California State University . Northridge

A Plaque Control Program
at the Sixth Grade Level

A thesis submitted in partial satisfaction of the
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by

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ABSTRACT

A Plaque Control Program at the Sixth Grade Level

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Conventional methods of dental health instruction, which rely on lectures or films, have not been effective in changing the dental health behavior of the nation's school children. For this reason, this study was designed to compare conventional methods with a new approach to dental health education, which includes the use of actual toothbrushing in the classroom, to determine whether one method provides more desirable results than the other.

In the study four groups were used. The first group, the control, received no treatment, the second and third classroom groups were exposed to two types of conventional instruction, and a fourth group received a conventional approach followed by preventive techniques which included daily classroom brushing for one month. It was found that the brushing group had significantly lower levels of

plaque accumulation and gum inflammation than the others, thereby indicating that the actual classroom practice of desired skills was the key factor which caused the significant difference in oral hygiene scores among the classroom groups.

Further confirmation of the role of supervised brushing in reduction of plaque accumulation and gum inflammation occurred when sixteen students, who had received low oral hygiene scores in a dental screening, participated in a two-week brushing program which resulted in significantly improved scores.

The study also appeared to agree with the observation that girls brush more effectively than boys. However, when both had the opportunity to practice brushing in the classroom, there was no significant difference in their scores.

The findings of this study indicate that the schools, if they are to serve their communities' diverse needs, must provide practice time for health oriented skills such as dental hygiene techniques, just as they do with math and reading skills, to help integrate desired habits into each child's life pattern.

The mouth in its entirety is an important and even wondrous part of our anatomy, our emotion, our life: it is the site of our very being. When an animal loses its teeth, it cannot survive unless it is domesticated; its very existence is terminated: it dies. In the human, the mouth is the means of speaking, of expressing love, happiness and joy, anger, ill temper, or sorrow. It is the primary sex contact; hence it is of initial import to our regeneration and survival by food and propagation. It deserves the greatest care it can receive at any sacrifice.

F. Harold Wirth, D.D.S. 44

CHAPTER I

THE PROBLEM

School nurses and elementary teachers who are in close contact with students do not find it difficult to believe statistics which indicate that dental disease is at the epidemic level, with over a billion untreated cavities in the United States alone. (6:30;45) Ninety-five percent of school children show evidence of decay, (14:97) twenty million Americans over thirty-four years of age have lost all of their teeth, and thirty-five million more are headed in that direction. (45:1) Daniel Corrigan, head of California's dental health unit, says that 500,000,000 dollars are spent each year for dental care "largely because many people are not aware that dental disease is highly preventable." (7:8)

Even though Alden lists Dental Health as one of five health subjects taught to most students in all the elementary grades, dental hygiene continues to receive the lowest individual priority in actual practice or behavior. (1:264) Compounding the problem is an increasingly short supply of dentists and the statistical fact that only one-half of the population visits those who are available. (6:12)

The California Health and Welfare Agency has designated dental disease as one of four top health problems in the state and plans to help communities mobilize for preventive action. The state dental health unit is developing guidelines and supporting action-oriented school programs which will promote the concept that teeth can last for a lifetime. (7:8)

While the prevalence of dental caries has been obvious, it is only because of the recent emphasis on preventive dentistry that periodontal disease, long recognized as a malady of adults, has been noticed in many children.(14:97) A broad range of research in preventive dentistry has also made it clear that dental plaque is the primary cause of both caries and periodontal disease.

Cursory dental examinations of elementary students, called in by the author for visual and auditory screening, revealed a large number of caries, fillings and gum inflammation at all age levels, raising serious questions about the efficacy of the dental health units taught each year in many elementary classrooms.

Because the schools have assumed a combined responsibility with the home for dental health education, it is necessary to examine current instructional practices to ferret out reasons for failure to transmit adequate knowledge, to encourage positive attitudes, and to stimulate sufficient motivation for functional dental hygiene behavior. Concomitantly, new instructional programs, which show promise for long range changes in attitudes and behavior, beg to be explored.

While other aspects of health are neglected in many classrooms because of lack of time, inadequate motivation, or faulty preparation of the teacher, Dental Health Week has at least focused the attention of virtually all elementary classroom teachers on this one aspect of health instruction. Why then do school nurses and dentists see such a large number of caries, so much materia alba at the gumline, and such a large quantity of plaque affixed to the teeth?

One reason may be that conventional dental health instruction

has usually been carried out by teachers who have received no inservice training in dental health concepts; who knew nothing of the new concepts of preventive dentistry; who felt that they had educated their classes if they had shown dental films and given the children a fill-in sheet of a tooth and its parts. It has not occurred to most of them, or they have not had the time, to bring about habit or behavior change by providing practice time and reinforcement as they do when teaching arithmetic or reading.

Another reason that the dental health program may fail is that too often a visitor is expected to provide the "magic" which will cause a desired change in behavior, ignoring the fact that even magic does not work without practice. Classroom visits by the nurse or a dentist might provide more up-to-date information and carry more weight because they are members of the medical profession. However, it has been demonstrated, to the dismay of this author, that fifteen minutes after an hour-long lecture demonstration of preventive methods of dental hygiene, supplemented by a film on brushing and flossing, student visitors to the health office, from the same classroom, were unable to do a return demonstration of techniques shown in class because there had been no opportunity to internalize the information by practicing what they had appeared to watch so attentively.

This experience helps to support Schreier's contention that classroom instruction has been singularly unsuccessful in teaching dental hygiene. He said that there has been success with teaching on a one-to-one basis in the dentist's office, but that new classroom approaches must be attempted if the necessary number of individuals

are to be reached in a manner which will result in desired behavior change. (35:559)

The best hope for change lies with the natural curiosity and concern that elementary students have for their own bodies. It is surprising how many questions they ask and how many personal and family experiences relating to health they volunteer in the classroom. If students' interest could be captured, along with the energy and enthusiasm they have for activities which capitalize on their wish to be attractive, it might be possible to cause desirable behavior change by utilizing a different approach to dental hygiene instruction.

The problem lies with overcoming the educational and motivational blocks which have interfered with the development of efficient oral hygiene habits. Since conscientiously applied plaque control techniques are credited with reducing caries and periodontal disease, it is necessary to test methods of teaching students concepts and skills which will help them incorporate these into their habit patterns and result in desired behavior change.

PURPOSE OF THE STUDY

This study grew out of a recognition of the failure of present methods of dental health education. It is hoped that a comparison of the dental health status of students who receive the conventional approach to dental health care with those who are given the opportunity to put preventive methods of dental hygiene into daily practice, will indicate to teachers and school authorities that changes in approach must occur if the dental health of people in the community is

to be improved.

If the classroom brushing program results in lower plaque concentration and reduced gingivitis in students, it should be evident to teachers, administrators, students and parents that learning and refining correct brushing techniques has a direct, salutary effect on dental health.

HYPOTHESES

The following two hypotheses will be tested in this study:

1. There is no difference in plaque accumulation and gingivitis between students who receive conventional methods of dental health instruction and those who follow the instructions with daily classroom practice.
2. There is no difference in plaque accumulation and gingivitis between boys and girls.

LIMITATIONS OF THE STUDY

The limitations of the study were a product of both lack of time and lack of experience. For one thing, the teachers were minimally prepared in new dental health concepts. While all the sixth grade teachers were invited, only the two teachers who supervised classroom brushing sessions attended the workshop provided. At that meeting, a dentist active in preventive work showed slides and explained processes of dental disease, as well as techniques of prevention and cure. He demonstrated the cleansing techniques with a brush and floss and gave each participant supplies with which to

practice.

The two teachers' knowledge was supplemented later by several viewings of the film, "Flossing and Brushing," and by the author's lecture-demonstration in their classrooms, but they received no additional reinforcement. They conducted the classroom practice sessions without an "expert" to advise them, though the author did visit the classrooms twice, on days when the disclosing tablets were used, and pointed out areas which needed better brushing.

Another limitation to the study was the failure to obtain evidence of long term behavior change. Brushing for one month in one classroom and two months in the other was not enough to effect permanent habit change in most of the students. Since there was no followup of the students after the study, the long-term effects of the actual practice of skills are unknown.

