PLAQUE CONTROL AND PREVENTION

B.M. Mor* and C.M.Um**

INTRODUCTION

Dental plaque has been cited as being the main aetiological factor in tooth caries and gingivitis. "A clean tooth never decays" dates as far back as to Greenwood. It has been established firmly that the dental plaque is a prerequisite for caries, being the source of the substances which attack the teeth (Jenkins, 1972). The relationship between plaque and caries cannot, however, be expected to be a simple one, because dietary carbohydrates as substrates for the plaque microflora are essential for cariogenicity, and because individuals and teeth may exhibit varying degrees of caries resistance (Keyes, 1962).

All pathological processes of the marginal periodontium are referred to as diseases. Healthy gingiva are found in the absence of plaque, and flora of the gingival crevice area is very sparse under healthy conditions consisting almost exclusively of Gram Positive Cocci and rods (Theilade et al 1966). When plaque accumulates at the gingival margin, the attach becomes stronger due to the increased numbers of bacteria and possibly, also, due to an increased virulence of the flora. The continued presence of plaque, which is outside the range of main defense mechanisms of the host acts as a reservoir of substances provoking and maintaining a chronic inflammation. The inflammatory process prevents the spreading of micro-organisms in the tissues but on the other hand, it also causes tissue destruction which continues as long as the plaque is present.

Thus, because plaque is such a significant factor in dental disease, its efficient removal must form a very important part of preventive dentistry.

FORMATION OF PLAQUE

Following thorough cleansing with abrasive paste, a pellicle quickly reforms on the cleaned tooth surface. This is usually virtually free of bacteria and is found on electron histochemical examination to be structureless. This material is derived from saliva, although which gland makes the major contribution is a matter of controversy (Baumhammers and Stallard, 1966, Ericson, 1967). It may be supposed that, because the submandibular and sublingual glands are inside the mouth, the saliva from these glands has greater access to tooth surfaces than that from the parotid glands. The layer of pellicle is remarkably uniform in thickness and is free of recesses or notches in its outer boundary (Sonju et al, 1974). Recent evidence has indicated that highly acidic sulfated glucoproteins may be specifically adsorbed onto the tooth surface and that their primary source appears to be the sublingual gland (Krogstad et al, 1975) and a wide variety of specific proteins which include IgA, IgG, IgM, lactoferrin, transferrin, and albubins. (Kraus et al, 1973; Orstavik

This essay was offered as a term paper in the diploma course of clinical dentistry (Conservertive dentistry) University of OTAGO DENTAL SCHOOL.

* B.M. Mor. : Senior Staff University of OTAGO DENTAL SCHOOL Dunedin, New Zealand.
** C.M.Um. : Dept. of Operative Dentistry, College of Dentistry, Seoul National University

and Kraus, 1973). The composition of 2 hour pellicle is characterized by low content of sulphur-containing amino acid and high amounts of acidic amino acid (Mayhall, 1970). The mechanism of pellicle formation is by adsorption rather than by precipitation. The precise mechanims involved in the adsorption have not been fully resolved.

In late stage, there are three types of pellicle that can be distinguished by their appearance (Tryggue, 1978). They are the globular type of pellicle which is characterized by the presence of globules of varying size and configuration, the fibrillar type of pellicle which is characterized by the presence of 3 and 7 nm wide fibrils and also frequently included small globular particles whose diameter generally ranged between 5 and 70nm, and the granular type of pellicle.

