Review Article

Chemical plaque control - A brief review

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Abstract

Dental plaque is a complex microbial population of bacterial and salivary polymers present on the tooth surface. It is understood that human diseases must be avoided and a high social concern for the population as a whole. The argument for the implementation of successful prevention measures is strong for life-threatening diseases or those with serious morbidity. However, regardless of seriousness, the case for avoiding any disease may be based on the belief that it is easier to be healthy than dead or sick. Thus plaque prevention is an efficient way to both treat and avoid periodontal diseases, it is an important component of gingival and periodontal diseases' primary management.

Keywords: Dental plaque, mechanical and chemical plaque control, periodontal diseases

Introduction

Dental plaque naturally grows on the tooth surface and forms part of the host defensive mouth of exogenous microorganisms by serving as a colonisation barrier. This barrier effect is known as resistance to colonization.[1] Plaques contain around 80% water and 20% solids. About half of the dry weight of the plaque is bacterial and salivary proteins. Approximately, 25% plaque dry weight is in the plaque matrix, in addition to its high protein concentration, carbohydrates, and lipids. Plaques are graded in accordance with their anatomical region as supra- or sub-gingival. Sub-gingival sulcus is normally scanty and fine, but bacterial accumulations in diseased periodontal pockets are much larger. Supragingival plaques play a crucial role in pathogenesis, whereas the initiation of various forms of parodontal diseases takes account of marginal and subgingival plaques.[2]

Periodontal disease refers to the inflammatory processes in tissues around the teeth that react to bacterial or dental accumulation on teeth.[3]

The accumulation of bacterial plaques on and around your teeth is associated with dental caries and chronic generalized gingivitis. It would thus seem to be rational to assume that methods for avoiding plaque formation or removing plaque from teeth should be affected in the prevalence of both these common conditions.[4]

Plaque management consists of the use of mechanical procedures and chemical agents that retard the formation of plaque. Mechanical methods of plaque prevention include toothbrushing, oral hygiene, and professional prophylaxis for interdental washing. The most effective method of plaque control at present appears to be mechanical plaque control. Chemical plaque regulation was used only as an extension

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and not as a replacement to the mechanical means. Further improve the performance of plaque management programs using anti-plaque agents as an adjuvant to mechanical plaque control.[5]

Plaque management is one of the landmarks of dentistry, which cannot be done or maintained without oral health. Plaque management, thus, means protection of the health for a good periodontium; optimal care for periodontal diseases after treatment and last but not least, prevention of disease recurrence for a patient treated for periodontal disease.[6]

Plaque Control

" Plaque control means the regular removal and prevention of accumulations of the dental plaque on the teeth and adjacent gingival surfaces."[6]

Objectives of plaque control

The two most important objectives of plaque control are:

1. Prevention of gingivitis and marginal periodontitis.
2. Prevention of dental caries.

Classification of plaque control

Plaque control is broadly classified in to two groups:

1. Mechanical plaque control.
2. Chemical plaque control.

Several classification systems exist in literature and compiled in Tables 1 and 2.

Modes of Application of Antiplaque Chemicals

Modes of application of an antiplaque chemical are often critical to its clinical success or failure.

In general, antiplaque agents can be delivered in the following ways:

Routine oral hygiene aids

Due to the relative inaccessibility of mouthrinsing at interdental and subgingival sites, alternate methods of application of anti-plaque chemical products are required. A variety of home care products have been used to use antiplaque agents interdentally, including brushes, floss, and toothpicks. Bacterial growth has been shown to decrease stanium fluoride containing floss (Kaufman *et al.*, 1982). The plaque was shown to decrease more than untreated floss with impregnated chlorhexidine floss (H. N. Newman, 1986).[7]

Mouth rinses (surfactants)

Mouth rinses are the most usual and easy way for antiplaque agents to be delivered. A mixture of alcohol with flavour and non-ionic surfactants is the most common vehicle to enhance cosmetic properties. The direct damage to bacteria, through electrostatic and hydrophobic interactions with bacterial enzymes, may have an effect on these compounds. In two main groups, mouth rinses may be graded. Mouth rinses for first and second generations.[7]

The rinses of the mouth will reduce plaque to approximately 20–50% 4 to 6 times daily. (Substantivity means an antimicrobial's ability to bind on the tooth surface to anionic groups on the

