental instruction programs that target these children are scarce. To show the importance and feasibility of such a program, we developed an oral hygiene program to serve the specific needs of visually impaired children. In our study, we were concerned about the following two research questions:

1. Would the participants' oral hygiene skills improve significantly when the oral hygiene program finished?

2. Could the teaching effects last for at least two months after all instruction ceased?

Methods

Participants

The participants were three female students with visual impairments—two who were totally blind and one with low vision—and no additional disabilities. Tina (aged 8), Helen (aged 8), and Mary (aged 7) were selected to participate out of 10 potential students with visual impairments at their elementary school in Taiwan. The criteria for selection included visual impairment as the only disability status and a cooperative nature in dental examinations. Other potential students were excluded from the study because of their fear of dental examinations. The three participants were reported to be cooperative for dental examinations according to the school nurses. Letter-of-consent forms were acquired from the participants' teachers and parents to ensure the participants' anonymity and confidentiality.

Tina was a third grader with congenital low vision whose primary reading medium was Chinese braille, although she sometimes used large print; she traveled freely without any mobility devices. Helen was a third grader with congenital total blindness whose reading medium was Chinese braille; she used a long cane for mobility. Mary was a second grader with congenital total blindness whose reading medium was Chinese braille; she also traveled with a long cane. In addition, when the study began, Helen and Mary both had fairly good manual dexterity (they could grasp pens well),

but Tina did not.

Setting

The study took place at an elementary school in the metropolitan area of Taipei, Taiwan, that serves approximately 2,000 students. This school has adopted an inclusive approach in which students who are identified with special needs are offered special services and participate full-time in general education classrooms. The participants attended regular classes for the majority of the school day and received vision-related services from teachers in the vision resource room (hereafter, vision teachers). The oral hygiene program was conducted at the participants' elementary school either in the vision resource room for group instruction or in the school health center for the dental examinations and individual instruction.

Materials

The oral hygiene program

The oral hygiene program (OHP) was developed by the first author, who is a general-practice dentist with a master's degree in special education and experience as a resource room teacher in special education. The program was then reviewed and modified by the second author, a professor of special education with a focus on the education of students with visual impairments. Two vision teachers and two parents of

the participants also reviewed the program to make sure it suited the children's needs.

The OHP had two major parts. The first part included classroom discussions (group instruction) implemented by a vision teacher. The units of the curriculum included Structure and Functions of the Mouth, Benefits of Brushing, and Using Dental Floss (see Table 1 for the objectives). The second part focused on individual coaching of oral hygiene skills by a dentist (the first author). The dentist taught students skills, such as tooth brushing and flossing techniques, and was responsible for the individual coaching and hand-over-hand instruction. To educate the children about cleaning their teeth, he had the participants smell the odor of their own dental plaque and feel the unclean and cleaned surfaces of their teeth with their fingers and tongues.

Teaching materials and strategies

In the classroom discussions and the individual coaching sessions, a full-mouth teeth model, a carved plaster-teeth model, new and old toothbrushes, dental floss, and full dentures were presented to the participants for them to touch and feel. As an additional hands-on teaching strategy, the instructor taught the participants to feel the presence of dental plaque on their teeth when it was found with a dental explorer tool.

Plaque control record

The plaque control record (PCR) method (O'Leary, Drake, & Naylon, 1972) is the most frequently used index in clinical dentistry to record dental plaque. This index provides excellent scientific data because it is an objective indicator of one's oral hygiene practice. The PCR method divides every tooth into four surfaces: the *mesial* surface (the side facing toward the center); the *distal* surface (the side facing away from the center); the *labial* surface (the outer surfaces of the anterior, or front, teeth) or the *buccal* surface (the outer surfaces of the posterior, or back, teeth); and the *lingual* surface (the inner surfaces of the lower teeth) or the *palatal* surface (the inner surfaces of the upper teeth). Dental plaque is found where loose, sticky deposits are detected with a dental explorer. The total number of surfaces containing plaque is divided by the number of examined tooth surfaces to obtain a percentage rate. The higher the percentage rate of teeth with plaque, the poorer a person's oral hygiene status.

PCRs have been used in teeth-cleaning contests in Taiwan elementary schools for years. The annual contests, sponsored by the Taiwan Dental Association, have aimed to popularize oral hygiene education. PCR results can prove the cleanliness of teeth surfaces or indicate the early symptoms associated with periodontal disease (Taiwan Dental Association, 1995).