The cell free layer is quickly covered by colonies of microorganisms and indeed individual colonies can be identified on the pellicle up to 24 hours after its initial formation. Tryggue (1978) demonstrated that the initial bacterial colonization in individuals on the low sucrose diet occurs by attachment of individual bacteria to the pellicle, and not by bacteria aggregates that settle down on the surface. Bacterial attachment to the pellicle may take place in different way (Fig.1). The most frequent mode of attachment is by a direct contact between the bacterial cell wall and the pellicle. Attachment may also occur by surface threads of various types. Occasionally, bacteria adhere to outgrowths of pellicle or to hydroxyapatite crystals in the surface without intermediate pellicle material, they may become entrapped in a local accumulation of organic material, or their attachment may be mediated by epithelial cells. A gross pattern of early plaque formation has evolved (Fig.2). Bacteria initally colonize irregularities or smooth surface area close to the gingival

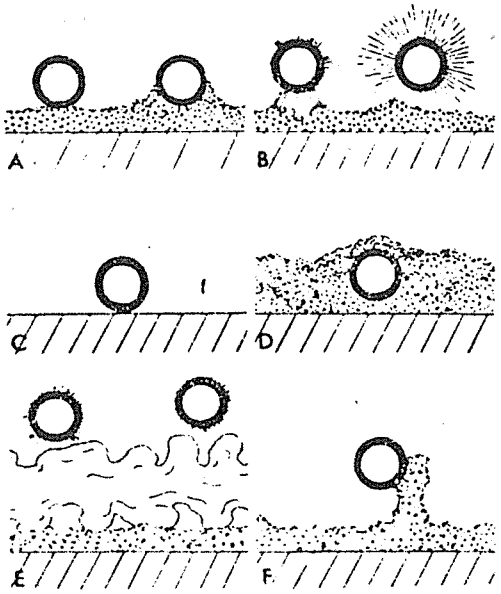


Fig. 1. Different modes of bacterial attachment. A, direct contact between bacterial cell wall and pellicle. B, attachment by surface threads of various types. C, direct contact between bacterial surface and hydroxyapatite crystals. D, entrapment of microorganism in local accumulation of organic material. E, attachment to an epithelial cell by a "fuzzy coat". F, attachment to an outgrowth of Pellicle

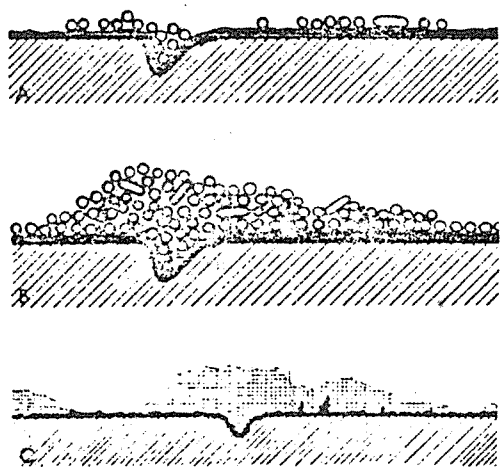


Fig. 2. Gross pattern of early plaque formation. A, initial colonization in a surface irregularity and on a smooth surface area. B, increase in volume of colonized area by multiplication of organisms and attachment of new cells at the surface, while growth at the periphery continues as an expanding monolayer. C. gross pattern where prolific plaque areas alternate with less extensively colonized regions.

margin. While such initial colonies increase in volume by multiplication of the organisms, the bacterial growth in the periphery continues and spreads as a single layer of cells that coalesces with neighboring plaque areas. At the same time additional organisms are attached to the pellicle or to the bacterial surfaces. The 48 hour plaque is located in the gingival part of the buccal surfaces and is characterised by areas of prolific growth alternating with apparently recently colonized areas. The microbial population of the plaque after 24 hours ranges from 72-103 million per mg wet weight, and increases after 3 days to 80-132 million. The predominant organisms are gram positive cocci, usually streptococcus mitis, sanguis and mutans. They comprise approximately 84% of the cultivable flora after 24 hours and 70% of plaque flora after 24 hours. As the plaque gets older filamentous forms of microorganisms appear and these form the largest group as a rule after the streptococci. After 4 days the flora is supplemented with spirilla and spirochetes (Theilade et al, 1966).

