

New Vistas in Plaque Control

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Abstract: *Plaque is the soft, tenacious material found on tooth surfaces which is not readily removed by rinsing with water. The most clinically observable plaque on the smooth surfaces of the teeth along the gingival margin may be termed dentogingival plaque. After tooth cleaning, the supragingival plaque along the gingival border of the teeth accumulates slowly during the following two days. The thickness of the plaque increases dramatically after the third day, to a maximum after seven days. Harnessing technical improvements in mechanical and chemical plaque control methods can lead to benefits that are significant in ways more than just efficient plaque removal. Fundamental research in biological methods may also add to effectiveness of established methods. It can thus be concluded that pioneering research must be done, the fruits of which must be spread around to dental practitioners and academicians for speedy adoption.*

I. Definition Of Dental Plaque

Plaque is the soft, tenacious material found on tooth surfaces which is not readily removed by rinsing with water. The most clinically observable plaque on the smooth surfaces of the teeth along the gingival margin may be termed dentogingival plaque. Dentogingival plaque which occurs on the approximal surfaces, apical to the contact points, is termed approximal dental plaque. Plaque may be found below the gingival margin in the gingival sulcus or in the periodontal pocket and is termed subgingival plaque. We normally will find non-attaching bacteria in the most apical position of the periodontal pocket. Dental plaque is defined clinically as a structured, resilient, yellow-grayish substance that adheres tenaciously to the intraoral hard surfaces, including removable and fixed prosthesis. The plaque as a potential factor in development of periodontal diseases has been well studied and documented in medical literature.

In children and adults up to 40 years of age, interproximal dental plaque is mainly subgingival because the gingival papilla normally fills up the interproximal space. In spite of some loss of periodontal attachment, the papilla will fill up the interproximal space due to edema. After tooth cleaning, the supragingival plaque along the gingival border of the teeth accumulates slowly during the following two days. The thickness of the plaque increases dramatically after the third day, to a maximum after seven days.

II. Prevention Of Periodontal Disease

There is overwhelming evidence indicating that complete removal of bacterial plaque from the dentogingival region is the most effective method of preventing gingivitis and periodontitis. Control of periodontal disease by eliminating pathogenic organisms of the microflora is, as yet, impossible, but it is theoretically an attractive approach. Based on epidemiological studies there is a very strong correlation between the localization of dentogingival plaque and periodontal disease. 1.1~ Epidemiological studies clearly show that there are certain key-risk-teeth (molars and premolars) and key-risk-surfaces (the proximal surfaces of the molars and premolars). Furthermore, 13- to 16-year-old Swedish children are the "key-risk age-groups" regarding the

progression of dental caries disease in the permanent dentition. In the same age group we find around 20% "key-risk individuals." Clinical studies carried out by Björn and coworker have showed that 75% of all interproximal fillings have overhangs in a subgingival position. Also, they found that the loss of periodontal attachment at the same tooth-surface was correlated to the size of the overhang as an effect on increased plaque retention. Hence, successful caries prevention will also result in the prevention of periodontal disease. The basic principle for preventive dentistry must be that the preventive measures will give the most significant effect if we concentrate them on "key-risk age groups," "key-risk individuals," "key-risk teeth" and "key-risk surfaces." That means preventive programs based on plaque control have to be concentrated on those tooth surfaces where the risk for development or progress of dental disease is most pronounced in a given population.

III. Definition Of Plaque Control

Plaque control normally means preventive measures aimed at removing dental plaque and preventing it from recurring. This can be accomplished either mechanically or chemically: sometimes the two procedures are combined.

Home Care

"Home care" means the sum effect of motivation, knowledge, oral hygiene instruction, oral hygiene aids and motor skill. Today, tooth brushing and other mechanical cleansing procedures are the most reliable means of controlling plaque at home. In Scandinavian countries almost 100% of the school-children brush their teeth once or twice a day. A Swedish survey showed that no less than 99.5% of all adults with their own teeth use a toothbrush as an oral hygiene aid. However, only 70% of men use a toothbrush daily from the age of 30, whereas 85-90% of women use a toothbrush daily. Nonetheless, industrious use of the toothbrush is not synonymous with tooth cleaning. In 1971, Hansen & Gjermou carried out an investigation with the object of evaluating the plaque removing effect of various tooth brushing methods on individual tooth surfaces. The subjects of the experiment allowed plaque to accumulate freely for three days.

Then a dental hygienist, using an ordinary toothbrush, tested the cleaning effect of the roll-brushing method, the Bass method, Charter's method, and the effect of an interspace brush. The cleaning effect expressed in terms of Silness & LSe's plaque-index is very modest for all methods of brushing despite the fact that brushing was carried out by a dental hygienist.