Variables and control of confounding factors

The independent variable was the oral hygiene program for elementary students with visual impairments. The dependent variable was the participants' oral hygiene skills, which was represented by the percentage scores on the PCR before and after instruction.

To avoid confounding factors, we monitored the PCR examination, the food that each participant ate for lunch, the quality of oral health instruction, and the oral hygiene status of the participant. The PCR examination was performed by a dentist (the first author) with the help of a trained dental assistant to note data on the PCR. Since there was no second dentist to confirm that the data were correct, after the PCR examination was performed, the dentist had the dental assistant read the records back, and he went through all the teeth again to see if the noted data matched what was observed. Regarding the food that the participants ate before the PCR examination, all three students had the same diet because they ate lunch at school every day, as reported by the vision teacher. Regarding the quality of instruction, the primary vision teacher and the first author were responsible for the classroom oral hygiene discussions and individual oral health coaching, respectively. The teacher was trained by the two authors before the study to ensure the quality of instruction. In addition, all three participants were screened by the first author for possible oral pathology, such as carious lesions, improper dental

fillings, dental calculus, or residual roots, which could have interfered with their oral hygiene status (Shih, 2001) and the validity of the study. Fortunately, no oral pathology was found.

Experimental design

The A-B_1-B_2-A´ single-subject research design, a modification of an ABA´ design, was used to compare baseline and intervention conditions (Richards, Taylor, Ramasamy, & Richards, 1998). The PCR was measured across all four periods. For the baseline (A), the oral hygiene status of each participant was examined and recorded in the PCR prior to any intervention. During the B_1 period, group instruction plus individual coaching were provided for the participants. Then the PCR was measured again. The classroom discussions were discontinued in the B_2 period, but the individual coaching continued, and again the PCR data were recorded. In the maintenance (A´) period, all instruction ceased. No prompts, reinforcement, or feedback were provided during this period, but the participants' PCR was examined to see if the teaching effects were maintained.

Procedure and data analysis

Preparation stage

The second author contacted the school personnel and

arranged several training sessions for the vision teacher who would conduct the classroom discussions on oral hygiene. The training was provided by the first author with contributions from the second author.

Baseline period (Weeks 1–4)

In this period, the participants were asked to clean their teeth after lunchtime without feedback or instruction on their methods. Then, their oral hygiene status was examined and noted in the PCR once or twice per week until at least four PCR points were noted for each participant. No prompts, comments, or reinforcements were given during the PCR examinations.

Intervention—B_1 period (Weeks 5–10) with the Chinese New Year holiday (Weeks 11–14)

During B_1 period, the oral hygiene presentations (group instruction) were given twice a week by the vision teacher (see Box 1). Each 30- to 40-minute presentation to the students was broken up into shorter activities. For example, when the vision teacher talked about the structure of the mouth, she first explained the components of the mouth and the functions of these parts. She then presented a full-mouth teeth model and let each participant touch and feel the shape of each tooth and the gums on the model. As the lesson continued, the participants washed their hands and then touched and felt their own teeth and gums. Next, the teacher showed the students how to brush their teeth.

When needed, the vision teacher provided hand-over-hand instruction to demonstrate the techniques for cleaning teeth, such as placing a toothbrush at the gum line on the teeth model, having the student touch the model, then putting a toothbrush on the participant's own gum line. Finally, once the teacher was satisfied that the students understood the brushing and flossing techniques, she reviewed the lesson by asking questions to make sure each participant understand the content of the lesson.

In addition, the B_1 period included PCR examinations, followed by individual coaching of participants' oral hygiene skills in the same session. In total, 12 group instruction sessions by the vision teacher and 6 individual training sessions by the dentist were offered in the B_1 period. Again, the PCR examination was conducted once or twice per week until at least four PCR points were noted for each participant. After this six weeks of instruction, there was a four-week winter break for the Chinese New Year holiday.

Intervention—B_2 period (Weeks 15–22)

The individual coaching of oral hygiene skills continued, but the classroom-based oral hygiene presentations were discontinued during this period. During each session, the PCR examination was conducted before the individual coaching began. In total, six PCR examinations and six individual

coaching sessions were performed by the dentist in this eight-week period for Tina and Mary, but Helen missed three sessions of individual coaching because of an eye operation.