It has been established that supragingival plaque consists of a mixture of microcolonies of a number of different oral microorganisms held together in an intermicrobial matrix. The microorganisms found are primarily gram positive cocci and rods with increasing numbers of gram negative cocci and rods and filamentous organisms as the deposit becomes older. (Theilade et al, 1966; Theilade E. & Theilade J., 1970). No principal differences in composition seem to exist between supragingival plaque on the free smooth surfaces of the teeth and that located on the approximal surfaces (Frank & Brendel, 1966; Theilade D. and Theilade J., 1970).

Subgingival plaque has been characterised only to a limited extent, probably because sampling of gingival pocket area is more difficult to standardize. The composition of subgingival plaque differs distinctly from that of the supragingival variety. This plaque forming in the gingival sulcus consists of many motile bacteria and, in the surface layer, significant numbers of thin filaments and spirochetes are present in close proximity to the gingival tissue forming the wall of the gingival crevice or periodontal pocket. The most superficial layer of subgingival plaque also contains an admixture of leukocyte from the host tissue (Listgarten et al, 1975).

Plaque also develops in the fissures and pits of the occlusal surfaces of the teeth. Fissure plaque is characterised by microorganisms and the flora of the fissures seems to be more stable after the first colonization has taken place: even after several months the cocci and rod predominated the flora (Theilade J., 1977).

PLAQUE CONTROL AND PREVENTION

There are many kinds of control and prevention of plaque formation. Silverstone (1978) describes 8 methods. In many countries people rely extensively on mechanical methods to remove or control dental plaque. The method of chemical agents, antibiotics, and enzymes have been extensively investigated. But tooth brushes and dental floss are the devices most frequently recommended for this purpose. These techniques must be centred in the home. Methods of plaque control and prevention are as follows:

1. Tooth brushing: In assessing any tooth brushing method, the most important factor is that plaque should be removed as thoroughly as possible without damage either the hard or soft tissue.

A wide variety of tooth brushes are commercially available. Selection of tooth brush by the public is probably based on the cost, availability, habit and colour of the handle. The most popular type of brush has a straight, semi-rigid handle about six inches long, with small head about one inch long. The bristles are about half an inch long and tufts of bristles which have rounded ends are trimmed to uniform height. For children with primary teeth, smaller brushes are advisable, the head of a tooth brush must be small and filaments, should be medium and uniform in length. The tooth brush should be multi-tufted for brushing efficiency.

Tooth brushing techniques have been reviewed by many scholars, but there is not strong evidence to support a particular techniques. Whatever the design or the technique used, thoroughness is essential.

Patients should be instructed to brush their teeth twice a day—in the morning after breakfast and in the evening before going to bed. However, it is far better that the patient cleans his teeth once a day thoroughly rather than in a quick and inefficient manner after every meal. If a once-a-day regimen is to be used the brushing period should be in the evening before going to bed. If the patient is willing to brush on more occasions, they should be related to meal times. Even in these cases, the brushing session in the evening should be the one which is carried out more efficiently, because the patient usually has more time than during the average day.

According to the position of the teeth size of the mouth and dexterity of the child, a health professional should determine the need for a larger brush.

Tooth brush should be replaced frequently because most adults and children use brushes that are no longer efficient. The average life of a tooth brush is about 3 months. Brushes that have curved bristles should be thrown away.

Even with thorough instruction in tooth brushing technique, close supervision and assistance are essential if most children are routinely to remove plaque effectively. For this reason, parents should be advised to brush the teeth of their preschool children. Generally until a child is seven or eight years of age, an adult should perform or closely supervise the plaque removal procedures at least once daily to remind and encourage the child to practise good tooth brushing at other times. Because children accumulate plaque at different rates, the recommended frequency of thorough removal of plaque should be based upon the needs of each child. Many factors should be taken into account in making specific recommendations, such as caries experience, gingival health, position of teeth and occlusion, but thorough plaque removal should take place at least once daily, preferable just before retiring at night (Horowitz, 1980).