Similar findings have recently been discovered in study by Bergenholz and coworkers. There is a strong correlation between brushing frequency and the reduction in plaque/gingivitis on the buccal surfaces. The vast majority of self-taught toothbrushers begins by scrubbing the buccal surfaces, especially at the frontal region, and rarely proceeds to the lingual surfaces. Interproximal cleaning is simply non-existent in the self-taught.

Most oral hygiene brochures say that tooth cleaning should begin with the use of a toothbrush and toothpaste on the buccal surfaces, followed by the lingual surfaces of the upper jaw teeth. Then the buccal surfaces of the lower jaw teeth should be brushed, and finally, the brush should be used on the lingual surfaces of the lower jaw teeth. Only then is interdental cleaning considered appropriate. However, there is no odontological necessity for this cleaning order of individual teeth surfaces. The level of ambition is always greatest at the beginning of a tooth cleaning operation. Moreover, more toothpaste is on the toothbrush in the initial phase and the brush bristles are most rigid. In the buccal region, the alveolar bone is very thin and may even

be absent altogether -- on the buccal surfaces of the canines for example, in the lingual and palatine regions, however, the alveolar bone is normally very strong. In light of all these factors, it is evident that the risk of inflicting traumatic lesions during tooth cleaning is very great if one decides to begin the operation with the buccal surfaces of the upper jaw teeth. Moreover, far too many people gradually switch from a correct bass method to a horizontal scrubbing method as the interval since the time of instruction increases. This again increases the risk of tooth cleaning trauma.

Plaque-Control

Plaque control is defined as the removal of microbial plaque and food debris from the oral cavity. The concept of plaque control is broadly based on factors of mechanical plaque control and chemical plaque control. The mechanical plaque control is mainly achieved through tooth brushing either using a manual brush or using a motorized toothbrush or with the help of pressurized water pump system involving the use of water under pressure pumped through fine blunt needle or nozzle. The chemical control of plaque includes organic or inorganic chemicals, which inhibit the accumulation, growth and survival of microbiota and debris.

IV. Mechanical Plaque Control:

The mechanical plaque control is achieved by instituting the different brushing methods, which helps in the disruption of plaque from sub gingival, marginal and supragingival region, hence preventing the maturation of plaque which leads to the expression of virulent pathogenic bacteria. Usually the dexterity and motivational level of individual to maintain the mechanical plaque control decreases with the time factor. The level of mechanical plaque control achieved at individual level decreases on a time gradient. Periodontal disease is highly prevalent and can affect up to 90% of the world population.

Since the 1960s the essential role of dental plaque as the etiological agent responsible for periodontal disease, the control of biofilm accumulation on teeth has been the key to periodontal disease prevention. Tooth brushing and the use of dental floss and other devices to remove bacterial plaque from the teeth are the most common ways of removing biofilm. Despite its important role in the control of periodontal disease, mechanical plaque control is not properly practiced by most individuals.

V. Power Driven Plaque Control

Dental plaque is structurally and functionally highly organized biofilm. Plaque biofilm has the ability to begin reorganization within days of being completely disrupted, and left undisturbed, can become the source of reinfection of gingivitis and periodontitis. Power driven plaque removal has many benefits, for the periodontal patient.

1. Power brushes with timers enable patients to consistently spend more time removing plaque. Brushes such as the Sonicare, Flexicare+, Sonicare for kids and Oral-B Professional care smart series 5000 have timers built into them for patients to brush until the timed sequence is over.
2. Studies have shown that in vitro plaque biofilm removal is possible beyond the reach of the bristles due to hydrodynamic shear forces of power brushes.
3. During the initial phase of periodontal therapy, power brushes have a superior ability to reduce supragingival plaque and reduce the level of bleeding on probing compared to manual brushes.

Different Types Of Powered Tooth Brushes For Plaque Control And Healthy Gums

Powered toothbrushes were first introduced commercially in the early 1960s, and have become established as an alternative to manual methods of toothbrushing. Powered toothbrushes have been designed with different movements of the bristles. It is therefore important to assess whether they cause damage to the gingival tissues during use. To compare powered toothbrushes with different modes of action, in everyday use, by people of any age, in relation to

1. removal of plaque
2. health of gingivae
3. adverse effects.

Chemical Agents In Control Of Dental Plaque In Dentistry: An Overview

Plaque can be removed by two methods-chemical and mechanical. In the chemical control of plaque, certain anti-bacterial agents are effective. Five categories of agents for approaches have been considered.