Except for the verbal information the children took home, there was no communication with the parents about the goals of this dental health unit. This may well have limited the effects of the program for many students and represented a failure to capitalize on the possibility of extending the effects of new knowledge from the school to the home.

DEFINITION OF TERMS

Several terms which are to be used frequently in the body of this paper are defined below for the purpose of clarity.

Conventional Dental Health Education

The presentation of a lecture or dental film to students,

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usually without planning for continuity or sequence from year to year. Concentration is on anatomy, development, and function of the teeth and on the importance of brushing three times daily in a given manner, with no opportunity to practice the recommended techniques.

Preventive Dental Health Instruction

Informs students of the nature, hazards and prevention of plaque accumulation and provides the opportunity to practice, over a prolonged period of time, the brushing, flossing, and disclosing techniques which will be effective in reducing caries and periodontal disease.

Preventive Dentistry

The philosophy and practice of dentistry which emphasizes preventive methods or oral hygiene which can be taught to, and carried out by, the patient to attack causes rather than to concentrate on remediation of the effects of dental disease.

Periodontal Disease

The inflammation and subsequent destruction of tissues and bones which support the teeth. The principal cause of loss of teeth.

Gingivitis

Inflammation of the gums, characterized by bleeding with gentle probing. Predisposes to periodontal disease.

Plaque

A nearly invisible coating which is continually forming on the

teeth. It consists of bacteria, oral secretions, and shed epithelial and blood cells. Plaque is thought to be the primary cause of both caries and periodontal disease.

Oral Hygiene Status

The score assigned to each student according to the presence or absence of plaque or gum inflammation.

Bass Technique

The method of brushing, flossing, and using disclosing tablets developed by Dr. Bass in the early 1940's.

CHAPTER II

REVIEW OF THE LITERATURE

Literature was examined to establish the extent of dental disease and its causes and treatment, but of greater interest was the exploration of newer concepts of preventive dentistry: its origins, the variety of methods advocated, the question of who will best be able to reach a broad base of the population, and the possibilities for long-term gains for the dental health of individuals trained in the new plaque control techniques.

Since it appears that dentists are limited in both numbers and time, and since many of them feel that the schools are best prepared to provide preventive dental health education, traditional methods of school dental health instruction were examined as were several studies which describe experiments undertaken in selected school districts in an attempt to improve dental health and to achieve permanent changes in dental hygiene behavior.

COMPONENTS OF DENTAL DISEASE

While tooth decay is the major cause of tooth loss in those under thirty-five, periodontal disease is the major culprit thereafter. (43) Although Scopp said that periodontal disease seldom occurs before eighteen years of age, (36:67) Fodor noted that it had been found in as many as 25.2 percent of one group of children with deciduous teeth. (14:97) World Health Organization figures indicated

that 67 percent of young adults, 80 percent of middle-aged adults, and 90 percent of those over sixty-five have some degree of periodontal disease.(40:106) According to Diefenbach, both caries and periodontal disease can be largely prevented, but we have not applied even the preventive knowledge we have at hand. He cited the fluoride controversy as a case in point.(6:12) Clark concurred by saying that fluoridated water reduces new caries by two-thirds, but warned that it has no effect on periodontal disease, which is responsible for one-half of all extractions.(4:27)

Diet has also been commonly associated with dental health. Primitive man ate the foods which helped him preserve the teeth so necessary to his survival -- natural grains, fruits, and vegetables. Modern man, with his extended life span, needs his teeth even longer but is propelling them to early destruction with a diet heavy in sugars and starches.(42:1) Scopp felt that the type of diet ingested affects deposits of calculus and plaque and that soft foods do not allow for functional massage of the gingiva.(36:65) Suomi's survey of three hundred dental publications caused him to conclude that diet can either help to cause or help to prevent periodontal disease, but he felt that more research in this area was necessary.(39:1281)

Dreizen feared that a prolonged, poor diet during the period of enamel and dentin formation can permanently affect teeth, since neither of these components can regenerate.(8:114)

Nutritionist Abraham Nizel warned that a preventive dental health program must be balanced and should include personalized nutrition counseling, the use of fluorides and the implementation of

plaque control methods. He asserted that it is dangerous to emphasize only the latter.(27:6)

Dental research is far behind medical research, lamented Kreshover, who noted a research scientist ratio of 1.9 for medical doctors and 1.53 for dentists.(22:43) Much progress has been made, but there appears to be a wide difference in understanding by dentists and laymen of the causes, pathology, control, and prevention of oral diseases. He added that genetic and environmental causes have barely been touched upon.(22:43) It appears, however, that enough controlled research has been done to make a strong case for the culpability of dental plaque in both dental decay and periodontal disease.(36:40)

DENTAL PLAQUE

The recognition of plaque is not new. Van Leeuwenhock saw many microorganisms in materia alba as early as the year 1683, while Miller was discussing dental plaque in 1897,(12:87) and Benjamin Franklin gave it the name of "tooth fur."(40:106)

Craig and Scopp described plaque as a gel-like mat which adheres to the tooth surfaces. It consists of bacteria and its products, of components of oral secretions, and of shed epithelial and blood cells, and is affected by the composition of saliva, diet, length of time of deposit, and each individual's bacteria population. It develops rapidly and cannot be rinsed away, but it can be disclosed by a dye.(5:7; 36:4)

The bacteria cannot begin their action until they are attached to the teeth as a part of plaque deposits.(5:7) Studies show that

dental plaque, which varies in its pathogenic effects, may be associated with periodontal disease, with caries, or with calculus, but in all cases it adheres to the tooth surface. Scopp felt that research on the adhesion mechanism might be helpful to efforts directed at caries and periodontal disease control.(36:4)

"It is probable," said Craig, "that a thin pellicle forms on the tooth, upon which bacteria colonize to form layers of plaque." (5:7) Streptococci develop in the gummy substance, fermenting the various carbohydrates and resulting in intracellular stores of polysaccharides, which can be used to produce acids if outside sources of carbohydrate are not available.(5:8; 36:4)

Arnim added that basic research strongly supports the concept that dental disease is caused by the plaque which adheres to surfaces where lesions have begun to form after ingestion of cariogenic foods. He felt strongly that present eating habits and oral hygiene account for the caries of 99 percent of the population.(2:269) Loe found that twelve people with healthy gingiva developed plaque and observable gingivitis within ten to twenty-one days when all oral hygiene measures were halted. When hygiene was restored, the plaque and gingivitis subsided.(5:9)

Normal gingiva is pale, pink, firm stippled tissue which surrounds the teeth much like a collar.(36:9) Symptoms of gingivitis or gum inflammation include bleeding with gentle probing of the gum, color changes and enlargement of the gingival crest, which begins to stand away from the tooth surface, instead of clinging as it should. (36:42)

"Calculus does not appear to be a direct cause of gingivitis," said Craig, "but seems to act as a holder for plaque."(5:9) Scopp added that deposits on the teeth, such as calculus, materia alba, dental plaque, stained embryonic remnants, and protein pellicles all contribute to caries and gingivitis. He described calculus as calcified bacteria and fungus accumulations which become attached to the teeth and which are the result of dental plaque formation. (36:2) He said that both calculus and plaque are encouraged by the same factors, but that plaque, with its bacterial masses, seems to be more directly involved with inflammation and tissue destruction. (36:38) The shiny plaque cover over the calculus causes retention of the microorganisms and their products.(36:39)

Some attachments of calculus seem to follow earlier carious processes and appear to form a very close inter-relationship which makes it difficult to remove prophylactically even from smooth tooth surfaces. Demineralization was often seen to occur on tooth surfaces which had been covered with calculus.(37:16) In decalcified sections, the close relationship between the interbacterial matrix and the fibers of the hard dental tissue were easily observed. Selvig added that plaque and calculus seem to attach themselves in the same manner to cementum and dentin as they do to enamel.(37:12) Scopp felt that the extent of the damage done to the teeth and their supporting structures is partially determined by the patient's resistance.(36:38)