Table 1: Classification of mechanical plaque control

1. Tooth brushes	2. Interdental aids	3. Aids for gingival stimulation	4. Others	5. Aids for edentulous & partially edentulous patients
a) Manual tooth brush. b) Electric tooth brush.	a) Dental floss. b) Triangular tooth pics. -Hand-held triangular toothpics. -Proxapic. c) Interdental brushes. -Proxabrush system. -Bottle-brushes. -Single-tufted brushes (flat or tufted). d) Yarn. e) Superfloss. f) Perio-Aid.	a) Rubber tip Stimulator. b) Balsa wood edge.	a) Gauze strips. b) Pipe cleansers. c) Water irrigating device.	a) Denture & partial clasp brushes. b) Cleansing solutions. 10

Table 2: Classification of chemical plaque control

First generation antiplaque agents	Second generation antiplaque agents	Third generation antiplaque agents
This may reduce the plaque to 20-50%. They have low mouth retention.	The plaque decrease is about 70-90% overall and is better preserved than the first generation. They demonstrate improved oral tissue retention and slow release characteristics	They block microorganisms' binding on or against the tooth. In contrast to second generation chlorhexidine, they have low retention capability.
E.g., Antibiotics, phenols, quaternary ammonium compounds and sanguanarine.	E.g,. Bisbiguanides (chlorhexidine).	E.g., Delmopinol.

oral silk and bacterial surface, and to create a sustainable release and thus increase antimicrobial effectiveness of the product.) Mouth rinses in the second generation are able to minimize plaque from 1 to 2 times daily by 70–90% and have a productive substantiveness of 12 to 18 hours or older. Example of first generation mouth rinses is Listerine and for second generation of mouth rinses is paridex (chlorhexidine).[8,9]

Dentifrices

Very few studies have been reported on dentrifices as a vehicle for antiplaque agents. A traditional toothpaste is made from abrasive and tensile ingredients, which can together remove loosely attached material, including plaque, film, and stain. Flavour and treatment agents, particularly fluoride, for the efficacy of antichildren are added (for the freshness of your mouth), for example, Mentadent G.[10]

Gels

Gels have been used in many studies as vehicles, particularly for the application of chlorhexidine interdentally, by means of a brush, floss, or sticks. A dental gel is nothing more but a clear thickened aqueous system with no abrasive or moisturising agents. It is also compatible with most antimicrobial agents.[7]

Chewing gums (dietary factors)

Chewing gum is one of several possible vehicles for determining the chemical agents in the oral environment in adequate concentration to minimize plaque formation. The advantage is that it is generally held in the mouth longer than rinses and dentures, e.g., chewing gum containing urea hydrogen peroxide, sorbitol-flavoured chewing gum, and chlorhexidine containing chewing gum.[11,12]

Periodontal dressing

Many of the periodontal dressings contain antimicrobials but few have been found to have marked effect clinically, except those containing chlorhexidine. Addy and Dolby (1986) found that dressing were preferred by patients to mouth washes, but that were no clinical difference between them. Non-chlorhexidine dressings allow bacterial growth to proceed between them and underlying tissues (H. Caney, 1976).[7]

Subgingival irrigation

Since it is impossible to completely remove all the plaque and calculus from moderate and deep pockets, a procedure that would reduce the critical mass of plaque to a level that the hosts defence can effectively control would be helpful. Instruments like Cavimed were equipped with an antibiotic agent to simultaneously irrigate and scale. There is no new definition of subjugation irrigation. -W. D. Miller (1890) wrote: "Sprinkle it with an antiseptic solution after all meals, when there are bags between gums and roots. Pitcher *et al.* (1980) found that gingival marginal direct irrigation was superior for mouth-washing entry, but that the perforatory penetration of the periodontal pocket only occurred by direct subgingival irrigation. If the irrigating needle is positioned in the pocket, then it can be done regardless of pocket width, the penetration of the apical plaque border and the ground of the periodontal pocket.

There are several antimicrobials that can be used to irrigate the pockets. The antimicrobial of choice is Peridex will bind to the tissue and tooth and release its antimicrobial effects over several hours. An extract of Sanguinaria may be effective in controlling plaque when used in sub gingival irrigation.[7]

Pulsated jet irrigation

Irrigating device for office use that are effective are pulsating devices, which can deliver the antimicrobial under low pressure to the bottom of the pocket. The cannula is placed as far as possible into the pocket and the foot control is depressed delivering the antimicrobial agent into the pocket. The cannula is traced around each tooth maintaining the tip in the pocket. They have been shown to be more powerful than jet pulsations with water. Studies have shown that periodontal inflammation is reduced even when only superagingival jet tip is put, particularly during stannous fluoride irrigation. However, pulsed jet irrigation can force particles in the epithelium of the periodontal pocket. This technique is clinically beneficial but requires more antibiotic concentration or alternative compounds to improve clinical health.[7]

