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Review

CHEWING GUM : BUBBLE OR TROUBLE ?

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ABSTRACT : In the present age of cut-throat competition we see the market flooded with formulations of drugs, that differ only in their packaging or dosage forms. The action of chewing gum a confectionery that can be used as a vehicle on plaque pH needs to be assessed against the background of other evidence, including clinical data. The purpose of this article is to review the existing published evidence on the dental effect of chewing gum and to answer the question "Chewing gum : bubble or trouble ?"

INTRODUCTION :

Human beings have been chewing gum-like substances since ancient time, but the chewing of gum as we know it today has relatively short history. [13] in 1896 a dentist Dr. William F. Semple from Ohio, first patented chewing gum. He considered that chewing gum was not only a tasty confectionery, but also had potential as a dentrifice. [2]

Chewing gum has several properties that are potentially either beneficial or detrimental to the health of the oral tissues. On the one hand, most chewing gum sold throughout the world is sweetened with sucrose and adds to the cariogenic 'load' of dietary carbohydrate. On the other hand, gum chewing can act as a salivery stimulant and has been claimed to 'cleanse' the mouth. Furthermore, the sucrose in chewing gums is easily substituted with sorbitol or xylitol, poorly fermented sweeteners that do not contribute to the cariogenicity of the diet. Finally, chewing gum has been proposed has a vehicle for the delivery of therapeutic additives such as antibiotics, phosphates and fluorides.

Of late, interest has turned to the use of chewing gum after meals and snacks, to stimulate salivation, which would be expected to neutralize plaque pH by increasing the alkalinity and buffering power of saliva and accelerating the clearance of fermentable carbohydrate still present from the previous dietary intake.

This single item of confectionery clearly has a considerable impact on the mouths of many of our patients, in relation to mastication, occlusion, salivary function, plaque accumulation and metabolism and their bearing on dental health. It is important therefore the knowledge of this confectionery item should be viewed against a background of existing published evidence on the dental effects of chewing gum.

Chewing gum consists of predominantly (15-40%) of a neutral and tasteless masticatory gum base together with several non-masticatory ingredients such as fillers, softeners, sweetening agents, flavoring agents and etexure regulating agents. [13].

It was only in 1970 sugar free gum was introduced. [13] With an increasing range of chewing gum available, the question to be addressed are not only whether chewing gum is beneficial or detrimental to oral health but also which types of chewing gum can be safely recommended.

The effects of chewing gum can be studied under the following aspects :

A. Dental Carios
B. Periodontal Health
C. Xerostomia
D. Vehicle
E. Side effects

A. CHEWING GUM AND DENTAL CARIES :

There have been only a few studies in which caries incidence in subjects who chew gum sweetened with sugar (sucrose) has been compared with that in controls who did not chew gum.

Trials comparing subjects who chewed gum sweetened with sucrose with controls who did not chew gums have not provided evidence to support its regular use. Although lack of adverse effect was found in two studies using chewing gum daily after meals (7) no beneficial effects on DMF levels were recorded. A study in 1981 by Glass (9) in which sugared gum was used twice daily between meals, caries levels increased by 36%, the gum obviously adding considerably to the cariogenic load of the diet. Other studies of the cariogenicity of sucrose-gum have used controls chewing a sugar free gum containing sorbitol or xylitol. (7,9,15,16,20).

Sugar-free gums contain artificial sweeteners that can be divided into two groups :

Intense sweeteners : (e.g., saccharin cyclamate, aspartame) are synthetic or neutral substances whose sweetness is very high compared with sucrose.

Bulk sweeteners ; are sugar alcohols, such as sorbitol and xylitol.

Both types of sweetening agents are other included in sugar free gums in various amounts and concentration. The anti-caries action of sugar free gum containing sorbitol or xylitol, or a combination has been proven in long term clinical trials. These initial long term studies were conducted using sorbitol as the artificial sweetener, in children between the age group 7-11 years. the gum was chewed after meals for 20 min. twice daily for 3 years. A 10-13% reduction in dental caries was achieved.

subsequently xylitol (only) gum was used and the studies showed a definite reduction in DMF scores from 37-39% to 50-80%, after a three year study. This effect is thought to be due to changes in the oral flora, such as selective inhibition of streptococcus mutants, and maturation of teeth under favorable physiochemical conditions.

Xylitol is used as a sweetener in confectionery ice cream, chewing gum and other foods. [1] It is also found in oral hygiene products, cosmetics and pharmaceuticals. [19] Metabolism of xylitol is insulin dependent and it produces less of a laxative effect than either sorbitol or mannitol, probably due to its high rate of absorption. (72 to 95%). Most people can tolerate 30 gm of xylitol in a single does and daily doses as high as 200 gm cause laxative symptoms only rarely.

The effects of xylitol in chewing gum can be explained by various phenomena :

The reduction in sucrose intake produced by dietary substitution with a non fermentable carbohydrate.

the sweet taste of xylitol stimulates salivary flow with an attendant increase in buffer capacity and defence factors.

Xylitol is associated with increased soluble calcium in plaque, which may assist in remineralization of enamel.