Stauffer said that plaque tends to collect in pits and fissures, in margins of the gums, and between the teeth and that it spreads and

thickens if not disturbed. The bacteria in the plaque form an acid, which is kept adjacent to the teeth by the plaque itself.(38:85) Dunn added that plaque, which is 80 percent bacteria, is found in greater quantity where the action of the cheeks, lips and food ingested are minimal. He did not see dental cleaning as a solution to plaque accumulation, since it results in a plaque-free mouth for less than a day, and a calculus-free mouth for less than two weeks. (9:365)

Some studies show that antibiotics seem to suppress calculus and plaque formation, which lends credence to the assertion that bacteria are important in the formation of both.(36:63) Suomi, Scopp, and Baboolal referred to studies which indicate that bacteria can produce toxins which may irritate the gingiva.(39:1272; 36:40; 3:248) Craig felt that plaque is more predisposing to gum inflammation than is mechanical irritation.(5:15) Valois noted that if periodontal disease is not checked, the gums recede and leave pockets of bacteria or exposed roots, resulting in disease of the bones and supporting ligaments.(40:106)

Scopp warned that food impacted on the gingiva, or between the teeth, may putrify, causing bleeding and breakdown of tissues. Mal-aligned teeth encourage this impaction.(36:65) He described materia alba as a soft, creamy white, or yellow deposit at the gum line which irritates the gingiva and can cause decalcification of the enamel underneath if it is not brushed away. It is composed of bacteria, microorganisms, epithelial cells and food debris, the last of which Scopp found to be closely correlated with gingivitis.(36:41)

Suomi reported that epidemiological surveys and clinical studies show a strong association between accumulated plaque, oral debris, calculus and periodontal disease; that improved oral hygiene reduces gingivitis and the degree of tooth attachment loss, and that nutrition, hereditary factors and allergies may predispose one to periodontal disease.(39:1271) Based on these findings, a strong movement toward preventive dentistry has been developing within the dental profession.

PREVENTIVE METHODS OF DENTAL HYGIENE

"Oral health," said Stauffer, "has often been neglected in favor of more immediate health problems." He felt that Americans have adjusted to poor dental health and that many have failed to see the value, or even the possibility of prevention of dental disease. (38:84) Gutman mentioned the vast backlog of dental disease and neglect due to public apathy toward maintenance care.(19:505)

Dentists have also been to blame for the poor dental health status of many patients. Suomi pointed to a three year study by Kimmelman which indicated that 60 percent of his patients were being instructed in preventive techniques for the first time. Another study by Bell indicated that a mere 10 percent of one thousand dental patients had received previous instruction.(39:1276)

Diefenbach insisted that only a full fledged preventive program will be able to cope with our vast dental problems,(6:12) while Dunn said that prevention is the most important objective in dentistry--that basic dentistry should ideally prevent the need for further

dental work.(9:361) Suomi added that prevention of dental disease rests with the individual, who must clean his teeth, and the dentist who must motivate, educate and do prophylaxis.(39:1271)

The concept of dental plaque control, first advocated by Bass in the 1940's and later by Arnim, did not receive much attention until Robert Barkley began lecturing on preventive dentistry in 1965. Masters recalled that he was one of several dentists who had scoffed at Barkley's advocacy of patient applied treatment through plaque control and food selection, but admitted that they all became increasingly impressed with Arnim's research, and subsequently began training their own staffs to carry out the recommended preventive program.(25:14) Another dentist, Ratcliff, found that 90 percent of patients could be taught to remove 90 percent of the plaque in their mouths, using already known philosophies and techniques for education and motivation in planning for their instruction.(32:15)

Arnim, at the time of writing his paper for a conference on preventive dentistry in 1966, had conducted a program of nineteen years' duration which had been effective in arresting caries and controlling periodontal disease in those who followed his instructions. He had some patients whose molars had remained healthy for as many as seventeen years.(2:264) Arnim admitted that it is not known why some people do not get cavities, regardless of their life styles, but stressed that it is known that simple preventive methods are effective in maintaining a good dental status.(2:265) He credited Bass with initiating the preventive concept and for suggesting the use of disclosing stains, for devising the rounded toothbrush, and for

developing the thin, unwaxed floss used for cleaning of vulnerable sites. The use of disclosing dye interested more dentists in the program because of its obvious use as a visual aid.(2:266) Arnim added a simple water irrigation to flossing and brushing with consequent improved results. (2:268)

The American Society of Preventive Dentistry, founded in 1967 by thirty dentists, now boasts seven thousand members who are enthusiastically urging patients to practice the new procedures.(28:1) Dentists who instituted preventive programs for fees when they found they could not keep up with constant repairs and emergency dentistry, have found the field very rewarding. Many have discovered that when patients see preventive methods working, they seem to place a higher value on their teeth and are more amenable to costly repairs and restorations, if they should become necessary.(5:4)

One group of dentists who began preventive care fifteen years ago, found that young adults whom they had treated as children by use of preventive methods, were not losing teeth or needing bridgework as their elders had.(12:820) Craig called attention to one dentist in Australia who found many of his young patients reaching the age of sixteen caries-free as a result of his preventive program.(5:5)

Armenta did not regard preventive dentistry as a specialty, but rather as a "philosophy of treating the cause before you address yourself to the results." He felt that pursuing only the results of dental neglect has put dental care in its present situation of crisis. Even the conventional custom of periodic dental checks is inadequate because plaque reforms the next day after a professional cleaning. He

insisted that the formation of plaque can be prevented if it is "disorganized" once daily.(45:2) Perhaps that is why Dunn seemed convinced that what is done at home between dental visits is more important than the frequency of dental checks.(9:370)

Even among dentists deeply involved in preventive care there is a difference of opinion as to the most effective methods of oral hygiene. Kreshover considered it unlikely that any single approach would solve the problem of dental disease; hence researchers and practitioners are planning attacks on all aspects of dental care and are using a combination of techniques.(22:43) However, there seems to be a consensus that prevention must begin with awareness and understanding of dental disease, hopefully when the problem is mild and easy to remedy rather than when full blown.(34:31)

Valois recognized the controversy apropos the most effective method of plaque control, but insisted that brushing properly is a crucial factor. Relying on a waterpick or a particular brand of toothpaste is not enough. Friction with a brush and rubbing with floss are necessary.(40:106)

At least seven methods of brushing are advocated by various factions in preventive dentistry, but Suomi and Craig agreed that the conscientious and correct use of any one of them is more important than the method. However, they felt that all the methods should be evaluated for effectiveness.(39:1272; 5:9)

Valois claimed that the most accepted method of brushing is the one developed by Bass, which involves the use of a brush with soft, even bristles positioned at a right angle to the gums, where the

gingiva and teeth meet, and vibrated sideways with short strokes several times at each placement. Pressure, she said, should be great enough to feel the bristles on the gums and to cause them to vibrate between the teeth. Only one or two teeth should be cleaned at each placement.(40:106)

All inner and outer surfaces must be cleaned carefully and the brush turned vertically, with up and down strokes to clean the front teeth.(38:86) Dunn suggested thinking of the brush as a series of toothpicks in terms of "picking your teeth with your toothbrush." (9:365)

Löe and Stauffer seemed to prefer Bass' method,(5:10; 38:86) Suomi mentioned the roll technique (39:1272) and others recommended electric brushes, especially for small children or for the handicapped. (20:11; 5:10; 39:1274) Suomi, in his ambitious review of the literature, found no single type of bristle or form of brush to be superior; rather he felt that the choice of brush should be tailored to individual needs, manual dexterity and anatomical configurations. (39:1274) Regardless of the method used, Voigt cautioned about the amount of pressure placed on the brush and the vigor with which it is used, for it is possible to abrade the gingiva even with soft bristles.(41:28)

Just as there is no consensus on the method of brushing, there is no agreement as to the ideal frequency of brushing. Suomi cited studies which found less dental debris with increased frequency, but felt that brushing twice daily was sufficient, since no added benefit was seen for those who brushed more often.(39:1273) McKendrick et al

found that oral debris remained fairly consistent during the day, regardless of ingestion of food. While they found that frequency of brushing reduced oral debris, the authors felt that their study did not prove that this was effective in improving dental health.(23:205) They admitted that some workers (Curson and Manson, 1965) did not find a significant relationship between the frequency of brushing and oral hygiene.(23:207)

The conventional theory is that teeth should be brushed three times daily after meals, but advocates of the plaque control concept recommend a thorough brushing once daily.(27:62) Dental hygienist, Valois, agreed with many preventive dentists that a thorough cleansing once daily will dislodge plaque effectively, unless there are special problems like crooked teeth and overlaps, or there is ingestion of a very cariogenic diet.(40:108) She said that it takes fifteen minutes daily at first to get accustomed to the new dental hygiene techniques, and a half-hour on weekends to check with the dye and mirrors, but that later it is possible to perform the entire task in less time, while reading or watching television.(40:108)

Other factors are felt to be important in plaque control techniques. Flossing, which is necessary for cleaning between the teeth and at gum margins, must be done daily.(49) Unwaxed floss may be wrapped around the fingers, or tied in a twelve-inch circle to facilitate its careful passage between each tooth to the gumline curve, where it is to be pulled into a C shape against the tooth and guided into the space between the gum and the tooth. It is then pulled up and down both sides of each tooth until squeaking is heard.

