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Spectrum of Remineralizing Agents and their role in caries management- A Literature Review

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Abstract

Demineralization results from a complex chemistry between bacteria, diet and salivary component. During remineralization, growth of newly formed crystals takes place, and with advancing growth, the crystals fuse with each other to form large crystals with hexagonal outlines. Therefore, the best strategy for caries management is to focus on the methods of improving the remineralization process with the aid of remineralization products.

This literature review includes all the fluoridated and non-fluoridated remineralizing agents and their remineralizing potential.

Keywords: Dental Caries, Remineralization, Demineralization, Remineralizing Agents

Introduction

The primary goal of modern dentistry is to manage non cavitated caries lesion non-invasively through remineralization in an attempt to prevent disease progression and to improve esthetics , strength and function.[1] The first International Conference on novel management of caries and remineralizing agents have suggested that the broad aim of new remineralization therapies should be to "facilitate caries control over a lifetime using evidence-based , clinically effective , multifactorial prevention to keep the caries process in balance" (Pitts and Wefel , 2009). [2]

Fluoride

Multiple systematic reviews on fluoride have confirmed that it remains the gold standard for controlling and arresting caries lesions (Benson et al 2013). The remineralization property of fluoride is limited by calcium and phosphate ions availability, fluoride is more effective on smooth surface caries than pit and fissure caries, and its overexposure can lead to fluorosis. This leads to the need for new age remineralization agents.[3]

CPP-ACP

The use of casein phosphopeptides as an anticariogenic and anti-calculus was first described by Reynolds in 1993 and then amorphous calcium phosphate (ACP) filled methacrylate composite 1996.-5. Pestes et al, in situ study has shown that chewing containing CPP-ACP can significantly enhance mineral precipitation of initial bovine enamel lesions, contributing remarkably in its microhardness recovery.[4]

Dicalcium phosphate dihydrate

Sullivan RJ et al in 1997 stated that Inclusion of DCPD in a dentifrice increases the levels of free calcium ions in plaque fluid, and these remain elevated up to 12 hrs after brushing, when compared to conventional silica dentifrices.[5]

Theobromine

In a comparative evaluation of the remineralizing potential of theobromine and sodium fluoride dentifrice by Amaechi et al in 2013, a significantly higher mineral gain was observed with theobromine and fluoride toothpaste relative to artificial saliva.[4]

Arginine Bicarbonate

The studies on the demineralized bovine enamel blocks by Yamashita et al with arginine and fluoride fomulations have shown that when used in combinations with fluoride, arginine significantly increased fluoride uptake compared with fluoride alone, and lesions treated with arginine containing toothpaste also showed superior fluoride uptake compared with those treated with conventional fluoride toothpaste.[4]

Nano hydroxyapatite

A concentration of 10% nanohydroxyapatite (nHA) is considered to be optimal for remineralization of early enamel caries. Toothpaste containing nHA revealed higher remineralizing effects compared to amine fluoride toothpaste with bovine dentin. An elevated Ca concentration in the remineralizing solution was also observed after a single treatment with the nHA dentifrice.[6]

P11-4 peptide

Schlee et al proved that when P114 is applied to the tooth, the peptide diffuses into the subsurface micropores and forms a 3D scaffold which is made up of small fibres these scaffold mimies proteins found in teeth development and supports hydroxyl apatite crystallization around it to regenerate tooth enamel over a period of 3 months.[7]

Ozone

Ozone therapy has proven to be effective with a wide range of dental applications, including prosthodontics, endodontics, periodontics, surgical procedures and preventive dentistry. It also stimulate remineralization of incipient caries following treatment for a period of about 6 to 8 weeks.[8]

Xylitol

Sano et al mixed three kinds of toothpaste with different contents (500ppm F, 500 ppm F+xylitol, silica based 500 ppm F content), they concluded that 500ppm F+xylitol was superior. Thus adding xylitol to fluoride toothpaste could improve remineralization.[9]

Triclosan

It is an antibacterial agent that could affect biofilm acid production that leads to higher saturation and therefore higher remineralization. There was a statistically significant reduction in coronal and root caries was seen by adding triclosan to dentifrice formulations (riley and Lamont 2013).[10]

Bioactive Glass

Bioactive glass was invented by Dr. Larry hench in 1960. It contains 45wt% SiO2, 4.5wt% Na20 and Cao and 6wt% P2O5. (RA then and now). Nova Min (Calcium Sodium Phosphosilicate) is the trademark

product of Nova Min Technology Inc., which was acquired by Glaxo smith Kline in 2009. The compound is a bioactive glass composed of minerals that naturally occur in the body and reacts when it comes into contact with water, saliva or other body fluids. -1. In vitro and in vivo studies have shown that bioactive glass particles can be deposited onto dentin surfaces and subsequently occlude the dentinal tubules by inducing the formation of carbonated HAP like materials.[4]

Nano bioactive Glass Material

Sheng et al have found that nano BG particles could promote mineral formation on dentin surfaces and they were shown to make dentin more acid resistant.[11]

Sodium TriMet phosphate (STMP)

It Is a condensed inorganic phosphate that is able to strongly bind to phosphate sites on enamel surface and remain adsorbed for a longer time compared to other phosphate (McGaughey and Stowell 1977). Freire et al in 2016, 18 months double blinded RCT showed a 500ppm low fluoride dentifrices supplemented with STMP was significantly superior to a 1100ppm fluoride dentifrice in lowering the caries increment of children.[12]

Proenamel

Proenamel contains 5% potassium nitrate to help relieve tooth sensitivity, has a neutral pH and a low Abrasivity and lacks the detergent sodium lauryl sulphate formally found in dentifrices. The fluoride component is sodium fluoride, giving 0l.15% w/v fluoride ion or 1500ppm, an increase of 50% above conventional dentifrices.[13]

Biomimetically modified mineral trioxide aggregate

The remineralization efficacy of MTA in phosphate containing stimulated body fluid by incorporating polyacrylic acid and sodium tripolyphosphate as biomimetic analogs of matrix proteins for remineralizing caries like dentin was examined and was concluded that biomimetic analog in modified MTA provides a potential delivery system for realization of the goal of biomimetic remineralization of dentin and widens the scope of MTA application in dentistry.[14]

Natural Product

Galla Chinensis, a leaf gall produced by parasitic aphids, which has been found to be effective in inhibiting demineralization, enhancing remineralization, and increasing the efficacy of fluoride (Cheng et al 2008,2010). G. chinensis remineralization is believed to be mediated through different polyphenol compounds that act as Ca2+ ion carriers onto the lesion body.[15]

Hesperidin, a citrus flavonoid and gum Arabic, an Acacia exudate, are other natural product that have been found to suppress acid-dependent demineralization and boost remineralization even under fluoride free conditions.[16]

Grape seed extract

Grape seed extract contains PA, which can visually form insoluble hydroxyapatite complexes when mixed with a remineralizing solution at ph 7.4. Epasinghe et al in 2017 have proved in vitro the synergestic effect of PA when combined with CPP amorphous calcium fluoride phosphate (CPP-ACFP) on remineralization of artificial root caries in which they noticed an enhanced mineral gain and increased the hardness of artificial root caries.[17]

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