The use of disclosing materials can provide a motivating influence on oral hygiene performance for at least a few weeks. Dentists should encourage their patients to use these materials regularly for at least this length of time (Melcer, 1979).

The electrical brush may have advantages for physically and mentally handicapped persons. It can be very beneficial for handicapped children with minimal arm and hand control. If the child is able to grasp and position the toothbrush, but unable to move his arm, he may be able to create a brushing stroke by moving his head (Albertson, 1974).

2. Accessory aids to plaque control: There is a wide variety of aids used to supplement conventional brushing. These include dental floss, interdental brushes, interdental sticks and oral irrigators.

Each one probably has a part to play in plaque removal but the two most commonly favoured are interdental sticks and dental floss.

Interdental sticks may be of hard or soft wood, plastic or metal. There are no studies which support any particular material. It is recommended that they be of soft wood, triangular in section and tapering to a point in order to fit the interdental space.

Interdental stimulators can be used to massage the tissue between the teeth and help to reduce local edema. Stimulators should be placed at right angles to the tissue to reach col depression. However, indiscriminate use of this approach may blunt the papilla, with an unattractive and potentially damaging result (Silverstone, 1978).

Dental flossing. No matter how efficiently one uses a toothbrush, plaque will not be removed between the tooth. Incorrectly used floss may cause damage to the gingiva. A significant proportion of dental caries involves proximal surfaces of teeth, especially deciduous teeth. Dental floss is the cleaning aid that is most frequently recommended for removing bacterial plaque from proximal tooth surfaces as a method of caries prevention. The recommendation of flossing as a method of preventing caries has been based on theory. Flossing is believed to act by dislodging the oral plaque from the proximal tooth surfaces. The removal of plaque should, then result in a decreased incidence of proximal caries (Wright et al, 1979). Dental floss has a greater plaque removing effect of the interdental areas than tooth picks, predominantly on the mesial surfaces on the teeth (Anaise, 1976). Frequent interdental flossing results in significant reduction incidence of proximal caries in deciduous teeth during a 20 month period: the magnitude of the beneficial effect of interdental flossing increases the longer flossing is continued: and there is little residual effect after flossing is discontinued (Wright et al. 1977). The effect of flossing results in a reduction of about 50% in the incidence of proximal caries in deciduous teeth over a 20 month period (Wright et al, 1979). Flossing per se temporarily reduces the proportion of strep. muans in interproximal plaque when these organisms are present in high numbers and flossing with iodine reduces the proportion of strep. mutans more than flossing along (Newbrun, 1980).

The use of dental floss in young children cannot be recommended without reservations. Procedure is quite demanding on the adults responsible for flossing children's teeth. Flossing, if recommended, should be probably limited to the area of a child's mouth where there is contact between adjacent teeth until a practitioner is confident that a child can use dental floss properly, an adult should do the flossing.

Many kinds of dental floss or types are commercially available; waxed, unwaxed, semiwaxed, shred resistant, minted and plain, and some floss is impregnated with fluoride or iodine. In recent years, many kinds of floss holder have been developed. The value of these devices has yet to be determined scientifically. The need for thorough instruction on their use is apparent. Floss can be carried by patients in handbags or small pockets and are therefore suitable for daily use.

Interdental brushes have an effect below the gingival margin to the same extent as it also has on the buccal and lingual surface. This is why it is superior to the tooth pick. The demonstration of the excellent cleansing capacity of interdental brushes has an important clinical implication in view of the fact that both caries and periodontal disease are most prevalent between teeth. In the caries

prevention it is extremely important that interdental brushes, in addition to its eminent cleaning capacity in the central part of the interdental space, also has an effect on the embrasures, because this is where the second caries attack most commonly appears. In the prevention of periodontal disease, it is equally important that the interdental brush has an effect below the gingival margin, because restorations so commonly are extended into the pocket in order to prevent second caries. Subgingival restorations are known to accumulate plaque and from their cervical margins the plaque is likely to proliferate apically and cause periodontal destruction and loss of the tooth. This sequence of events can be broken by the interdental brush which will prevent plaque from being formed at least if there are no overhangs.