If the gums bleed, they are not healthy. With practice, flossing should be accomplished within five minutes.(48; 49)

Disclosing tablets can be used to test the effectiveness of flossing and brushing techniques, either before or after the cleaning. Floss can then be used to clean the areas which were missed. With constant repetition and checking, brushing techniques will improve. (40:108)

Suomi said that chewing gum is not as effective as brushing, flossing and rinsing, but saw possibilities for its use in the future if plaque retardant enzymes are developed and included in its formula.(39:1276) He also read studies which found no statistical difference between apple and carrot chewers and individuals in control groups, some of whom had performed no oral hygiene tasks for eighteen days. He cautioned that raw food cannot be depended upon to remove plaque accumulation in protected areas of the mouth.(39:1275)

Rinsing does not remove firmly adhered plaque either, said Suomi. Water sprays may be a helpful adjunct to brushing and flossing, but cannot be considered a substitute.(39:1274)

One study, reported by Gomer et al, indicated a reduction in plaque accumulation when different rinses were used with each of three control groups, but the authors were not certain whether the effects were due in part to the increased awareness of oral hygiene during the study. They wondered if rinsing with any liquid might have had the same results.(18:55)

Voigt pointed out that the use of too much toothpaste interferes with the removal of plaque and materia alba.(41:27) Craig recommended

fluoride dentifrice with a mild abrasive for plaque control and carlostasis.(5:10)

Gjerme and Flötra found, in a study of young people with relatively healthy gum tissue, that floss was superior to toothpicks in tight spaces, but that when a single tufted brush was used in addition to the toothpick, the combination was equal in effectiveness to the use of floss. Each method took about four minutes to perform. A control group improved its plaque index somewhat with uninstructed brushing, probably because of the high interest level stimulated by the study, but significant change occurred only with the use of floss, or with the use of brush and toothpick.(17:235) The authors felt that irrigators had mixed results and that chemical agents have not been shown to be beneficial thus far.(17:230)

Gilmore and Bhaskar reported a study which was done to determine whether tongue brushing reduced dental plaque, since the tongue is the home of the same type of bacteria which are a component of dental plaque. Brushing was done by drawing a soft brush from the back of the tongue forward eight to ten times, with care to prevent gagging.(16:893) Individuals in one group, who engaged in routine tongue brushing had a reduced streptococcus count, but the habit had to be maintained to be effective. Stopping for one week increased the streptococcus count ten-fold. With a second group of subjects, who did not routinely brush their tongues, it was found that brushing for one week did not cause a consistent reduction of bacteria. In either case, brushing with toothpaste was more effective than brushing with water alone.

In the same study, bacteria removed from the tongue and grown in culture produced a plaque on a smooth steel wire, which became stickier in three to four days, leading to the inference that bacteria on the tongue may be closely related, or be the same as that found in dental plaque. Since plaque accumulates on clean teeth within twenty-four hours, the authors felt that it is quite possible that the tongue acts as a reservoir for bacteria.(16:894) Also noticed during the study was a lower bacterial count in caries-inactive subjects than that found in the caries-active population, further suggesting the relationship between bacterial population of the tongue and plaque formation.(16:895)

Both Craig and Johnson recommended that parents brush the teeth of children who lack the manual dexterity necessary to do an adequate job--usually until seven years, but sometimes to the age of nine years. If they wish, parents may clean the teeth first and allow the children to practice afterwards until the skills are learned. Standing behind the child and holding his head back seems to be the most functional way to reach all of his teeth.(5:10; 21:825)

CURRENT EDUCATIONAL PROGRAMS

Recently, dental prevention has gone beyond the dentist's office to be found in such mass media publications as the Los Angeles Times and Ms magazine, where articles geared to public consumption are attracting increasing attention.(28:40) Some school dental health programs are also beginning to expand as increasing numbers of dentists and their ancillary workers have realized that they are too busy trying

to keep up with the results of dental disease to carry the entire load of preventive education.

Scopp felt that the schools must help the dental profession provide adequate dental health knowledge, attitudes, and practices, for too often the desire for good dental health is frustrated by ignorance of proper methods of control.(36:97) Fodor agreed that preventive dental health education must be used as a supplement to the restorative work done by dentists, and concurred with Scopp's statement in saying that the mere desire for good dental care is not enough.(14:97)

Schreier felt that school dental health programs are the most effective means of reaching large groups of youngsters, but realized that in this day of accountability and mandated courses, the programs must be effective or there would be no time found for them in the already crowded school day. He felt that school dental health education, as presently instituted, has not been nearly as effective as one-to-one instruction of the individual by dentist or hygienist, but he realized that sheer numbers make it important to find another solution to this problem.(35:559)

Consensus has it that dental health education should begin at the early elementary level where attitudes and habits of students are flexible and easily reinforceable, through future years of school and through several levels of maturity.(1:471; 24:257; 26:39) Alden said that a positive approach should attend the dispensing of knowledge, and felt that the schools must realize that they and the teachers can be a "positive source of influence."(1:264)

It is not enough, continued Alden, to show films, pamphlets, and posters and expect people to follow advice "because it is good for them." Present dental education, unfortunately, repeats what children already know, concentrates on dire warnings about sweets as the cause of decay, and fails to plan for sequentiality, continuity and freshness.(1:265)

Elementary school teachers and school nurses have conducted their dental health programs for years with the best of intentions, but with consistently poor results. Dental health week has been a time for diversion, rather than a beginning for improved health habits. Rehberg set the tone when he said that children respond best when fun is combined with learning. He recommended animated visuals, hand puppets of happy and sad teeth, and bacteria bugs which attack teeth and make them unhappy, but made no mention of actual practice to learn and internalize adequate dental hygiene techniques.(33:5)

Eiseman described a curriculum design based on the use of concepts and behavioral objectives to provide the needed motivation for students to make the kinds of decisions which enhance dental health. He stressed action as a key to the success of classroom instruction and reminded us that the dental health programs presented thus far by most of the schools have failed to improve the dental health status of the citizenry.(10:466)

Alden felt that present programs could be improved by making it possible for students and faculty to brush after eating, thus moving from the "talking level" to the "doing level" and making it possible for behavioral change to be measured.(1:265)

The Framework for Health Instruction in California Public Schools (13:24,25) offers a conceptual approach to dental health instruction, which is excellent for sequential planning and a welcome replacement for the continuous repetition which Alden deplores. However, unless it is used innovatively, the schools will continue to fall into the typical pattern of telling rather than doing, and will find that dental health behavior still does not change.

Research and clinical studies show that skillful brushing and the development of consistent habits is effective in the control of dental disease, said Masters, who felt that educational programs must directly attack the causes, rather than merely the results of the disease.(24:257) Closely related is Gjermo's statement that the role of bacterial plaque in dental disease has been demonstrated by controlled clinical trials which show that improved oral hygiene reduces the incidence and severity of gingivitis.(17:230) It seems apropos then to pursue an educational program which will affect knowledge, attitudes and practice in such a way that habits of plaque control will become as natural as combing one's hair in the morning.