Xylitol also possesses an antibacterial property reportedly due to its entering the bacterial cell well via the fructose phosphotransferace system. The xylitol 5-phosphate thus formed, inhibits becterial growth partly by establishing an energy-consuming futile cycle and partly by inhibiting glucose uptake and metabolism.

Xylitol does not lower the pH of dental plaque (either in vivo or in vitro). This is marked contrast to sorbitol, which does lower the pH although by much less than sucrose.

Studies in Belize demonstrated the ability of Xylitol-containing chewing gum, and the researchers concluded that proper usage of polyol gums can indeed be associated with a significant rehardening of extensively carious primary teeth. This apparent dentinal remineralisation is particularly veluable in populations with limited access to dental services and/or a low recognition of the need for treatment.

LABORATORY STUDIES OF THE CARIOGENIC POTENTIAL OF CHEWING GUMS.

The most effective method of assessing the cariogenicity of a product is a long term clinical trial involving human subjects. Unfortunately, these studies are difficult and very expensive to undertake, so alternate approaches are necessary. In its early stages dental caries is an arrestable or reversible process and several factors exist intra-orally which help to reverse decay and encourage remineralisation. To evaluate the effects of a material such as chewing gum on dental caries it is necessary to examine its effect on the following.

- Saliva quality and quantity.
- Plaque pH
- enamel remineralization and
- cariogenic micro-organisms.

SALIVARY FLOW :

Both sucrose containing and sugar-free gums stimulate salivary flow, due to a combined effect of gustatory stimulation from the sweetening and flavoring agents and mechanical stimulation from chewing [4, 5]. An increase in salivary flow may lead to more frequent replenishment and greater supply of antibacterial factors, sialin, buffers, minerals and other beneficial constituents ; reducing plaque acidogenicity and increasing pH and buffering capacity of whole saliva. Chewing also increases salivary film velocity approximately tenfold and ensures better mixing of saliva in the month.

The effects of saliva may be attributed to :

(A) accelerated clearance of dietary sugars

(B) increased salivary bicarbonate, leading to alkaline pH and greater buffering power.

(C) increased supply of nitrogenous substrates in saliva of alkali production in plaque.

(D) accelerated removal of plaque acids resulting from carbohydrate mechanism.

In addition to tis effects on plaque pH, mastication stimulation increases the amount and/or concentration of the ions in saliva (Ca+2, PO4-3, F, OH-) which are constituents of tooth mineral.

However the method of use of gum, as well as its constituent sweetener, is of major importance. Once the small increment of dietary sugar has been 'chewed out' of the gum, requiring less than five minutes, the remaining chewing period is effectively the same as with sorbitol or xylitol gum. The duration of chewing as well as the after meal timing is of critical importance for the salivary effect to be paramount.

PLAQUE PH :

Measurements of plaque acid production by observing pH changes in response to chewing gums have shown that sucrose gums elicit a moderate pH full, while sugar free gums stimulate a rise in pH [10, 14]. These results are consistent with the clinical evidence cited above, that a moderate pH drop may increase the demineralising potential of the plaque, while a rise in pH will (on its own) have no effect. The increase in pH with sugar free gum may be enhanced when urea is included in the formula, because of ureolytic activity by oral organisms leading to the production of ammonia, with its attendant alkalinity.

However, recent studies have focused on the effect of food sequences on plaque pH. It has been known for over ten years that the pH fall which follows consumption of an acidogenic food or drink can be abolished by immediately following this with a non acidogenic food or a non-food salivary stimulus such as paraffin was Jansen showed that sorbitol chewing gum acted in the same way, by repidly restoring plaque pH to baseline levels when chewed after sugary snack food. A similar effect had been briefly noted many years earlier by Hein et al., and has been confirmed by other groups. The effect has generally been attributed to the extended salivary stimulation provided by the chewing gum, without substrates in the gum for significant acid production by the plaque organisms. With sorbitol gum alone, the pH of plaque rises-that is, any acid produced from sorbitol (which is slowly fermented by certain plaque organisms including streptococcus mutans) is more than neutralized by the stimulated saliva.

REMINERALIZATION OF ENAMEL :

Various studies have been undertaken to evaluate the effect of chewing gum on intra-oral demineralization and remineralization. This work is usualy conducted using an intra-oral applicance containing sound or partially demineralised enamel. The effect of sorbitol gum has been tested on remineralization of artificial caries lesions, produced in laboratory in small pieces of enamel cut from extracted teeth. When they were placed in the mouth of volunteers who chewed sorbitol gum for twenty minutes, five times daily after meals and snacks. The lesions remineralised to a significantly greater extent than control lesions treated identically except for omission of gum chewing. [3] All the subjects used fluoride tooth paste during the experimental period. Sorbitol gum has also been found to reduce experimental intra-oral demineralization of enamel when chewed after a sucrose challenge, compared with no gum controls.

