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Remineralization Therapy

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Introduction

Dental caries is a multifactorial disease that happens by the combination of dietary sugars, dental biofilm, and the dental tissue of the human. It happens from the periodic changes of demineralization and remineralization at the junction of tooth surface and biofilm.

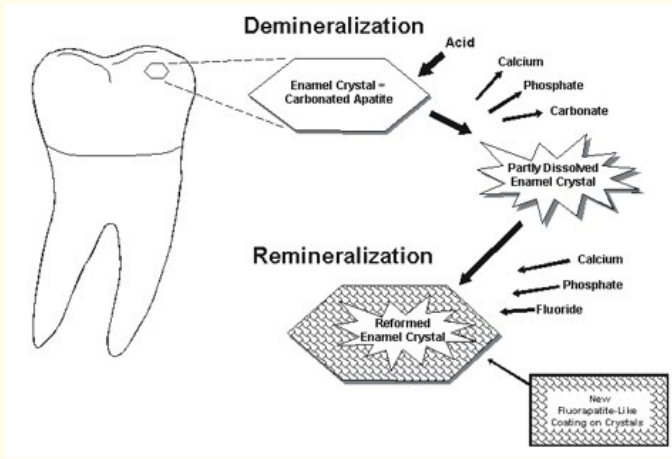
There are two types of carious dentin-infected dentin and inner caries-affected dentin. The dentin-impacted by caries has a varied mineral distribution and the depth of the caries can extend a few hundred of micrometers. The ground substance of the dentin affected by caries is physiologically remineralizable and is not biochemically or physically different from that of sound dentin, in contrast to denatured caries-infected dentin.

Demineralization-Remineralization Cycle.

[1] Demineralization is the process that causes the removal of mineral ions from hydroxyapatite crystals in hard tissues, such as enamel which can lead to dental caries if left unchecked. The remineralization process can reverse the lost calcium and phosphate ions that occur during demineralization.

The amount of accessible calcium and phosphate ions as well as the salivary pH levels that coexist in teeth over an individual's lifetime are some of the factors that indicate the rate of demineralization and remineralization [11]. Dental caries is a potent process caused by an imbalance between demineralization and remineralization pathways.

Since dental caries is a pathological process driven by microbes, some in vitro studies have included antibacterial agents in addition to various biomimetic agents to evaluate the effectiveness of anti-caries against *S. mutans*.



Type 1 collagen is the major protein in dentin which makes about 80-90% of the collagen matrix. These help with the deposition of minerals in dentin remineralization.

[2] Demineralization begins within the crystalline structure of the enamel and will progress toward the dentin. As the lesion advances through the enamel, it starts to damage the hydroxyapatite crystals in a tapered funnel-like shape.

[3] The reverse process of remineralization occurs when the acid ions are neutralized, but Ca2+ and (HPO4)2- ions are maintained. The apatite solution precipitates; in this instance, the composition of the apatite is ascertained by the plaque fluid.

Due to this regular pH cycling, the outer layers of enamel gradually alter chemically, becoming less soluble over time. This phase is called post-eruptive maturation.

The precipitation of calcium and phosphate ions from saliva, plaque, and biofilm back into the enamel is what drives the remineralization process, which depends on pH.

The partially demineralized layer at the tooth-resin interface is susceptible to endogenous matrix metalloproteinases (MMPs) and therefore acts as a site for further caries progression affecting the durability of the restoration [4]. Remineralization of demineralized dentin is an important factor for increasing dentin bonding stability and controlling primary and secondary caries.