NEW EDUCATIONAL APPROACHES

Several studies have been developed to test and measure the results of new dental education programs. Since new preventive programs are based on the involvement of elementary teachers, a study of the dental health knowledge of teachers was undertaken in Bowling Green, Kentucky.(27:60) The results indicated that the teachers lacked knowledge and understanding of dental concepts. They knew the

conventional facts, but did not understand why some of them had been stated, and few of them had adequate knowledge of modern plaque control concepts. One purpose of the study was to use the results for a new school dental health education package, for the authors felt that the teachers had to have a broader understanding of dental health concepts if they were to be effective with their students.

(27:64)

Fodor and Ziegler undertook a four-year program in which leading dental authorities provided current dental information to teachers, nurses, and administrators in the Los Angeles School District through a series of workshops.(14:97) They hoped that the favorable responses of the participants in the workshops, the development of a curriculum guide and visual aids, the presentation of inservice programs to keep school personnel up to date, and the development of dental appraisal and community orientation programs would result in the improved dental health education which is necessary if the national dental health problem is to be alleviated in the future.(14:98, 99)

Masters described a pilot program which involved training teachers in dental health knowledge and skills, after evidence indicated that the conventional approach to dental health education, supplemented by occasional visits to the dentist, was not preventing dental disease.(26:41)

Since pretests indicated that the teachers knew very little about dental health, and less about modern concepts of care, they were given information about dental disease, were taught to care for

their own teeth so they could feel more secure about teaching the techniques, and were provided with feedback sessions in workshops held four times during the first month. They were provided with films, charts, posters, fact sheets, and dental kits, which included rounded bristle brushes, floss, disclosing tablets, and small face mirrors. Letters were sent home to parents, explaining the program and requesting their support.(26:41)

Activities varied by classroom, but most groups used brushes and floss daily for a month and stained twice weekly. During the second month, they brushed and flossed two to three times weekly and stained once a week. During both months, dentists reinforced the teachers with large group lectures.(15:42) Masters felt that the teacher workshops were essential to the success of the program: they provided underpinnings of knowledge for the teacher and provided for consistency of presentations.(26:43)

In one classroom 88 percent of the group showed improved gingival health and reduced plaque after ten weeks of the program. The authors felt that a period of twelve to sixteen weeks of classroom practice was needed to produce the desired skill levels, but that extension of the program to a full school year, with reinforcement in subsequent years, would produce more long lasting results.(26:43)

The final evaluation of the program was on the positive side. The enthusiasm of the students kept the teachers interested and involved in the program (26:43) and one sixth grade science teacher felt it was the most important thing he taught his class during the whole school year.(26:49)

Masters felt that the study indicated that a professional educator with the right training and materials could be taught to do a very effective job in a minimum of time,(25:10) and was convinced that this was an efficient use of manpower, since one dentist could train ten teachers who could, in turn, teach preventive dental hygiene techniques to three hundred children per year. He admitted to finding roadblocks set up by the schools because of the time limitations and costs, but felt that these could be overcome by state and district requirements and support. He also felt that if an administrator were convinced that the program was valuable, he would make time for it in the school day.(26:45)

Clark and Fintz reported another pilot study, done in the Cleveland schools, where it was realized that the largest captive audience, among the 60 percent of the population which did not visit the dentist yearly, was school children. Here, as in most other districts, dental health had been handled as a once-a-year lecture, culminating in the dispensing of new toothbrushes to children. Since this routine had not resulted in desired behavior change, it was decided to try a new approach.(4:27)

Teachers were trained by a local dentist and his assistant, who would ultimately have the most teacher contact. The program was based on two hypotheses: caries and periodontal disease may result from plaque; a change in teaching method would be effective in reducing oral disease.(4:27)

After a pretest of knowledge and plaque removal performance, sixth grade students were exposed to a planned program of dental

health information and skills training. On the first day the dentist lectured on plaque production, gum disease, cause of caries, diet, detergent vs non-detergent foods, brushing, fluoride, staining solutions, floss, and brushes. Then each student began his daily routine of staining, brushing and flossing.

On the following day there was a review, followed by films, then brushing; on the third day another review and the demonstration of plaque under a microscope; on the fourth day the students placed and viewed their own plaque in the microscope; on the fifth day there was another review, a written exam and a stain test.

The next week the students brushed daily and checked each other for plaque after staining, under the supervision of the dental assistant. The procedure took ten minutes of class time. The follow-up continued weekly for the entire school year, as the dental assistant administered the disclosing solution to each child, the students checked each other and referred to the dental assistant for reinforcement when necessary.

In order to enhance the possibilities of success, instructions were sent home with the students and the mass media was used to inform the community of the dental health program and to ask for support.

(4:28)

Because much of health instruction involves using fear techniques, such as "bad things will happen if one does not brush his teeth," (31:1086) Ramirez et al made a study at a boys' reform school in which subjects were divided into three groups, each of which received a dental health instruction program of equal length but of

varied emphasis. A pretest, used to determine current dental habits and tooth cleanliness, indicated that the three groups were statistically similar. (31:1089) Color slides of both diseased and healthy gums were used in addition to a taped narrative. (31:1087) One presentation involved a high fear approach with recommendations for care; one was a low fear approach with recommendations for care; and a third group received only the recommendations. Behavioral measurements and questionnaires, which preceded and followed each presentation, indicated that the high fear group retained more of the information in the recommendations, but the authors felt that what was measured was knowledge and intent to behave, rather than the potential of actual dental health practice in the future. In the end, Ramirez et al concluded that the low fear group seemed most likely to adopt the recommendations. (31:1086)

Evans saw two challenges to the psychology of persuasion and behavior modification: examining the value of the use of emotions, such as fear, in educational messages to cause attitude change, and exploring the relationship between attitude change and behavior change as it relates to the possibilities for long term, or permanent change in behavior. After a conversation with Arnim, in which the problems of motivating individuals to use disclosing tablets, correct brushing and flossing techniques were discussed, he thought that preventive dentistry programs might be a fruitful area in which to explore these aspects of behavior. (11:110)

Evans' review of the literature revealed that Leventhal had suggested that highly specific instructions, even without fear, might

be most effective in changing health practices, while Janss had shown that moderate fear with instruction was more effective than a high fear appeal with instruction. However, he found no report of the use of a positive appeal emphasizing good results due to actual dental practices.(11:111)

Thus, as part of a research program, a series of investigations was established to test the effects of various motivators on the dental health behavior of junior high school students in the Houston area. Pretests consisted of photographs of each student's pink stained teeth, before receiving oral hygiene instruction, and questions about his brushing behavior.

Students were divided into five groups and given instruction as follows: (1) general instructions with very high fear content, (2) general instructions with moderate fear, (3) general instructions with positive appeal, (4) elaborated specific instructions without fear or positive appeal, and (5) control group. The students were retested in five days, in two weeks, and in six weeks.(11:111)

Highly important was Evans' finding that reported oral hygiene practices varied significantly from actual behavior, so that results depending on only reported behavior could be quite misleading. He seemed surprised by the results of post-tests which indicated that one-time exposure to specific elaborated instructions resulted in a significant change from the pretest, and that the oral hygiene instruction with positive appeal was nearly as effective. Significantly less effective was the inclusion of fear appeals. However, at six weeks, the teeth of all five groups were nearly as

unhygienic as they had been at the time of the pretest.(11:111)

The problem now being faced by his research group is how to prevent the regression to previous habits. Continuing research includes using behavior modification techniques suggested by Skinner and others, which include repeating instructions, providing feedback of results of tests, applying various combinations of fear and positive appeals, and providing specific skill training instead of general instructions. Some of these have been showing promise of more permanent change.(11:111)

Evans felt that a concentrated preventive program, preferably beginning in the first grade, should be effective in improving oral hygiene for months, but the key to success rests with the ability to transfer the practices to the home, where internalization of motivation and positive reinforcement must continue. Otherwise, the continuation of the type of project tried in Houston, which focused on nearly daily brushing for sixteen weeks, with a thirty-two week followup, will not fulfill the goal of developing adequate lifetime oral hygiene habits.(11:112)

Reed added that attitude and behavior change can be facilitated if the teacher is aware of his objectives, teaches at the learner's pace, corrects mistakes in technique immediately and reinforces the correct action continuously.(32:30)