During the 14 years Waerhang (1976) has used the interdental brush he can not remember seeing caries develop on a surface which it has been used daily. A comparison of the bone height in the radiographs taken before, and 10 years or more after the introduction of the interdental brush, reveals no loss of attachment which could be related to the use of the brush.

Time studies in a number of cases have shown that a well instructed and trained patient needs from 30 to 75 seconds to carry out the interdental brushing properly. Obviously the time required will depend on the skill of the patients and the number of interdental spaces to be cleaned.

Waerhand (1976) concluded that interdental brush is undoubtedly the most efficient tooth for the cleaning of the interdental spaces. When restorations are made, room should be provided for it wherever possible. If the restorations are finished above the gingival margin, caries will be prevented, if they are extended into pockets, destructive periodontal disease will be prevented.

3. Scaling and Polishing: It has been well established that plaque control can be achieved through its active removal at regular interval by mechanical means. However, it has also become apparent that this cannot be accomplished without considerable patient cooperation and motivation. Scaling and polishing at 6 month intervals may be sufficient for those patients who practice near-perfect oral hygiene. It is a good chance for the assistant or dentist to instruct the patient's oral education for treatment.

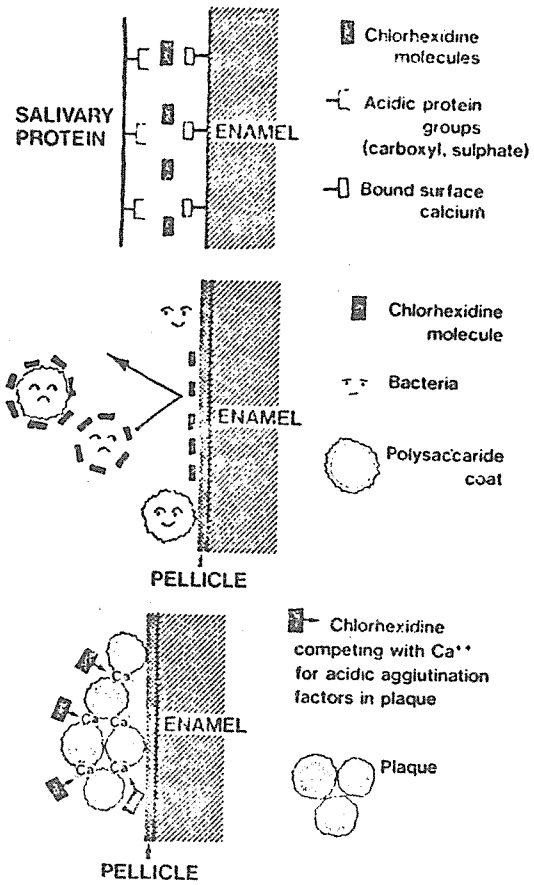
While hand and ultra-sonic instruments appear to be equally efficient in calculus removal, the ability of any available instruments to remove all calculus deposits present appears doubtful. No significant difference in the efficiency of removal of calculus was found when comparing ultrasonic and old or new curettage (Jones et al, 1972).

4. Chemical methods of plaque control: Mechanical brushing, flossing and the use of soft wood sticks are currently the only practical means of control. No matter how well performed, these methods are tedious and require some skill and so are not particularly popular. It is therefore not surprising that dental researchers have been trying for many years to find other methods of plaque control which would be more acceptable to patients. Chemical application aimed at controlling the initiation and growth of the plaque has potential clinical value. Several antibiotics and chlorhexidine show plaque reducing properties or prevent initial formation of plaque.