CARIOGENIC MICRO-ORGANISMS :

Subjects with high levels of caries often harbor high numbers of streptococcus mutans. In 1984, Loesche et al., found that chewing xylitol-containing gum decreased the numbers of Streptococcus mutans in the saliva and plaque. This contrasted with an increase in microflora levels in subjects chewing sorbitol or fructose containing gums. Both long term and short term clinical trials have shown that xylitol consumption reduces the number of cariogenic bacteria, and Makinen et al concluded that available evidence supports an antimicrobial effect of xylitol being responsible for caries reduction rather than a chemical one. No research papers have evaluated the effect of sucrose containing gum on levels of oral microflora. [12].

B. CHEWING AND PERIODONTAL HEALTH :

The traditional concept of natural cleansing using food stuffs is not valid, yet chewing is been widely studied for its cleansing actions. early investigations revealed gum chewing to have no beneficial effect on gingival inflammation and calculus formation, although later works showed that sorbitol containing gum reduced plaque and xylitol gum reduced it even further. slightly long term studies showed that daily gum chewing in combination with normal oral hygiene practices reduced plaque accumulation and gingival inflammation. The authors attributed this improvement to the chewing maechanically removing plaque and increasing salivary flow and consequently flushing teeth accretions. In addition, and possible more importantly, sugar alcohols such as xylitol reduce the plaque microflora, and it is this factor that may lead to improvements in periodontal health. [18,20].

C. CHEWING GUM AND XEROSTOMIA :

The ability of chewing gum to stimulate salivary flow is well established. The role of chewing gum in the management of xerostomia is also received some attention. [6,2, 17].

Treatment of xerostomia depends on whether functional salivary tissues can be stimulated to increase salivary flow. Methods used have been : addministration of pilocarpine; use of mint and sugar-free confectionery; and artificial saliva. Studies have examined the role of chewing gum in treating dry mouth, by assessing treatment on salivery flow rates, elevation of salivary pH, by assessing treatment on salivary flow rates, elevation of salivary pH, and subjectively by questioning patients. studies have reported short term increases in saliva flow on chewing gum, both in people with xerostomia and with normal flow rates. the long term effects of chewing gum on saliva flow rates is more controversial.

People suffering from xerostomia should avoid gum containing sugar as it seems unlikely thatt any saliva stimulation induced would be sufficient to counterbalance the cariogenic balance from the sugars. Furthermore, after 12 weeks use of sorbitol gums, the oral floras have been seen to metabolize sorbitol and thus sorbitol gum may represent a small cariogenic challenge in persons with low salivary flow. This adaptation has not yet been found with xylitol. The effects of chewing gum of different flavor, consistency, chewing frequency and xylitol/sorbitol concentration need to be fully evaluated in patients with xerostomia to ascertain which regimes produce maximum benefit with the fewest side effects.

D. CHEWING GUM AS A VEHICLE FOR MEDICAMENTS :

In 1924 the first medicated chewing gum (which contained acetyl salicylic acid) was marketed in USA. However, it was not until nicotine containing gums become available in 1978 that chewing gum as system of drug delivery began to gain acceptability. Chewing gum is listed in the guidelines for pharmaceutical dosage, isued by the Commission of European Communities. In this document chewing gum is defined as a solid preparation with a base consisting of gum that should be chewed and not swallowed, providing a slow steady release of the medicament contained. Therapeutic substances have been added like fluorides, enzymes, ascorbic acids, peroxide, penicillin, dicalcium phosphate, sodium trimetaphosphate, stannous EDTA, zirconium silicate, carbamide, chlorhexidine, hydrogen peroxide, miconasole, calcium phosphate in an attempt to prevent dental caries, calculus formation, periodontal disease, candide or other oral conditions. (13)

E. ADVERSE REACTIONS OT CHEWING GUM :

Very few adverse reactions to chewing gum have been reported in the literature, althogh gum is used extensively throughout the world. One report claims that excessive sorbitol chewing gum ingestion results in diarrhoea and another reports ten cases of allergic reactions to cinnamonflavored chewing gum, the symptoms of which apeared mild. Further concerns have been expressed about chewing gum and gastric secretion, yet research hs shown that chewing sugar less gum does not increase gastric fluid volume or acidity. [13].

The clinical evidence relating to sugr-free gums containing sorbitol or xylitol clearly indicates their non-cariogenicity. Moreover when these products are used in a particular pattern, that is to say for 20 minutes, after meals and snacks, they may reduce the cariogenic challenge due to other dietary items and thereby may have a potential anti-caries effect. This action may be supplemented by enhancement of the remineralization of incipient carious lesion produced by dietary carbohydrates. On balance, the evidence therefore suggests that sugar-free gums can be used by patients without hazard to dental health, and with increasing confidence that they may have a beneficial effect. Healthy patients who wish to use sucrose gum and are willing to substitute a sugar free product might be advised to adopt a pattern of consumption that may minimize or perhaps eliminate the caries risk, by chewing one stick of chewing gum after meals and snacks for atleast 20 minutes. A sondly based judgment on the dental aspects of the use of all types of chewing gum used must await further clinical trials.

"Therefore Sugar free gm is without doubt a bubble and not trouble."

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