Fodor and Ziegler's study incorporated the use of disclosing tablets to motivate students to improve their brushing habits. Eight seventh grade classes were paired socioeconomically into four groups and all students were given a pretest which included staining and rinsing

their teeth, having them photographed under controlled conditions, and then brushing to remove the stain.(15:204)

Each of the students in the four groups received two tooth-brushes and a four-week supply of toothpaste, but each group received different instruction. Students in Group A were told of the value and use of disclosing tablets, then were given four tablets, which they were asked to use weekly. Group B students were instructed in the value of brushing and were shown correct procedures, with the use of visual aids. Students in Group C were instructed in the values of both brushing and disclosing tablets, were given four tablets and were asked to use them weekly for four weeks. Group D received no instructions. At the end of four weeks the procedures of the pretest were repeated and the teeth of each individual's post-test compared to his pretest.(15:204)

The greatest decrease in plaque was found in Group C, where the students had received instructions in both brushing and use of the tablet. Those using the tablets alone had a decrease in stain, while those not using the tablets at all had a significant increase in stain. While there is no proof that the use of disclosing tablets will motivate students to improve their dental hygiene, Fodor and Ziegler felt that the tablet was a useful adjunct to an instructional program designed to reduce plaque concentration.(15:207)

Regardless of the method of dental health education desired, Masters stated that, in order to get it into the schools on a practical basis, it is necessary to gain the interest of local dentists and school administrators. This may be accomplished by

arranging a demonstration for them, and possibly for state and local politicians as well. A budget needs to be developed and dental consultants and auxiliaries trained to participate in teacher workshops and future support programs.(24:260)

Gutman added that the communication gap between the school and community must be closed if the instructional program is to be effective.(19:505) Parents should be advised in advance of the dental health program and included in its over-all plan if they are to be expected to supervise the children and reinforce them at home. A note home can be used, but doing this on a yearly basis is not enough for sufficient awareness and motivation on the part of both parents and students.(19:506)

CHAPTER III

METHODOLOGY

A pilot dental plaque control program was conducted at the sixth grade level of a middle school, which is located in one of the least affluent sections of a middle class suburban city in Los Angeles County.

THE POPULATION

The socio-economic status of the school community was essentially working class, as indicated by pupil record cards which showed that 77 percent of the fathers were employed in non-professional positions. Fifty-one percent of the mothers worked, 92 percent of these in non-professional occupations, and 30 percent of the children were living with step-parents, single parents, or grandparents. Ten percent of the population was Mexican-American, 4 percent were Oriental, and the remaining 86 percent were Caucasian.

Of the 244 sixth grade students who took part in the program, 125 were boys and 119 were girls, with an average age of eleven. The seventh and eighth grade classes completed the total school population of 800 students.

PROCEDURES

The sixth grade class was chosen in order to take advantage of the yearly dental screening conducted by local dentists, who volunteered their time to check the teeth of all first and sixth

grade students in the school district. It was convenient to use this grade level because the sixth grade students' coordination and ability to follow instructions was far superior to that of the first graders.

Eight sixth grade classes were involved in the study. Each class consisted of approximately thirty students. Since the students had been assigned to each teacher on a random basis, it was possible to assume that the composition of each classroom was comparable. The classes were paired for the convenience of statistical measurements and computation, but otherwise were treated individually.

During the preliminary planning stage, it was decided that one group would act as a control, while the other three treatment groups would be subjected to varying degrees of instruction and practice. A meeting was held with all of the sixth grade teachers, at which time the program was explained, and they were given an opportunity to choose the treatment they wished to follow. Because the dental program was voluntary, it was impossible to make random assignments of classes for the treatments. Two classes were assigned to each of the four groups. The groups were set up as follows (see Table 1):

Group A, the control, received no planned instruction.

Group B was shown a five-minute film, "Flossing and Brushing," after teachers explained that there was a new brushing technique which students should learn because good oral hygiene was important. The teachers avoided bringing up the subject of dental health on other occasions.

Group C listened to a lecture-discussion by the author, who used color slides to show the causes and effects of caries and

periodontal disease and to demonstrate methods of prevention and control. The forty-five minute presentation was followed by the film, "Flossing and Brushing," which is an excellent vehicle for explaining proper brushing and flossing techniques. Throughout the hour-long presentation, students were encouraged to ask questions. The teachers did not follow up with dental health instruction in the classroom.

Group D received the same presentation as the students in Group C, but the teachers followed up with further instruction in the classroom as they began training their classes in the Bass method of plaque control.

Table 1

Treatments Assigned to Each Group

Group	Lecture	Film	Brushing
A	No	No	No
B	No	Yes	No
C	Yes	Yes	No
D	Yes	Yes	Yes

None of the students were told they were part of a study, nor why they were exposed to each of the treatments, except that those who were to brush were told that they would have an opportunity to learn to remove disease-causing plaque from their teeth and that this would also make their teeth and smiles more attractive. They seemed eager to begin the program. When students in the other classes asked why they were not brushing, they were told that there were not enough

toothbrushes for everyone.

The daily brushing practice was conducted immediately after the lunch break in both Group D classrooms. Each teacher stood at the front of the class to direct the brushing while watching to see that the students were using the prescribed technique.

Toothbrushes with rounded bristles were used without toothpaste. The students were instructed in the Bass technique, which involved pointing the bristles toward the gum line at a 45-degree angle to the teeth and vibrating the brush in place in a gentle, circular motion. Approximately two teeth at a time should be cleaned in this manner.

A pattern of brushing was established to facilitate habit formation and to help the students make certain that all of their teeth had been cleaned, inside and out. Floss was used in one of the Group D classrooms. Disclosing tablets were used twice weekly, after brushing. The students inspected their own teeth and those of their desk partners, using small mirrors, and the teacher did spot checking. On two occasions, the author inspected each student's teeth after he had brushed and used a disclosing tablet, and pointed out areas needing further attention. The students were praised for improvements in plaque removal.

The film, "Flossing and Brushing," was repeated at weekly intervals for reinforcement.

After the first dental screening scores were obtained, another experiment was conducted with sixteen students who had been found to have both plaque and inflamed gingiva. The second experiment was an attempt to support evidence of the effectiveness of supervised

brushing in removing plaque and controlling gum inflammation. Two boys and two girls were selected from each of four classrooms which had not participated in the brushing program. One classroom had been a control group, one had seen only the film, and two had received both the presentation and the film. The students were asked if they would like to brush daily for two weeks in the nurse's office to see if they could clear the plaque from their teeth and restore their gums to a healthy state. They all agreed and faithfully kept their after-lunch appointments.

Each student was given a new brush and shown the Bass method of brushing. As before, no toothpaste was used, although the use of a fluoride toothpaste was recommended for home use. A large mirror was available for self inspection and the author observed the brushing, making suggestions for improvement when necessary. Disclosing tablets were used once each week, but on a surprise basis, in order to avoid influencing the quality of brushing. After staining, each student inspected his teeth and brushed again. Then the author inspected them and pointed out areas needing added attention.

THE MEASUREMENT TOOL

A measurement tool was designed to assign scores to each student according to the existence or non-existence of plaque or gum inflammation. Three scores were possible: E indicated there was no visible plaque or evidence of inflamed gingiva; G indicated that some plaque was visible on the teeth, but that the gingiva was not inflamed; P indicated that both plaque and inflamed gingiva were observed.

Table 2 provides the method of scoring.

Table 2
Method of Scoring Oral Hygiene Status

Score	Plaque Visible?	Inflamed Gingiva?
E	No	No
G	Yes	No
P	Yes	Yes

In order for the results of a study to be generalized for other uses, it is necessary to have terminology and measurement tools defined as precisely as possible so they may be used by others with a minimum of training or preparation. For those involved in dental hygiene education, it would be useful to be able to check the results of a toothbrushing program, or substantiate the need for one, by being able to check the oral hygiene status of students in the absence of a dentist, or other medical expert.

If it is to be valid, the tool must measure what the dentist and the author planned to measure, in this case the presence or absence of dental plaque or gum inflammation. The instrument can be considered reliable if independent observers assign the same scores to subjects with a minimum of random or chance errors. To determine whether the tool met these criteria, correlation coefficients were computed for two independent judges.