Antibiotics–It is beyond doubt that antibiotics effective against gram positive microoganisms may also reduce dental plaque formation, dental caries and even periodontal disease if used repeatedly for long periods of time. However, such a use of these potent remedies is considered to

be contraindicated by most scientists for a number of reasons. Drug resistant microorganisms may appear, and toxic or allergic reactions may occur in some individuals. Most scientists seem to be of the opinion that antibiotic drugs should not be used constantly for prevention of plaque formation, dental caries and periodontal disease. Medically important antibiotics such as penicillin and tetracycline should be reserved for more serious infections. However, they may be used for short period medication on very specific indications for example in subjects with rampant dental caries when it is desirable to change the flora rapidly, or in persons with Vincent's stomatitis, or after periodontal surgery to prevent plague formation and post operative complication (Lobeme et al, 1972).

Chlorohexidine—Current research in antibacterial methods of curbing plaque growth centres on chlorhexidine that is a chemical active against both gram positive and gram negative bacteria and yeast organisms. Many antiseptics have proved inactive in the human mouth. Failure may be due to the short retention time of the antimicrobial agent in the oral cavity. Good retentive properties have been observed with chlorhexidine (CHX) (Ainamo, 1977). Two daily 1 minute rinses with 0.2% aqueous solution of CHX digluconate totally prevents growths of supragingival plaque and even when CHX has been included in gel and dentifrices, a both statistically and clinically significant reduction in the amount of plaque has been demonstrated. The following mechanisms of plague



1. The number of bacteria in saliva available for adsorption to the teeth is significantly reduced.
2. Blocking of acid groups on the salivary glucoproteins reduces the protein adsorption to tooth surface (top).
3. By binding to the surface of the salivary bacteria including the polysaccharide coats, an interference with bacterial adsorption mechanisms to the teeth may be imagined (center).
4. By precipitating the acidic agglutination factors in saliva and displacement of calcium which is involved in "gluing" the plaque to gether (bottom).

Fig. 3. Postulated mechanisms of plaque inhibition by chlorhexidine. Top, influence of chlorhexidine on pellicle formation; center, influence of chlorhexidine on adsorption of plaque to teeth: bottom, influence of chlorhexidine on agglutination factors in plaque.

inhibition by chlorhexidine may be suggested (Fig.3) (Rolla et al, 1975).

Chlorhexidine in clinical practice (Ainamo, 1977)

1. The 0.2% aqueous chlorhexidine solution is used as a rinse to remove germs prior to all oral surgery and to improve wound healing for 3-4 weeks after periodontal operation.
2. Chlorhexidine is also occasionally used for motivation of patients. In these cases it is used for teaching patients the feeling of cleanliness which they should learn to maintain by mechanical plaque control.
3. Chlorhexidine has also been utilised for differential diagnosis, to discover if some obscure changes in the gingiva are caused by the bacteria plaque or whether they are caused by a virus or some other type of pathogenic agent which does not respond to the antimicrobial effect of chlorhexidine.
4. Chlorhexidine is used longterm in critical periodontal cases where absolute plaque control is necessary. Side effects such as desquamative or local hyperkeratotic lesions have been observed occasionally. Such untoward changes have disappeared in a few days as the chlorhexidine rinses have been interrupted.

Alexidine—Alexidine mouthrinse is effective in reducing plaque (Carlson et al, 1977) but it does increase the propensity of the teeth to acquire extrinsic stains at significant levels. The clinical importance of this staining is partially offset by the fact that it is removed by prophylaxis, is influenced by the subject's consumption of tea, coffee or tobacco (Spolsky et al, 1977).

5. Immunization: From a theoretical point of view, it would seem futile to try to use the most specific of all scientific methods, the antigen-antibody reaction, against dental plaque formation, dental decay and periodontal disease which are generally accepted as phenomena caused by a mixed flora of many different species of microorganisms. Vaccines against strep. mutans cells have been found active in reducing dental decay in rats and monkeys infected with this organism. It seems more rational to try to develop antibodies against specific enzymes which are considered to be of fundamental important in development of dental plaque, dental caries and periodontal disease.