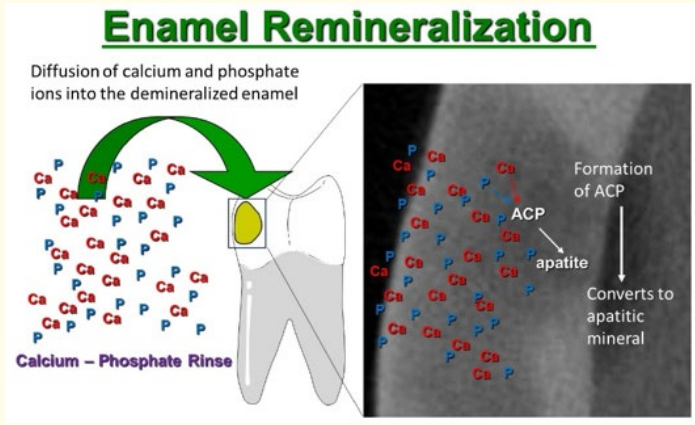
Numerous investigations on the biological regulation of many collagens including intrafibrillar collagen mineralization by noncollagenous proteins resulted from this. The noncollagenous proteins are essential for the mineralization of bone and dentin.

Calcium hydroxide- the Gold Standard for IPT and other potential Remineralizing Agents

[4] The functional role played by collagen in calcium phosphate biomineralization has been deduced based on the results of the past several decades of research.

Over the years, calcium hydroxide has emerged as a gold standard for IPT. The benefits include anti-inflammatory effects, low thermal conductivity, and an ability to act as a buffer against direct restorations.

[5] Calcium and phosphate ions together help in remineralization by increasing the formation of new fluorapatite crystals. The formation of phosphoenol pyruvate is interrupted, which is an intermediate in the glycolic pathway of bacteria.



[5] Calcium, phosphate, and fluoride ions play an important role in the battle between demineralization and remineralization processes and accordingly modify the susceptibility of the tooth to caries progression.

Enamel, dentin, and cementum release phosphate after the release of calcium ions during demineralization. Therefore, it would be more effective to block the demineralization process with calcium rather than phosphate.

Since calcium hydroxide is alkaline, it promotes pulp-dentin remineralization and reduces bacterial infection, making it an effective treatment for damaged dentin.

Cements containing calcium hydroxide are used for direct pulp capping procedures or to line specific areas of cavities. These cements are beneficial for indirect pulp-capping procedures involving carious dentin because of the antibacterial properties of calcium hydroxide.

[6] Its primary function is probably antibacterial in most clinical situations, with the added benefits of cauterizing activity and high pH, also in the consistency of a paste, it physically restricts bacterial colonization of the canal space [10]. Calcium hydroxide is applied as a thick, creamy suspension in sterile water, saline, and a variety of other, viscous or oily vehicles.

[9] The mineral trioxide aggregate (MTA) is a dental material that is biocompatible with orofacial tissues. It seems to come closest to our goal of the formation of a natural dentinal bridge across the exposed pulpal tissue. The properties of MTA are biocompatibility, good sealing properties, antimicrobial activity, and the ability to set in the company of moisture blood, and saliva.

Plant-based products are being used because of their antimicrobial, anti-inflammatory, analgesic, and sedative properties [12]. A plethora of literature studies reveal the potential of anticaries activity of some herbal products, which have been proposed as viable substitutes to conventional therapeutic remineralizing agents. The dentin hypersensitivity symptoms are removed by the remineralization method, which mechanically occludes the exposed dentinal tubules and decreases their permeability.

Methods to Measure Remineralization of Dentin

Energy dispersive X-ray analysis was used to determine calcium and phosphorus content in % weight of sound, demineralized, and remineralized enamel.

[8] A spectrum of the energy vs. relative counts of the detected X-rays is obtained and evaluated for qualitative and quantitative determinations of the elements present in the specimen using a computer-based program.

SEM, on the other hand, aids in reading surface topographical changes seen on enamel caused by the mineral deposition [7].

Microhardness test is another way to measure the remineralization of dentin, which includes Knoop, Vickers, and Rockwell tests. These are used to analyze the depth of penetration. When the depth of penetration is less, it is indicative that the material has good remineralization potential.

Conclusion

With the recent advances seen in the field of restorative dentistry, the focus has been shifted to a more conservative approach, one of which is the remineralization process.

This is a more radical and optimal way to remineralize the lost dentin. This method works by correct non-restorative treatment, and identification that saves time, manpower of the dentist, and the morbidity of the patient.

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