Maintenance period—A′ (Weeks 27–35)

Four weeks after all instruction ceased, the first author initiated follow-up PCR examinations of the participants. No prompts or comments were presented to the students at that time. Six PCR examinations were also carried out in this period.

The data collected are presented using graphs. They were also analyzed with a visual inspection strategy, a method commonly used in single-subject research (Richards et al., 1998). In addition, an informal interview with the teachers, parents of the participants, and school nurses during the maintenance period investigated the adults' perceptions of the effects of the oral hygiene program on the participants' dental cleaning skills.

Results

Tina

Figure 1 shows Tina's PCR values for each period. The initial data indicate a high PCR percentage, signifying Tina's poor original oral hygiene status. During the baseline observation, when Tina cleaned her mouth

using her existing oral hygiene habits, she had a mean PCR percentage of 67% (range of 57% to 78%), compared with 30% (range of 10% to 64%) when she was receiving group instruction, together with individual coaching sessions, by the dentist in the B_1 period. After the winter break, when she was receiving only individual coaching during the B_2 period, Tina's mean percentage was still almost half her original percentage, at 39% (range of 23% to 63%). In the maintenance period, Tina's mean PCR percentage was the lowest of any period, at 27% (range of 23% to 32%). Compared to her mean percentage in the baseline period, her PCR values decreased 41%. These data demonstrate that Tina's oral hygiene skills improved dramatically as she learned more dental cleaning techniques.

Helen

Helen's PCR values are shown in Figure 2. These data indicate a high PCR percentage before instruction, mirroring Helen's poor initial oral health. During the baseline observation, Helen had the highest mean percentage of the three girls, at 76% (range of 60% to 85%), which decreased to 41% (range of 23% to 70%) in the B_1 period. Even after the winter break, Helen's mean PCR percentage dropped to 35% (range of 23% to 55%) during the B_2 period. In the maintenance period, Helen's mean percentage decreased further, to

30% (range of 24% to 35%). Compared to the baseline period, her PCR values decreased by 46%. These data demonstrate that Helen's plaque control improved steadily as she learned more oral hygiene skills.

As noted, Helen missed the individual coaching for three weeks because of an ophthalmic operation. Her first PCR value when she came back during the B_2 period was 55%, compared with the last point in the B_1 period (24%), showing a clear rebound phenomenon.

Mary

Figure 3 presents Mary's PCR values during each period. During the baseline observation, Mary had the lowest initial mean percentage of the three girls, at 35% (range of 24% to 44%), compared with 14.8% (range of 13% to 19%) when she received the group instruction. Mary's mean percentage increased slightly to 16.0% (range of 13% to 21%) during the B_2 period, perhaps because she ate sugary foods during the Chinese New Year holiday. In the maintenance period, Mary's mean percentage was 20% (range of 17% to 31%), showing a slight rebound phenomenon. However, compared to the baseline period, her PCR values decreased 15%, demonstrating that Mary's oral hygiene improved because of the educational intervention.

Informal interviews

At the end of the program, the vision teachers, three parents, and two school nurses were interviewed about the oral hygiene skills of the three participants. Both the parents and vision teachers believed that the curriculum had significantly improved the participants' oral health and that it had a positive impact on the participants' oral health knowledge, skills, and practices. The parents and teachers also noted that the participants' motivation to clean their teeth had increased. However, Tina's father was worried that he could not supervise Tina's oral health because of his own blindness. The school nurses reported a noticeable improvement in the participants' oral hygiene habits as a result of this program and suggested that the parents and vision teachers should continue to supervise the students to encourage their new oral hygiene behaviors.

Discussion

The results of the study indicated that the participants' oral hygiene skills improved significantly after the completion of the 35-week oral hygiene program. The PCR demonstrated the positive benefits over time of classroom-based instruction in conjunction with individual coaching. Walsh's (1985) study proved the positive effect of classroom education on the general population's knowledge of dental health, attitudes, and behaviors. The findings of our study are in line with those of Walsh. In particular, the findings are consistent with Willette and Savage's (1978) research,

as discussed in the literature review. We found that the mean average for the PCR of the three participants dropped from 59% to 26%.