It was decided that oral hygiene of each student would be

checked by observing his mouth in its natural state using only the naked eye of the observer, a flashlight and tongue depressor to pinpoint plaque accumulation and gum inflammation. The decision was made to omit use of disclosing solution because this would facilitate the use of the measurement tool in the future, whether in the health office to score a few children at a time, in the classroom for more students, or even in the entire school if the need should arise.

After the dentist and author agreed on valid readings for the measurement tool, they checked a classroom of students to compare scores for reliability. They used the scores of E, G, and P defined earlier in the study. They checked five students' mouths together, then separated to opposite sides of the room to score each of the next twenty-five students independently. Comparisons afterwards showed disagreement in only four of the twenty-five scores (see Table 3).

Table 3 indicates the dental scores assigned by the two judges. A coefficient of correlation of .646 indicates that the evaluation tool is reliable. Reliability of the tool is enhanced by the knowledge that there was a third score possible, E, which both judges independently decided that none of the students attained.

The degree of agreement on the scores in Table 3 makes it feasible to consider training school nurses or teachers to screen students for oral hygiene status without needing to use disclosing dyes or special lights, or needing to call on the services of busy dentists.

Table 3
Dental Scores Assigned by Two Judges

Observations	1	2
1	P ^a	P
2	P	P
3	G ^b	G
4	P	P
5	P	P
6	G	G
7	P	P
8	G	G
9	G	G
10	G	G
11	P	P
12	P	G*
13	G	G
14	P	P
15	P	P
16	P	P
17	G	P*
18	P	G*
19	P	G*
20	P	P
21	P	P
22	P	P
23	P	P
24	P	P
25	P	P

Coefficient of correlation .646

Table value .505, Significant at .01 level

*Disagreement between judges

P^a=Plaque and inflamed gingiva

G^b=Plaque only

E =No plaque or inflamed gingiva (No students obtained this score.)

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to attempt to determine whether dental health instruction, which incorporates classroom brushing practice, is more effective in producing a desirable oral hygiene status than is the conventional method of instruction which depends solely on lecture-discussion, dental films, or diagrams. To achieve this end, the following two null hypotheses were tested:

1. There is no difference in plaque accumulation and gingivitis between students who receive conventional methods of dental health instruction and those who follow the instructions with daily brushing practice.

2. There is no difference in plaque accumulation and gingivitis between boys and girls.

As each classroom was screened by the dentist, scores were carefully recorded for each individual student and tabulated (see Table 4). The chi-square test was used to determine whether the observed plaque scores could have occurred by chance. The .01 level of significance was chosen as the criterion for this study.

The chi-square scores tabulated in Table 4 indicate a significant difference among the classroom groups. Further examination of the table reveals that the scores of the first three groups fell into similar patterns which were distinctly different from those in Group D.

Table 4
Comparisons of Scores of all Classroom Groups

Score	Group A Control	Group B Film	Group C Film and Lecture	Group D Film, Lecture and Brushing	Total Students
P	35	40	31	12	118
G	19	20	27	22	88
E	7	0	4	27	38
Total Students	61	60	62	61	244

Chi-square 62.646 Table value 16.800 Level of significance .01
P=Plaque and inflamed gingiva
G=Plaque only
E=No plaque or inflamed gingiva

Table 4 shows that students in Group B, who saw only the film, received the greatest number of P scores and no E scores; the control, Group A, received slightly higher scores. Students in Group C, who were exposed to both film and lecture, had fewer P scores and more G scores than either of the other two, but the dramatic difference was seen when scores of students in Group D were compared to those of the other three groups.

Figure 1 illustrates that all four groups had similar numbers of students receiving a score of G, which indicated that they had plaque without gingivitis. However, there was a wide difference between Group D and the other groups, both in the P scores, which indicated that both plaque and gingivitis were present, and the E scores which indicated that neither was present. These findings

Figure 1

Comparison of Students' Scores by Four Groups

* No individuals in this group attained score of E

Group A=Control

Group B=Film only

Group C=Film and lecture

Group D=Film, lecture and brushing

suggest that the brushing procedures carried out by students in Group D resulted in the dental plaque removal pattern which was significantly different from all three of the other groups. The difference was so obvious that the dentist knew, after examining four mouths, when he was in a classroom which had practiced brushing.

The distributions of the plaque from different groups were compared to each of the others in order to locate the instructional procedures which caused the significantly different results. When the chi-square of each group's oral hygiene score was compared to the others, Group D was again found to be significantly different from each of the other groups (see Table 5).

Table 5
Comparison of Groups

Groups Compared	Chi-square
A - B	7.35
A - C	7.68
B - C	6.15
A - D	23.24*
B - D	42.17*
C - D	25.95*

Significant at .01 level Table value 9.2

A=Control

B=Film only

C=Film and lecture

D=Film, lecture and brushing

The scores listed in Table 5 indicate that daily classroom brushing under supervision was the factor which caused the significant difference in results. Thus it is necessary to reject the first hypothesis, which states that there is no difference in plaque accumulation and gingivitis between students who receive conventional methods of dental health instruction and those who follow the instructions with brushing practice.

The boys' and girls' oral hygiene scores followed the same patterns as their groups, but more favorable individual scores were noted for the girls (see Table 6).

Table 6
Number of Boys and Girls Assigned
Each Oral Hygiene Score

Students	P Plaque and Inflamed Gingiva	G Plaque Only	E No Plaque or Inflamed Gingiva	Total
	No. (%)	No. (%)	No. (%)	No. (%)
Boys	72 (58)	42 (33)	11 (9)	125 (100)
Girls	46 (38.5)	46 (38.5)	27 (23)	119 (100)
Total	118 (48)	88 (36)	38 (16)	244 (100)

Chi-square 12.507 Table value 9.2 Level of significance .01

The difference between boys and girls within their group was found to be not significant, but when the scores of all the girls were compared with those of all the boys, the resultant chi-square of 12.506 indicated that the girls had significantly better oral hygiene.

Figure 2 shows some similarities in the total boy and girl scores and the scores of boys and girls in Group D, but while the first group was found to be significantly different in oral hygiene, Group D differences were not significant at the .01 level.

Figure 2

Comparison of Boys' and Girls'
Oral Hygiene Scores

When chi-square scores of boys in each group were compared with those of boys in each of the other groups, a significant difference was seen only in cases where boys in Group D were compared to the others. Similar results were found in the girls' scores (see Table 7).

Table 7
Comparison of Oral Hygiene Scores
of Same Sex Students by Groups

Groups Compared	Chi-score Values	
	Boys with Boys	Girls with Girls
A - B	4.49	7.59
A - C	4.89	.08
B - C	4.00	7.98
A - D	16.07*	13.04*
B - D	15.25*	28.52*
C - D	14.86*	15.55*

* Level of significance .01 Table value 9.2

A=Control

B=Film only

C=Film and lecture

D=Film, lecture and brushing

The findings do not indicate that any one of the didactic instructional methods was superior to the other, but that brushing in the classroom was responsible for the significant difference in oral hygiene which did occur (see Table 7).

On the basis of findings in this study it is necessary to reject the second hypothesis, which states that there is no difference

between boys and girls in plaque accumulation and gingivitis (oral hygiene).

The experiment involving sixteen students with inflamed gums and plaque, who were given the opportunity to brush daily under supervision, indicated that brushing properly for as little as two weeks can cause a startling difference in oral hygiene scores.

When the dentist rechecked the oral hygiene status of these students, he found that all but two of the boys had cleared their gums of inflammation and that five students had moved completely over to the E column by additionally removing all evidence of plaque (see Table 8).

Table 8

Oral Hygiene Scores of Participants
in Two Week Brushing Project

	P Plaque and Inflamed Gingiva		G Plaque Only		E No Plaque or Inflamed Gingiva		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
First Dental Inspection	16	(100)	0		0		16	(100)
Second Dental Inspection	2	(13)	9	(65)	5	(31)	16	(100)

Thus, the findings indicate that 87 percent of the students in

the sample were able to rid themselves completely of gum inflammation and that 31 percent of them were also plaque-free at the end of the two week period.