Herbal extracts

Sanguinarine

The anti-plaque/anti-gingivitis agent is currently used as sanguinarine in both mouth rinses and tooth pastes. This is an alkaloid of benzophenathridine derived from the alcoholic mining of powdered rhizomes of the Canadensis blood root crop. Antimicrobial activity is conducted against gram-positive and oral isolates. The activity of various enzymes is also suppressed, probably by oxidation of thiol groups. It is claimed that sanguinarine has better antiglycolytic effect on salivary bacteria than chlorhexidine and cetylpyridium chloride. It demonstrates antiplaque activity, oral cavity retention, and fluorescent properties. It has high specificity for plaque. The cationic sanguinarine molecule chemically combines with plaque and remains detectable in the plaque for up to 4 h after use. It appears to alter the receptor sites in freshly formed pellicle, reducing the ability of bacteria to adhere to it. Rinsing with active solution appears to prevent both plaque formation and gingivitis. The effect being more marked at the buccal and lingual surfaces.[13]

The present formula includes 0.03% (equivalent to 0.01% pure sanguinarine) mixed extract and 0.2% zinc chloride to boost an antiplaque effect. In the United States the Viadent mouthrinse and toothpaste sanguinarine products are available. The pH for the rinse is 4.5, the alcohol is 11.5%. The dentrifices pH is 5.2%. ADA (American Diabetes Association) is not accepted either.

There are no outward side effects (except for an occasional burning sensation).[14]

Bisbiguanides

Bisbiguanides are a category of antimicrobials, including chlorhexidine and analogues, and they have been used since 1953 as a broad-based antiseptic in clinical and veterinary medicine. The benefit of such compounds is that antibacterial characteristics with low patient toxicities can be paired with slow mucosal absorption. Both hydrophobic and hydrophilitic features are present in the bisbiguanides. There is probably a mode of action associated with their ability to bind to the cell membrane surfaces of the bacterial cell and create alternations in membrane permeability resulting in intracells leaking and precipitation and cytoplasmic coagulation. Many studies have shown that bisbiguanides are effective as a mouth-washing compound for preventing microbial plaque accumulation.[15]

Chlorhexidine

Cationical bisbiguainide was introduced as an antiseptic cream for use in skin wounds in 1975, to human use in the United Kingdom. Since then the use of chlorhexidine has extended to over 20 products that contain chlorhexidine. This agent is commonly used in the management of routine plaques as a chemical supplement. It appeared as Hibiclens, an antimicrobial skin cleanser with a 4% solution. It caught the dental world as a solution 0.2% of chlorhexidine for managing gingivitis.

Clinical applications

Application of *chlorhexidine* is a nonspecific attempt to control microorganism and judicious timings of therapeutic interactions can aid in obtaining a healthy periodontium. Various modes of chlorhexidine delivery techniques have been suggested, and each technique provides different advantages:

Chlorhexidine can be delivered in the form of mouth washes, tooth pastes, gels, periodontal dressings, sprays, and irrigation.[16]

a. Rinsing:
The best known literature is the use of *chlorhexidine* digluconate for a mouth wash. The two 10 ml daily rinses guarantee full plaque inhibition with a maximum of 0.2% (chlorhexidine solution). When such a concentration is used, dentures and teeth can become discoloured in a few weeks. Since concentration-related side effects, the desired plaque reduction can be accomplished by 10 ml 0.1% of chlorhexidine solution for one or two daily applications. Reduce chlorhexidine levels even further in mentally ill children to help reduce discolorations.

In summary, it may be stated that the short-term application of chlorhexidine digluconate in a concentration of 0.1% or 0.2% chlorhexidine solution may be recommended routinely after periodontal surgery. Once daily rinse for 2–3 weeks following the procedures may be satisfactory. Furthermore, the incorporation of chlorhexidine hydrochloride powder in to the periodontal dressing will improve the chances of periodontal attachment.