Vaccines against dextrans and mutans have been developed since these substances are believed to play an important role for the adherence of microorganisms to tooth surfaces but so far these vaccines have shown no effect against dental plaque formation and dental caries. However, due to the very complex nature of dental plaque formation, dextran and mutan production and the enzymology of this field, there is still some hope that vaccines may be developed which are effective against dental plaque formation, dental caries and periodontal disease (Trostall et al. 1978).

6. Changes in the ecology of the oral cavity: It has been adequately demonstrated in a great number of studies that the ecology of oral cavity may be changed by variation of the diet. Increased and frequent administration of fermentable sugar will cause an increase in the total number of microorganisms in oral cavity as well as increase in the number of streptococci, lactobaccilli and candida yeasts. It is a common goal in the treatment of dental caries to establish certain food habits in order to change the ecology back to a more natural state of order. Even minor changes in the diet may cause extensive shown that dogs, given throat and lung tissues as their sole diet, are healthy and have small amount of dental plaque and gingivitis in a few weeks. The flora also changes quali-

tatively, with an increased proportion of proteolytic microorganisms in plaque.

There is a most striking correlation between the consumption of refined sugars and especially of sweets and chocolates, which are often eaten between meals, and the caries incidence. It should be noted, however, that increased refined sugar consumption has usually been accompanied by a decrease in bread consumption, by a raising of the extraction rate of flour, or by the preparation of flours, bread and other cereal foods of finer texture: these latter changes would account equally well for the varying incidence of caries (Hardwick, 1960).

In theory, dental caries could be prevented by removing dietary sucrose or other fermentable carbohydrate from the diet. However, this approach is impractical because it is difficult, if not impossible, to change a nation's diet, and it is quite unrealistic to suppose that significant numbers of people would change their dietary habits.

The dental profession needs a safe palatable sugar substitute which can be recommended to patients. The help and cooperation of the food manufacturers in producing and marketing sugar-free goods and beverages is essential if dietary control and prevention of dental caries is to become a realistic goal for the population at large (Newbrun, 1974).

CONCLUSION

Several antibiotics and chemicals have been used to prevent plaque formation in some cases, but the exact brushing methods with flossing are the most important to everyone. Thorough plaque removal should take place at least one daily, preferably before retiring at night. When the bristles are curved, the brush should be thrown away. For those patients who practice near perfect oral hygiene, scaling and polishing at 6 monthly intervals may be sufficient.

SELECTED READING

Ainamo, J. (1977). Control of plaque by chemical agents. Journal of Clinical Periodontology. 4:23-35.

Albertson, D. (1974). Prevention and the handicapped child, Dental Clinics of North America. 18:595-608, No.3.

Anaise, J.Z. (1976). Plaque removing effect of dental floss and tooth picks in children 12-13 years of age. Community Dent. Oral Epidem. 4:137-139.

Baumhammers, A., Stallard, R.E. (1966). Salivary mucoprotein contribution to dental plaque and calculus. Periodontics. 4:229.

Ericsson, T. (1967). Adsorption to hydroxyapatite of proteins and conjugated proteins from human saliva. Caries Res. 1:52-58.

Frank, R.M., Brendel, A. (1966). Ultrastructure of the approximal dental plaque and the underlying normal and carious enamel. Archs. Oral. Biol. 18:883.

Frostell, G. Ericsson, (1978). Antiplaque therapeutics in carious prevention. Carious Res. 12:74-82.

Carlson, H.C., Porter, K.(1977). The effect of alexidine mouthwash on dental plaque and gingivitis. J. of Periodontology. Vol. 48, No.4 216-218.

Hardwick, J.L. (1960). The Incidence and distribution of caries throughout the ages in relation to the Englishman's Diet. British Dental J. 109(1):9-17.

Horowitz, A.M. (1980). Oral hygiene measures. J. Canad. Dent. Assn. No. 1. 43-46.

Jenkins, G.N. (1972). Current concepts concerning the development of dental caries. Int. Dent. J. 22:350.

