



ORIGINAL RESEARCH PAPER

Pedodontics

REMINERALISING AGENTS IN DENTISTRY-A REVIEW

KEY WORDS:

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ABSTRACT

The main component of the human dentition is hydroxyapatite, which is a highly mineralized tissue. The weight of all oral diseases worldwide is exacerbated by dental caries. Caries is not a one-way process that only involves demineralization; rather, it is a cyclical process with stages of both demineralization and remineralization. The intricate interplay between saliva, diet, and bacteria causes demineralisation leading to cavitation. With the aid of the right tools and even non-fluoride remineralization methods, initial non-cavitated lesions can be repaired. Using a range of topical remineralizing treatments, the formation of fluorapatite in enamel and white spot lesions is inhibited and remineralized. The minerals, including ions and hydroxyapatite crystal lattices, are replenished naturally through a process known as remineralization. Putting a strong emphasis on the remineralization concept is the best strategy for managing caries. New mineralization agents have been developed to preserve the enamel's structure and prevent the growth of carious cavities. The goal of modern dentistry is to halt the progression of disease and enhance appearance, tensile strength, and function by remineralizing non-cavitated caries lesions.

INTRODUCTION

The human dentition contains highly mineralised tissues of the body such as hydroxyapatite as the primary constituent. Dental caries add to the burden of all oral illnesses globally[1]. Dental caries is not a unidirectional process involving only demineralization, but it is a cyclic event containing phases of demineralization as well as remineralization. The complex interactions between bacteria, diet, and saliva cause demineralization leading to cavitation [2,3]

Saliva acts as a source for remineralizing the lesions since it includes mineral and fluoride ions. Minerals are lost in the early phases of demineralization at quite a distance that is typically far from the enamel's surface. Often referred to as "white spot lesions," and these lesions in the subsurface appear as a white, opaque patch that may be distinguished out of a healthy enamel. Initial caries refers to this onset of the caries, which initially appears as white spot (WS) and can occasionally develop brown due to pigmentation into the enamel pores[4,5,6]. A natural recovery process called remineralization replenishes the minerals, including ions and hydroxyapatite crystal lattices[7]. The best method for caries management is to focus on the principle of remineralization [8]. This article explains about different remineralising agents and also their mechanism of action in treatment of carious lesions.

REQUIREMENTS OF REMINERALIZATION AGENTS:

An ideal remineralization material must possess the following requirements

- Must work in an acidic pH
- Ions of calcium and phosphate must be transported to the subsurface.
- Calcium should not be delivered in excess
- Should not help in the formation of calculus

- Aid the saliva in remineralizing properties
- Effective in patients with xerostomia[9]

VARIOUS REMINERALISING AND BIOFILM MODIFYING AGENTS ARE

1. Fluorides
2. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP)
3. Bioactive glass
4. Tricalcium phosphate (TCP)
5. Nano HAP particles
6. Beta tricalcium phosphate (TCP)
7. Biofilm modifiers
8. Arginine
9. Triclosan
10. Xylitol
11. Probiotics
12. Herbal compounds[10,11]

1.FLUORIDE

The benefits of fluoride in drinking water following an eruption and the use of topical fluoride to prevent the incidence of dental caries were originally discussed by Arnold in 1957.[12].

The four ways that fluoride works are described by Soi et al. as follows:

Prevention of demineralization because the produced fluorapatite crystals are more acid-resistant than hydroxyapatite crystals.

Acceleration of remineralization by hastening the creation of new fluorapatite crystals, which facilitate the binding of calcium and phosphate ions.

Remaining on dental plaque, oral mucosa, and hard structures in the mouth reduced demineralization and boosted

remineralization. It hinders the development of carious bacteria that create acid by interfering with the production of phosphoenol pyruvate, a necessary step in the glycolytic pathway of bacteria. [13]

a)Fluoride containing dentifrices

The stannous and fluoride ions are provided by stannous fluoride, which possess antibacterial properties. [14] Fowler et al. discovered that toothpaste formulations containing 1426 ppm F (sodium fluoride) or 1400 ppm F (amine fluoride) significantly protected enamel from erosional changes in comparison to a 0 ppm F placebo toothpaste stress in vitro[15] As per Pradubboon et al., using fluoride toothpaste twice a day and 0.05 NaF mouthwash every day effectively accelerates the remineralization of developing caries. [16]

2. CALCIUM PHOSPHATE COMPOUNDS

The dominant form of calcium present in bovine milk is calcium phosphate. As a major integral of Hydroxyappetite crystals, calcium and phosphate concentrations in plaque and saliva play a crucial role in demineralization–remineralization processes of the teeth[17]

A)Enamelon :

Sodium fluoride with phosphate salts and unstabilized calcium can be found in enamelon. In the middle of the toothpaste tube, a plastic divider separates the calcium salts from the phosphate salts and sodium fluoride. It is predicated on the idea that calcium and phosphate ions do not stabilise, allowing them to mix to form an insoluble precipitate. These precipitates when dissolved in saliva releases amorphous calcium fluoride phosphate which promotes remineralisation and inhibit demineralization. [18]

B)Recaldent:

It is available as casein phosphopeptide stabilised amorphous calcium phosphate. It is derived from casein (protein derived from cow's milk.)These ions freely diffuse to enamel subsurface lesions and promote remineralisation[18]

C)Dicalcium Phosphate Dihydrate (DCPD):

DCPD abrasive is well known for fluoride stability and prevention of plaque pH drop when compared to silica. Toothpaste that contains mono fluoro phosphate (MPF) and DCPD was more efficient than MPF/ silica toothpaste[19].