The long-term application of chlorhexidine in the above-mentioned concentration can also be recommended from the point of view of protection and effectiveness. The discoloration, however, is produced using chlorhexidine for a long time. Therefore, a low dosage may be advised if the medication is to be used for a long time. The optimal concentration of a long-term application should always be individually determined, as broad differences in colouration occur from one person to the next. All rinses can last at least 30–45 s with chlorhexidine laundry. The optimal dose of chlorhexidene in this time may be limited to 30%.[17]

b. Tooth pastes and gels:
The attempt to incorporate chlorhexidine in to tooth paste was only partially successful. Although the application of chlorhexidine containing tooth pastes created only minor discoloration a complete chemical plaque control could not be achieved with this vehicle. It is most likely that the added chlorhexidine may be inactivated by flavouring agents and detergents. The same applies to the application of chlorhexidine in gels. Gels may be applied as tooth pastes as well as in acrylic trays. The gels and pastes are much more expansive than mouth rinses.[17]

c. Irrigators:
The plaque inhibitory potentials are also at risk if chlorhexidine rinses are decreased to decrease the amount of stain. This was particularly observed when lower levels were used in interproximal areas. The reduced clinical impact will counteract the increase in the dose, making an irrigator an ideal tool for antimicrobial agents.

The use of 400 ml of chlorhexidine 0.02% once daily in oral irrigator has been shown in recent storeys to result in full plaque inhibition. However, for partial plaque reduction in concentration of as low as 0.006% will still gave some plaque inhibition.[17]

Side effects of chlorhexidine:
a. Occasionally dulling of taste sensation.
b. Discomfort from the bitter taste.
c. Burning sensation of the mucosa.
d. Dryness and soreness of the mucosa.
e. Epithelial desquamation.

Recent Advances

Xylihex

It is the preparation consisting of chlorhexidine, sodium fluoride, and xylitol in the tablet form. This tablet can be used anywhere. Ready to use mouth wash solutions are impracticable, but the subjects claim that the taste of XYLIHEX to be the worst compared to chlorhexidine and sodium fluoride.[18]

Delmophenol Hydrochloride

It has been developed as plaque control agent. The mode of action is not known in detail. Delmophenol is surface active agent which may interfere with the adhesion force between microbes and surroundings.[19]

Plax (prebrushing rinse)

The pre-brushing rinse, plax (Pfizer) was introduced in European market in the fall of 1989. The rinse is the combination of anionic and ionic surfactants including sodium lauryl sulphate and polysorbate.[20] It is basically the soap, which acts upon already formed plaque to loosen and remove the deposits. Use of rinse is recommended before daily brushing. The efficiency of plax has been the subject of controversy, as placebo-controlled studies failed to demonstrate plax's efficiency. The findings from a 6 months clinical study have shown recently, however, that plax performance (Colgate, UK) is substantially improved if the prebrush rinse contains triclosan 0.3% and a copolymer 0.125% of methoxyethylene and malic acid. Moreover, no adverse effects reported in these commercial products.[21]

Polydimethylsiloxane

The surface tension of polydimethyl siloxane (silicone oil). The solid surface is absorbed strongly and the close film is hydrophobic and waterproof. Because of this low surface tension, the silicone oil absorbs hydroxyapatite and tooth (dentinal enamel) and forms a thin, resistant, hydrophobic layer which affects the surrounding properties of the teeth. The principal mechanism of deposition of the acquired pellicle under normal conditions is ionic interactions between positive loaded calcium on the enamel surface and negatively loaded protein (e.g., the phosphoprotein). Owing to the hydrophobial aspect of silicone oil treated region a coating of silicone oil causes the deposition of various pellicles, which can be eluted by water. Silicone oil is primarily non-toxic and resistant to bacterial degradation. A reservoir of fat-soluble antimicrobial agents, soluble in silicone oil, will serve the layer connecting the teeth with physical rather than chemical forces. This allows the teeth to develop an antibacterial film which slowly releases antibacterial activity in saliva.[22]

Antibiotics

These are substances produced by some species of microorganisms, which suppress the growth or kill other microorganisms at very low concentrations.[23]

The conditions for the oral topical use of antibiotics prescribed by regulatory agencies are:

a. Actually not in life and death circumstances for medical reasons.
b. There are no cross sensitive.
c. Low dosage and active.
d. Non-sensitive, allergic to oral tissue or distracting.
e. Is not immune to oral ecology changed.
f. No major absorption.