Jones, S.J., Lozdan, J., Boyde, A. (1972). Tooth surfaces treated in situ with periodontal instruments. British Dental J. 132:57.

Keyes, P.H. (1962). Recent advances in dental caries research. Bacteriology, bacteriological findings and biological implications. Int. dent. J. 12:443.

Kraus, F.W., Orstavik, D., Hurst, D.C., Cook, G.H. (1973). The required pollicle: variability and subject dependence of specific proteins. J. Oral Path. 2:165.

Krogstad, S., Sonju, T., Melsen, B., Rolla, G. (1975). Isolation of a S-labelled sulphated glucoprotein from the rabbit submandibular gland. J. Biol. Buccale 3:53.

Lie, T. (1979). Morphologic studies on dental plaque formation. Acta Odont. Scand. Vol. 37, No.2, 73-85.

Listgerten, M.A., Mayo, H.E., Tremblay, R. (1975). Development of dental plaque on epoxy resin crowns in man. A light and electron microscope study. J. Periodont. 46:10.

Lobene, R.R., Soparkar, P.M., Heir, J.W., Quigley, G.A. (1972). A study of the effects of antiseptic agents and a pulsating irrigating device on plaque and gingivitis. J. Periodont. 43:564-467.

Mayhall, C.W. (1970). Concerning the composition and source of the acquired enamel pellicle of human teeth. Archs. Oral. Biol. 15:1327-1341.

Melcer, S., Fieldman, S.M. (1979). Preventive dentistry teaching methods and improved oral hygiene. A summary of research. Clinical Preventive Dentistry. Vol. 1, No. 1., 7-13.

Newbrun, E, (1974). The role of food manufacturers in the dietary control of dental Caries. J. Am. Soc. Prev. Dent. 4:33-44.

Newbrun, E., Heiblun, R., Mayeda, A. (1980). Effect of flossing with and without Iodine on human interproximal plaque flora. Caries Res. 14:75-83.

Orstavik, D., Kraus, F.W. (1973). The acquired pellicle: Immunofluorescent demonstration of specific protein. J. Oral Path. 2:68.

Rolla, G., Melsen, B. (1975). On the mechanism of the plaque inhibition by chlorhexidine. J. Dent. Res. Spec. No. B. 54:57-62.

Silverstone, L.M. (1978). Plaque control. Preventive dentistry. 1978. 35-52.

Sonju, T., Christensen, T.B., Kornstad, L., Rolla, G. (1974). Electron microscopy carbohydrate analysis and biological activities of the proteins adsorbed in two hours to tooth surfaces in vivo. Caries Res. 8:113-122.

Spolsky, V.W., Forsyth, A.B. (1977). Effect of Alexidine 2HCl mouthwash on plaque and gingivitis after six months. Dent. Res. 56:No. 11:1349-1358.

Theilade, E., Wright, W.H., Jensen, S.B., Loe, H. (1966). Experimental gingivitis in man. II A logitudinal clinical and bacteriological investigation. J. Periodontal Res. 1:1.

Theilade, E., Theilade, J. (1979). Bacteriological and ultrastructural studies of development dental plaque: Dental plaque ed. McHugh, D.W. p. 27, Livingstone, Edinburgh.

Theilade, J. (1977). Development of bacterial plaque in oral cavity. J. of Clinical Periodontology. 4:1-12.

Waerhaug. J. (1976). The interdental brush and its place in operative and crown and bridge dentistry. J. Oral Rehabilitation. Vol. 3, 107-113.

Wright, G.Z., Banting, D.W., Feasby, W.H. (1977). Effect of interdental flossing on the incident of proximal caries in children. J. Dental Res. Vol. 56, No. 6, 574-578.

Wright, G.Z., Banting, D.W., Feasby, W.H. (1979). The Dorchester dental flossing study: Final report. Clinical Preventive Dentistry. Vol. 1., No.3. 23-26.