3.BIOACTIVE GLASS

Calcium, sodium, phosphate, silicate, and chlorine make up bioglass (BG). They react when in contact with physiological fluids and begin to build up calcium phosphate on their surface as a result. [20] There are 45% SiO₂, 24.5% Na₂O, 24.5% CaO, and 6% P₂O₅ in a bioactive glass known as NovaMin. Despite physically filling the empty tubules, NovaMin particles bind with the exposed dentin surface and produce a layer of hydroxycarbonate apatite (HCA) that is protective. [21] Although having a minimal cytotoxic effect on dental pulp cells, it as remineralizing effort on both enamel and dentin. Moreover, it assists in the remineralization of teeth and exhibits antibacterial activity against Streptococcus mutans (S. mutans) and S. sanguis. [22]

4. TRICALCIUM PHOSPHATE (TCP)

Dentifrices include tricalcium phosphate, while contacting with the surface of enamel during brushing, releases calcium, phosphate, and fluoride[23].Fluoride alone does not result in as much enamel remineralization or as much acid-resistant mineral as fluoride combined with TCP does[23]. A 5% sodium fluoride varnish and a dentifrice with 5000 ppm sodium fluoride are two products that can be purchased with TCP. Numerous investigations have found that TCP offers greater surface and sub-surface remineralization in comparison to CPP-ACP and fluoride at 5000 parts per million.[24]

5.NANO HAP PARTICLES

In terms of crystal structure and shape, nanoscale HAP (n-HAP) resembles the apatite crystal found in enamel[25]. According to Li et al., 20 nm n-HAP particles are a good fit for the diameters of the nanodefets on the surface of enamel that are brought on by acidic erosion. The demineralized enamel surface is strongly adhered to by the nanoparticles, which also prevent additional acid attack[26]. Because of its poor mechanical and stability qualities and extended mineral formation time (ranging from several hours to days), its clinical applicability is constrained[27].

6.XYLITOL

A nonfermentable sugar alcohol with benefits for teeth called Xylitol has cariostatic and noncariogenic properties. [28]. It is the most commonly used sugar substitute, especially as chewing gums[29].Xylitol has the following abilities :

- Reduction of dental plaque formation
- Reduces the adhesiveness of plaque
- Reduces cavities by up to 80%
- Lowers S. mutans levels
- Significantly reduced caries over the long term (88–93%)
- Promotes enamel remineralization
- Reduces lactic acid generation, which neutralises plaque acids.
- Reduces gum tissue irritation and aids in the management of dry mouth and poor breath.[30]
- It's been noted that utilising a combination of fluoride with xylitol is more efficient than using only fluoride . [31][32][33][34]

7.ARGININE

The calcium carbonate-containing amino acid arginine bicarbonate is more adhesive to the mineralized surface. The mineral in enamel and dentin can be remineralized when calcium carbonate dissolves in the oral cavity and releases calcium. As opposed to this, a small local pH rise may result from carbonate release. [35]

8.TRICLOSAN

Triclosan has a history of reducing root and cervical caries. There is a linear relationship between S. mutant cells uptake of triclosan and the suppression of acid formation. As a result, triclosan's effectiveness depends less on concentration than it does on how many cells are exposed to the dosage used to destroy mutant cells. [36]

9.PROBIOTICS

It is a new way of remineralizing the tooth by decreasing oral bacterial levels there by remineralizing the tooth structure.[37]. The Lactobacillus and Bifidobacterium have been commonly used probiotics in remineralisation.[38]

10.THEOBROMINE:

Theobromine, a xanthine family member found in chocolate (1.89%) and cocoa (240 mg/cup), increases the crystalline structure of enamel [39].

11.HERBAL COMPOUNDS

Tea tree oil (TTO) consists of aromatic volatile hydrocarbons. It has an antimicrobial composition that causes membrane integrity leakage and inhibits bacterial cell respiration[40].

Proanthocyanidins (Pas) are the main component of grape seed extract (GSE), which possesses potent antioxidant and vasodilatory properties., and antiseptic and anti-carcinogenic effects. It also contains a variety of flavonoids that act as scavengers by increasing calcium absorption. It increases collagen stability through polyphenol components (41).GSE promotes the remineralization of demineralized dentin, by its pH and concentration, mainly arising through high polyphenolic content (42). It can also be regarded as a powerful natural treatment for non-invasive removal of

carious lesion(43).

In addition to have no harmful effects, rosemary and ginger rhizomes from natural food sources (*Rosmarinus officinalis* L., *Lamiaceae*, and *Zingiber officinale* Roscoe, *Zingiberaceae*) have antifungal and antibacterial actions on pathogens of the oral cavity [44, 45].

CONCLUSION

According to the findings, initial non-cavitated lesions can be remineralized with the help of suitable technologies and even non-fluoride remineralization techniques. The production of fluorapatite in enamel and white spot lesions is inhibited and remineralized using a variety of topical remineralizing treatments. To maintain the integrity of the enamel and stop the development of carious cavities, new mineralization agents have been created. Contemporary dentistry focuses on the remineralization of non-cavitated caries lesions to stop disease development and improve appearance, tensile strength, and function.

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