REVIEW ARTICLE

REMINERALIZE THE EARLY CARIOUS LESION- REJUVENATE THE TOOTH : A REVIEW AND RECENT UPDATES ON REMINERALIZING AGENTS

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ABSTRACT

Now-a-days management of dental caries has shifted to more preventive and minimally invasive approaches. Carious lesion in its early stage can be remineralized which not only halt the disease progression, but also restore normal morphology, esthetic and function. Remineralization of early carious lesion can be done with a variety of remineralizing agents which include both fluoride and non-fluoridated agents. The aim of this paper is to review the contemporary remineralizing agents available for the treatment of early carious lesion and to explore the ideas for their relevant use in clinical practice.

KEY WORDS

Early carious lesion, remineralizing agent, CPP-ACP

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INTRODUCTION

Dental caries is a multifactorial microbial disease of calcified tissue of tooth which causes demineralization of inorganic portion and destruction of organic substance and often leads to cavitation.[1] It is a dynamic process which occurs due to disturbance in demineralization remineralization equilibrium.[2] On fermentation of carbohydrate present in diet by acidogenic bacteria, formation of organic acids take place which result in dissolution of enamel mineral content and initiate carious process.[3] The initial carious lesion of enamel appears as white opaque spot with a relatively intact enamel surface and mineral loss in subsurface area.[3] This white spot lesion is softer than adjacent sound enamel and mostly caused by the dissolution of interprismatic substances.[3,4] Early carious lesion which is produced by initial enamel demineralization can be described by various terms like incipient lesion, surface-softened defect and white spot lesion.[3] As these lesions are reversible with proper remineralization approach, early detection and diagnosis of early carious lesion can prevent the disease progression and cavitation. Remineralization of these lesions can be done by ensuring a constant supply of calcium and phosphate ions in oral environment which leads to ion deposition in crystal voids in demineralized area.[5] Although fluoride in various topical forms is traditionally known to produce remineralization of early lesions, various calcium and phosphate based technologies are proved their efficacy in recent years.[6]

Properties of an ideal remineralizing agent:[7]

- It should be effective in acidic pH.
- It should come in contact with subsurface area of enamel and should provide a constant supply of calcium and phosphate into that area.
- It should not favor plaque and calculus formation.
- Should be effective in dry mouth or xerostomic patients.
- Should enhances the remineralizing ability of saliva.

Fluorides in remineralization of early carious lesion: Fluorides in various topical forms helps in

remineralization of early carious lesion which is believed to be the major cariostatic activity of fluoride ions. It promotes the deposition of hydroxyapatite from calcium and phosphate ions solution at low concentration. It also active in acidic environment and can maintain the integrity of deposited crystals.[8] It also inhibits different bacterial enzymes like enolase, phosphatase and peroxidase which in turn interferes with the carbohydrate uptake by bacteria and with the formation of extracellular polysaccharides.[9]

Besides its effectiveness, it has some disadvantages too. Although fluoride is highly efficient on smooth surface lesion, its effect is questionable on pits and fissures. Inadvertent exposure to high dose fluoride can leads to fluoride toxicity and skeletal or dental fluorosis can be precipitated from long term exposure. Moreover in some parts of the world suggestion have been given to limit its exposure to avoid its adverse effects.[10] Fluorides are available in the form of varnish for topical application. It is also incorporated in dentrifices and mouthrinse.

Amorphous calcium phosphate (ACP) : The ACP technology was introduced by Dr. M S Tung which requires two paste delivery system that prevents the premature reaction between calcium and phosphorous components. When this two paste are mixed, formation of amorphous calcium phosphate takes place which precipitate on tooth surface and can readily dissolve into saliva and also ensure its availability for tooth remineralization.[11] Enamelon and Enamel Care these are the two dentrifices which were introduced with incorporated ACP technology in 1999 and 2004 respectively.[12]