In addition, the results of the three participants' PCR decreased significantly from the baseline to B_1 period, indicating the short-term effectiveness of this oral hygiene program. During the B_2 period, when the classroom-based instruction was withdrawn and individual coaching with a dentist continued, the mean PCR of the participants continued to decrease, indicating that the individual coaching was also effective.

It is noteworthy that the participants' first PCR points in the B_2 period displayed some degree of rebound. This situation may have occurred because the onset of the B_2 period followed the winter break for Chinese New Year, a festival in which children often eat sugary foods. Hence, their oral hygiene may have been neglected briefly. Therefore, it is important for parents to supervise their children's oral hygiene during holiday periods.

In a nutshell, this study's oral health curriculum improved the oral hygiene skills of all three participants. Among the three, Helen was the most motivated to learn the skills and to clean her teeth and had fairly high motivation to do her schoolwork. On the basis of the data from the final PCR examinations,

the effects of this educational intervention program proved to have lasted for at least two months.

Regarding the teaching strategies that were used, since disclosing agents for staining plaque are ineffective in educating children who are visually impaired, we adopted a multisensory approach using touch, taste, and smell to teach the students about oral hygiene. These strategies were found to be effective in the dental literature (Greeley et al., 1976; Ligh, 1979), which reported that the creative use of the other senses is key when instructing persons who are blind in oral hygiene. We recommend the use of multisensory methods, which were extremely effective in this program for children with visual impairments, in future studies.

A salient factor in this study was the dampening effect of the three participants' difficulty with manual dexterity for dental flossing, which takes more finger dexterity than does grasping pens, perhaps because of their young age or the lack of encouragement at home to complete grooming tasks individually. It was observed during the individual coaching sessions that the three participants had difficulty putting the floss into interproximal spaces and winding the floss on the middle fingers of both hands. This finding was in contrast to that of Willette and Savage's (1978) study, which reported that 14 of the 17 sighted participants with mild mental retardation could floss their front teeth. However, their participants were adults, whose

motor skills may have been more proficient than those of the young participants in this study.

A dental study in Taiwan determined that sighted 8- to 9-year-old children without physical disabilities are able to floss their front teeth (Taiwan Dental Association, 1995). This finding led us to believe more strongly that children with visual impairments may not be encouraged to pursue grooming tasks on their own. Therefore, future dental education programs for visually impaired children should focus on teaching students how to floss their teeth properly.

We regret that previous research on oral hygiene skills of students with visual impairment is sparse. As a result, there are few studies to provide a basis for comparison with the current study. However, the findings of this study are in congruence with those of the oral hygiene programs with similar formats, such as that of Hawkins et al. (2001), who reported improved competence in toothbrushing among first graders without disabilities after they received classroom-based instruction, along with two small-group sessions.

Conclusion

This study developed an oral hygiene program for three elementary students who were visually impaired, in the hope that this program could be implemented in a larger study. Future studies can investigate the effects of teaching oral hygiene skills to a more extensive

group of students with visual impairments. An effective follow-up program to the curriculum would be a secondary program to teach parents (such as Tina's father) the same methods that their children learned to ensure their knowledge and support. Formally training teachers after the completion of the dental program may help them to monitor students' progress as well. In addition, researchers could also investigate the long-term (longer than 12 months) effects of support by teachers and parents on the oral hygiene practices of children with visual impairments.

The positive outcomes for Tina, Helen, and Mary need to be interpreted within an appropriate context. This sample of participants was small and was all female. The application of the findings will require systematic replication among both boys and girls and participants with various degrees of vision loss to confirm the findings. An additional limitation is that the dental plaque check was conducted by only one dentist because a second dentist was not available. But, as noted, to prevent the possible impact on the reliability, the dentist went through a full-mouth check for a second time while the data were recorded on the PCR with the help of a dental assistant to ensure that the data noted were correct. Another drawback of the study was its lack of breadth, since only three participants were included. Because of this low number of participants, our generalization of the results should be interpreted with caution. However, to our knowledge, this was one of the few programs that attempted to

provide thorough training in oral hygiene skills to students with visual impairments.

This program is feasible to use with either elementary school or older students with visual impairments. Since it has proved to be both attainable and effective, with enduring oral health improvements, we look forward to the day when this neglected curriculum is standard in all schools that educate students who are visually impaired.

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