A The at least analysis or the animal test for antiplaque behaviour was the target of various antibiotics.[24]

Penicillin

It is bactericidal and inhibits cell wall synthesis of bacteria. Penicillin as well as tetracycline has been shown to be successful in inhibiting plaque formation in animal experiments. The antibiotics have either been added to the diet or were applied topically. Even though penicillin might inhibit plaque formation successfully, this antibiotic which is of utmost medical importance should not be used in chemical plaque control. It has to be reserved for the treatment of life-threatening infections. Furthermore, the great danger of sensitization exists.[17]

Vancomycin

This antibiotic is the non-absorbable polypeptide effective against gram-positive organism. It is bactericidal and acts by interfering with cell wall synthesis. Topical application of vancomycin inhibited plaque formation. Hamster adhesive paste containing 1% vancomycin reduced plaque development in mentally retarded children. The current consensus is that vancomycin might be a useful therapeutic agent in situations in which it is necessary to remove substantial amount of plaque for relative short periods.[14,17]

Niddamycin

Niddamycin (cc 10232) a gram-positive antibiotic macrolide used as a rinse twice daily at a 0.1% concentration. Plaque accumulation reduction of 11–77% has been recorded. Cross-sensitisation to erythromycin was not followed for its clinical application.[14]

Tetracycline

The use of 5% solution of tetracycline resulted in greatest plaque reduction. It appears that the systemic administration of tetracycline has no advantage over the local debridement and mechanical plaque control. Since the clinically improved conditions achieved with the administration of tetracycline is only of short duration when compared to routine mechanical procedures.

Although there is no doubt about the very good inhibiting effects of several antibiotics, the potential dangers involved in the prolong use were not pursued, however, because of cross sensitization to erythromycin.[14]

Kanamycin

The wide spectrum of kanamycin action seems more powerful than the restricted range of antibiotics for use in antiplaque. In fact, a plaque weight of 5% in Orabase emollients of an adhesive paste had an effect with poor oral hygiene.

Even though several agents have proved effective in short-term studies, there is a general agreement that the antibiotics are inappropriate for routine use as antiplaque agents. There are number of reasons, why antibiotics are contraindicated for

regular use in mouth rinse. These include the development of hypersensitivity, emergence of bacterial resistance, and super infection by fungal organisms.[14]

Importance of Family Medicine in Dental Plaque

Whether oral health products are primary cosmetics or medicines is a field of significant uncertainty. If a product is of health benefit, then it may be argued that the product should be treated as a drug. If it is said to be treatment result. Some countries consider mouthrinses and toothpaste more likely to be cosmetic preparations, as long as the efficacy claims do not show that they have undergone treatment. In accordance with Country,[25] the overall availability of unique products for oral hygiene containing anti-plaque agents is different. Some products can be purchased in shops like supermarkets, whereas others are only available in pharmacies and others need a prescription. The noteworthy example is chlorhexidine mouthrinse, which can be bought from a drugstore without prescription, while a dentist or physicians. There may be a variety of factors which reason this difference, but it certainly takes into account factors such as potential adverse effects and long-term protection. It may be encouraging that distributing and categorising the substance is a matter for the law enforcement authorities in the region. However, the issue is whether anti-plaque formulations for the general use of the public should be fully deregulated. It is clear that there is less impediment to the sale of these preparations to the general population when labelled as cosmetics. The biggest risk of this strategy would be that efficacy criteria are more likely to be tested before the product is placed on the market without clinical support and any subsequent adverse effects are less likely.

Future Challenges in Chemical Plaque Control

New methods are therefore important for controlling oral plaque-related diseases in the hour. Probiotics aims at the removal of pathogenic bacteria to ensure biological plaque regulation. Probiotics have not only antimicrobial properties but are also able to modulate the immune system into anti-inflammatory actions.[26] Another field of research is now being developed for vaccinating oral biofilm-related disease. Further research to determine the potential use of these agents are of the utmost importance.[27] Natural products provide structurally diverse substances with a broad range of biodiversity that may be useful for alternative or adjunctive plaque therapy.[27] Hence, chemical plaque control, though just an adjunct to mechanical plaque control, offers promises, challenges, and unexplored arenas.[28]

Ethical approval

This research did not need any informed consent because we did library research. References and quotations were written based on the journal guideline.

Summary and Conclusion

One of the main aspects of dentistry practise is plaque management. It encourages every patient to take on everyday responsibility for their own oral health. Optimum oral health cannot be obtained or maintained without periodontal therapy. In all dental procedures, every patient should be trained and encouraged to follow regular plaque control. Effective plaque management allows people with gingival and periodontal problems to return to health, prevents deterioration of their teeth and maintains oral health for a lifetime.

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Conflicts of interest

There are no conflicts of interest.

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