Casein phosphopeptides and amorphous calcium phosphate complex (CPP-ACP): In 2002 Eric Reynolds and his coworkers introduced and patented CPP-ACP complex at the University of Melbourne. It is a protein nanotechnology where specific phosphoproteins derived from bovine milk form nanoclusters with amorphous calcium phosphate. Casein phosphopeptide helps the ACP to binds with the dental enamel and also stabilizes calcium phosphate present in the solution as amorphous calcium phosphate. The Streptococcus mutans count is also decreased as it has got the ability to integrate in the pellicle.[13] By providing a pool of calcium and phosphate it helps in supersaturation of saliva, it also buffers the plaque pH and increases calcium and phosphate content within dental plaque. By doing all these it actually keep calcium and phosphate concentration high in subsurface lesion area which in turn produces remineralization.[14] The role of CPP-ACP have been demonstrated in several in vitro studies and it was also found that it has synergistic remineralizing effect when used with topical fluoride.[15,16,17] It is available as chewing gum, toothpaste, mouth rinse and tooth mousse for topical application.

Tricalcium phosphate: Tricalcium phosphate can be obtained by combining calcium carbonate and calcium hydrogen phosphate at a temperature over 1832 degree F for 24 hours followed by milling to produce 0.001-5 micron size particles.[7] It enhances the level of calcium and phosphate in plaque and saliva and there by helps in remineralization of incipient carious lesion. A study was conducted using 2.5% tricalcium phosphate by weight added chewing gum have shown similar effect when compared to a control group.[18] Caresorb, Biovision and Bio-Resorb are examples of some tricalcium phosphate products available in market.

Bioactive glass: Bioactive glass comprises of 45% SiO_2, 24.5% Na_2O, 24.5% CaO and 6% P_2O_5.[19] When applied to the tooth surface, it comes in contact with saliva and rapidly releases sodium, calcium and phosphorous ions in oral environment which helps in remineralization and formation hydroxycarbonate apatite. The release of ions and transformation into hydroxycarbonate apatite may continue up to two weeks after initial application until all particles completely transform into hydroxycarbonate apatite.[20] Novamin technology is a commercially available bioactive glass which forms a strong mineralized layer resistant to acid attack when applied to exposed dentinal surface.[21]

Nanohydoxyapatite: In a recent study remineralizing ability of 10% biomimetic nanohydroxyapatite have been compared with 2% sodium fluoride in in vitro condition. It was concluded that the fall in calcium phosphorous ratio following demineralization did not increase significantly after 2% sodium fluoride application, whereas an increase in calcium phosphorous ratio close to that of biological enamel have been found after nanohydroxyapatite application.[22] It can be incorporated in toothpaste and its daily use to promote remineralization have been encouraged in recent years.

Xylitol : Itself it is not a remineralizing agent. It is a sugar substitute and can be used in chewing gum. Xylitol containing chewing gum can increases salivary flow which enhances the protective properties of saliva. As the concentration of calcium, phosphate and carbonate are higher in stimulated saliva, plaque pH increase and tooth demineralization is prevented. Higher concentration of these ions in saliva also helps in remineralization of early carious lesion.[23]

Trimetaphosphate ion: It acts by forming a barrier coating on enamel surface which prevents enamel surface dissolution from acid attack and thereby prevents demineralization.[24] The role of sodium trimetaphosphate as a templating analog of dentin matrix phosphoproteins for inducing intrafibrillar remineralization of apatite nanocrystals present within matrix collagen of incompletely resin infiltrated dentin was observed by Gu et al.[25]

Grape seed extract: Grape seed extract contains Proanthocynadin which can inhibits glucosyltransferase enzyme and there prevents carious process. Although it is a promising remineralizing agent, further research is needed to elaborate and establish its role in remineralization.[26]

CONCLUSION

In last few years, treatment modalities for dental caries have been shifted towards preventive and minimally invasive approach which resulted in an increased demand of newer materials that can remineralize the tooth structure. So understanding of these remineralizing agents is very important particularly for the treatment of early carious lesion from a preventive point of view. Although traditionally topical fluoride was the treatment of choice for remineralization of early carious lesion, now-a-days non fluoride remineralizing agents have become popular and seem to be gold standard in near future. Still further studies are needed and more to be explored in clinical field.

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