1. Broad spectrum antiseptics.
2. Antibiotics aimed at specific bacteriae.
3. Single or combinations of enzymes that could modify plaque structure or activity.
4. Non-enzymatic dispersing or modifying agents.
5. Agents that could affect bacterial attachment.

Antimicrobial plaque inhibitory agent in mouthwashes or toothpastes used to inhibit bacterial plaque formation and thus to prevent or resolve chronic gingivitis. The degree of effectiveness of commercial mouthwashes is very variable and depends on the composition of both the active and various additional agents within the mouthwash. Uses of anti plaque mouthwash

- a) To replace mechanical tooth brushing
- b) As an adjunct to normal mechanical oral hygiene in situations where this may be compromised by discomfort or inadequacies.

Solar Powered Tooth Brush Cleans Using Electrons

The Soladey-3 ionic tooth brush from Japan apparently busts plaque with electrons that work with saliva to remove it from your teeth. A solar panel attached to handle absorbs electrons from light and transmits them to your teeth through ionized water and a titanium oxide semi conductor in the upper shaft of the tooth brush. It is different from most electric toothbrushes, which vibrate and sometimes shoot water at your teeth, but still rely on tooth paste to help remove plaque.

VI. How It Works?

There is a light activated titanium rod (semi conductor) inside the handle. When exposed to any light source (a fluorescent bathroom bulb, a plain light bulb or sunlight), the photo-sensitive titanium rod inside Soladey converts light into negatively charged ions (electrons). The rod releases these ions, which blend with saliva to attract positive (hydrogen) ions from the acid in the dental plaque on your teeth. A systemic review of the effectiveness of self-performed mechanical plaque removal in subjects with periodontal disease concluded that it had limitations. Therefore, adjunctive use of chemical plaque control might be beneficial. Hence a chemical plaque has to be addressed on individual level on daily basis for proper maintenance of oral health.

VII. Chemical Plaque Control

Agents are classified into three generations

First Generation

- a) Phenols (Triclosan): It's a phenol derivative which is synthesized used as a topical

antimicrobial agent with a broad spectrum of action including against both gram -ve and gram +ve bacteria. It also has specific action against mycobacterium and candida species. Mechanism of Action: Triclosan acts on cytoplasmic membrane and induce leakage of cellular contents which leads to bacteriolysis and Cell death. Triclosan is included in toothpaste to prevent plaque formation. It is used along with zinc citrate or its polymer gantrez to enhance its retention in the oral cavity. It also inhibits prostaglandins and leukotriens thereby it reduces the degree of inflammation.

Metallic ions: These are Zn -ions and Cu -ions. It acts by reducing the glycolytic activity in bacteria and hence delays bacterial growth.

Quaternary Ammonium Compounds: These are Benzathonium Chloride, Benzalkonium Chloride and Cetylpyridinium.

These are cationic antiseptics and surface active agents which are effective against gram +ve organisms.

Mechanism of action: Positively charged molecule reacts with negatively charged cell membrane phosphates and thereby disrupting the bacterial cell wall structure.

The side effects include staining and enhanced calculus formation, it also causes burning sensation and desquamation. **Sanguinaria:** Sanguinaria chloride is currently used in both mouth rinses and toothpaste. It is an extract from blood root plant *Sanguinaria canadensis*. It is an benzophenanthredine alkaloid. Mechanism of action is not known. It is most effective against gram positive organisms.

Second Generation

Bisbiguanides is biguanides possess anti plaque activity including Chlorhexidine, Alexidine and Octenidine. Chlorhexidine gluconate, a cationic bisbiguanide is the best known and widely used member of this class. The antiplaque properties of chlorhexidine are unsurpassed by other agents.

It has much greater and more prolonged effects than other antiseptics.¹⁰ The digluconate of chlorhexidine (1: 6 - Di 4 - chlorphenyl - diguanidohexane) is a synthetic antimicrobial drug which is effective in vitro against both gram positive and gram negative bacteria including aerobes, anaerobes, yeast and fungi.

Mechanism of action: Prevents pellicle formation by blocking acidic groups of salivary glycoprotein's thereby reducing glycoprotein adsorption on to tooth surface. Prevents adsorption of bacterial cell wall on tooth surface. Prevents binding of mature plaque. Antibacterial action of Chlorhexidine consists of two actions, i.e., bacteriostatic at low concentration and bactericidal at high concentration.