The rejection of both hypotheses tested in this study indicates that there was no advantage to any of the instructional methods used in the classroom, but that the supervised brushing practice was the factor which made the difference in the students' oral hygiene status.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

Among the groups of students participating in this study, the findings indicated that conventional methods of dental health education, which included the use of lectures, films, and diagrams, were much less effective than newer approaches which used actual toothbrushing instructions and practices as part of their format.

In order to collect data for this study, eight sixth-grade classes of a middle school were involved. Two classes were assigned to each of four groups. One of the four groups of students received no instruction at all; a second group saw only a five-minute dental film; the other two groups were exposed to a lecture-demonstration with slides and the same five-minute film shown to the second group, but only one of these last two groups took part in the daily brushing procedures.

Findings indicated that it was the addition of the brushing practice which caused the significant difference in the degree of dental plaque accumulation and gum inflammation between students in the group which brushed and the other groups. The boy-girl comparisons indicated that the girls' total oral hygiene score was found to be significantly higher than that of the boys. There were mixed results when boys and girls were compared to themselves and to each other within and between groups, but the results indicated that

in most cases the girls had significantly higher scores than the boys.

The additional mini-study of sixteen students, who significantly changed their oral hygiene scores by brushing under supervision for two weeks, added further support for the use of this mode of instruction. In this case, again, the brushing obviously was the factor causing change because the students were taken from classrooms which had received three different treatments: control, film only, and film with lecture.

In each case there was reason to reject the null hypothesis which essentially stated that there was no difference in dental plaque accumulation and gingivitis between students who received conventional methods of dental health instruction and those who had been given the opportunity to brush daily.

CONCLUSIONS

The results of this study coincide with much of the material found in the review of literature.(2; 5; 6; 39) Plaque formation did appear to be prevented by its daily disorganization. This was accomplished by using the Bass brushing technique recommended by many preventive dentists.

The findings of the mini-study of sixteen students, who reversed poor oral hygiene scores in two weeks' time, were comparable with the results of Le's study of twelve subjects with healthy gums, who developed plaque and observable gingivitis within ten to twenty-one days of ignoring mouth care, and then reversed their dental hygiene status again when oral hygiene measures were restored.(5:9)

The fact that this study successfully demonstrated that classroom brushing makes a significant difference in dental hygiene scores, seems to support the contention of several of the authors reviewed that the school provides the most desirable conditions for conducting dental health education programs. It is the only institution in which all children must be in attendance between the ages of five and sixteen; it is oriented to education of students; it is committed to some degree of health education, based on the philosophy of helping students develop into socially, emotionally, and physically healthy adults. Because of these goals, effective dental health education should be considered one of the school's inherent responsibilities.

Current demands for accountability and pressure for time make many administrators feel that it would be difficult, if not impossible, to squeeze in an additional activity, but they seem to forget that time is already being taken for dental health education which is not effective. This is easily verified by figures which reveal the current dental health status of our nation. Time can surely be arranged for an effective program.

As was noted in the literature, it was found that teachers could be taught new dental health concepts and techniques in a relatively short time and could, in turn, teach an enlarging circle of children to implement techniques which would reduce both dental decay and periodontal disease. The fact that such significant results occurred in this study indicates that an improved dental health program can be implemented, even with minimal preparation, and still be far superior to what most schools are presently offering. However,

the motivation and enthusiasm of the teacher is an important factor in the success of a dental health program.

Review of the literature indicated that the best time to begin oral hygiene instruction would be in the early elementary grades and then to follow it with consistent reinforcement in subsequent years. This author agrees, but with the qualification that the students be old enough to have developed a reasonable degree of manual dexterity and the ability to follow verbal and visual instructions. The choice of third grade students would coincide with recommendations made in the literature that parents brush their children's teeth until they are at least seven years of age.

It is important, however to reach the youngsters before their brushing habits are firmly established. The sixth graders in this study had a great deal of unlearning to do and some were resistant to giving up the brushing methods they had learned in earlier years. Thus, while there is evidence that the brushing program can be very beneficial at the sixth grade level, if it is continued long enough to form new habits, it would be more advantageous to start much earlier.

Since many third graders are beginning to have cavities, prevention would be more desirable than waiting until the children are older and subject to even more decay, and perhaps the beginnings of periodontal disease. In addition, younger children are eager to please and seem to want to learn to care for themselves, while sixth graders are just beginning to be self-conscious and resistant to what adults say is good for them.

One interesting discovery, which came out of this study, could contribute to long-term behavior change in students who receive dental hygiene instruction. A Group D classroom teacher was very concerned about one of her academically talented students who could not raise her oral hygiene score above a P. She did not know if the girl was being stubborn, or just did not understand the concept upon which the brushing technique was based. Arrangements were made for the girl to go to a nearby elementary school to tutor individual second graders in toothbrushing for one hour, under the author's supervision. As a result, the second graders were impressed that a "big girl" was teaching them and the sixth grader's score jumped to E within a few days.

This incident offers excellent justification for the use of student tutors to reinforce dental health techniques taught in the classroom. In this case, both the tutors and the students being tutored are reinforced in positive behavior. It is not difficult to envision a dental health program which begins in the third grade, is reinforced every few weeks for the next year, or two, with the aid of fifth or sixth grade tutors, and which, in turn, reinforces the tutors in their oral hygiene techniques. This would save the teacher time and greatly extend the effects of the program.

The actual brushing experiments used in this study worked well in one particular school and community, and could be conducted easily in any self-contained classroom, in any community which placed value on such a program. After the first few days of instruction and supervised practice, it would take only ten minutes a day to carry out the

procedures, with added time allowed for weekly or bi-weekly use of disclosing tablets--truly a minute amount of time when compared with the positive results such a program could produce.

It is likely that the procedures used for this study could be improved by having the students use a disclosing tablet before the first brushing session, as was done in the Fodor and Ziegler study.(15) Allowing the students to confront themselves with the extent of the dental problem with which they are dealing should be highly motivating to even the most apathetic among them.

In addition, the brushing period should be extended over a much longer period of time than was covered by this experiment, if permanent behavior change is to be the ultimate goal of the dental health program. Master's recommended twelve to sixteen weeks of classroom practice, followed by reinforcement for the rest of the school year, as well as in subsequent years, seems necessary if desired skills are to be developed and integrated into daily habit patterns.

Unfortunately, long term-behavior change did not result from the month-long practice time involved in this study. The author was brought to this conclusion, when in a moment of curiosity, several of the Group D students were called in to the office a month after their oral hygiene program ended. An examination of their teeth disclosed that several of them had dropped in their scores, though they were not as low as the non-brushing groups had been. Continuing to brush and use disclosing tablets on a weekly basis for several months, then less often for the rest of the school year, might have produced more favorable long-term results.

Ideally, dental health education and classroom brushing practice should be supplemented by presentation of nutrition information to both students and parents. The latter could be offered nutrition workshops at school, at a time which would be convenient to them. In addition, the dental health education program would be enhanced by involving members of the community in the program as helpers, as contributors of needed supplies, and as learners through the use of the mass media, via newspaper and magazine articles and television programs. In fact, the mere act of persuading the toothpaste companies to use preventive toothbrushing techniques in their advertisements might be the greatest boost ever for dental health.

With this kind of community support, the schools would have the stamp of approval needed to move ahead with an effective dental health program; legislators would be more amenable to providing funds or necessary mandates; dentists and hygienists would be willing to donate invaluable time; and teachers and administrators would feel that the time taken for classroom practice was well spent.

A dental health program, such as the one piloted in this study, can be carried out with a minimum of expense. However, students cannot be counted on to supply the brushes, disclosing tablets, floss, and small mirrors which are needed, nor can teachers be expected to pay the bills. The school budget covers pencils, paints, paper, ditto fluid, bandaids, flashlight batteries, and other items ad infinitum. Why not the supplies needed to start all third grade students on the way to dental health?

At present, one large dental supply company furnishes tooth-

brushes for all second graders in the school district. It would be possible to begin by using those brushes in the third grade to implement an effective dental health program, but more supplies would be needed to reinforce it in subsequent years, if third grade classes were to be started each year on a two- or three-year program. The potential for success is there: all that is needed is support and time.

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