Bacteriostatic action at low concentration is mainly due to the negative energy of the bacterial cell wall reacts with positive energy chlorhexidine molecule. This alters the integrity of cell membrane and Chlorhexidine binds to inner membrane phospholipids and increases permeability. This leads to the vital elements leak out resulting in bacterial cell death. Bactericidal Action is due to the higher concentration of chlorhexidine. This causes progressive greater damage of membrane and the larger molecular weight compounds loss and coagulation and precipitation of cytoplasm. The Free CHX molecules enter the cell and coagulate proteins and vital cell activity ceases and cause resultant cell death. It has shown that 0.2% CHX mouth rinses will prevent development of experimental gingivitis, it has been shown that Chlorhexidine is more effective in preventing plaque accumulation on a clean tooth surface than in reducing pre existing plaque deposits. The adverse effects of chlorhexidine include brown staining of tooth and restoration, loss of taste sensation and stenosis of parotid duct. It affects the mucous membrane and tongue; and may be related to the precipitation of chromogenic dietary factors on teeth

and mucus membrane. It is probable that one cationic group attaches chlorhexidine to the tooth and mucosal surface, which the other cationic group lyse the bacterial cell wall. Thus the cationic group can also attach dietary factors such as gallic acid derivatives found in some foods and beverages including tea, coffee and wines. **Essential oils**¹¹ (Listerine): It's a combination of phenol related essential oil, thymol and methyl salicylate. It has shown to have moderate plaque inhibitory effect and anti gingivitis effect. It has poor oral retention and has burning and bitter taste.

Mechanism of Action: The action of phenol acid is cell wall disruption and inhibition of bacterial enzyme. The phenolic compounds are also known to act as scavengers of oxygen free radical and hence has an effect on leucocyte activity.

Third Generation

Delmopinol¹⁴ : It's a relatively new preparation which inhibits plaque growth and gingivitis. It interferes with plaque matrix formation and also reduces bacterial adhesion and adherence.

It ceases binding of plaque to tooth, thus aiding the easy removal of plaque by mechanical procedures. It is indicated as a pre brushing mouth rinse. Adverse effects of Delmopinol are staining of tooth and tongue, taste disturbances and mucosal soreness and erosion. Miscellaneous agents include Salt of Zn and Cu, bispyridine cetridine, amylases, proteases and clostranase.

In conclusion all these agents were effective in plaque disruption and preventing its maturation. Clinicians should advise their patients after considering the positive effect of each of these agents against a favorable result could be derived by their patients. As a result, there is a very positive correlation between brushing frequency, gingival retraction and trauma caused by an abrasive lesion on the buccal surfaces. Up to the age of 25, the greatest loss of periodontal attachment is found on the buccal surfaces in the average patient. This is brought about principally by tooth brushing, and is particularly unfortunate in cases where the bifurcations have been exposed on the buccal surfaces of the molars, indirectly causing root separation or extraction. A fundamental principle for all preventive action is that the positive effect is greatest

where the risk of disease development is greatest. The patient has the greatest chance of being able to see positive results in his oral hygiene efforts if he concentrates initially on "key-risk teeth" and "key-risk surfaces." After this we can make more stringent oral hygiene demands by including buccal surfaces where results are largely indiscernible.

A Swedish survey shows that approximately 46% of adults use toothpicks sporadically. Of these, 12% use toothpicks daily. On the other hand, dental floss is used irregularly by 12% of adults, and 2% of these use dental floss daily. In other words, toothpicks are used six times more frequently than dental floss as an oral hygiene aid by adults. Despite this, it must be recognized that interdental cleaning is practically non-existent as an established habit in most countries. In the light of normal plaque distribution and dental disease in the dentition and on individual tooth surfaces, we can therefore state that needs-related tooth cleaning does not take place. The aspirations of the adult patient today focus principally on those tooth surfaces with the least disease formation, and cleaning, therefore, only produces approximately a 20% effect. In other words, there is a largely unexploited source of dental care here which we must tap. Yet out of

8760 hours per year, the individual patient normally spends no more than two hours in the dental clinic.

VIII. Conclusion

A perusal through the scientific literature on methods of plaque control makes it clear that various methods have been tried from time to time. Further, it clarifies that innovations in technology can make older methods less suitable since side effects and causes of inefficiency can gradually be corrected. However, slow pace of spread of novel ideas outside research or academic circles and similar lack of speed in general administration of such methods is seen and it can be surmised that procedures are being done at lower efficiency levels. Harnessing technical improvements in mechanical and chemical plaque control methods can lead to benefits that are significant in ways more than just efficient plaque removal. Fundamental research in biological methods may also add to effectiveness of established methods. It can thus be concluded that pioneering research must be done, the fruits of which must be spread around to dental practitioners and academicians for speedy adoption.

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