In Vitro Study for Effect of Different Desensitizing Agents on Dentin Remineralization

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List of Contents

List of Tables

List of Figures

Pain and discomfort due to hypersensitivity is one of the most common dental complaints. Dentine hypersensitivity has been defined as short, sharp, severe pain associated with external thermal, tactile, or chemical stimuli of patent dentinal tubules which results in the movement of dentinal fluid within the tubule in accordance with the hydro dynamic theory that result in pain. [1,2]

Dentine may be exposed to the oral environment as a result of trauma, caries, gingival recession, tooth fracture, wear and abrasion which leads to hypersensitivity.[3] One of the major etiological factors that cause exposure of the dentinal tubules are the dietary acids that eliminate large amount of minerals covering dentin and initiate dentin hypersensitivity. [4] The consumption of high amounts of acidic foods and drinks due to the change in lifestyle in the last decade might be responsible, for the loss of tooth structure. Dental erosion is a common phenomenon that causes dissolution of dental hard tissue by acids regardless the presence of bacterial activity. [5,6]

To overcome this problem, several methods were established to decrease the probability and prevent dentin hypersensitivity, either by physical occluding of dentinal tubules, which was considered the most widely used treatment modality; or by chemically blocking the neurotransmitter in the tissues, through depolarizing the nerve synapse [7,8]Furthermore, dentine is more soluble than enamel under acidic attacks. As a result, some materials were introduced in our field as bioactive agents based on milk products which have the ability to release some components enhancing the remineralization of the enamel and dentine casein phospopeptide-amorphous calcium

phosphate (ACPF) through maintaining super saturation of the minerals.[9,10]

Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) has been already proven to prevent enamel demineralization and promotes remineralization of subsurface enamel lesions in animal and human in situ caries models. [10] The effect of CPP-ACP material on dentin also was proved, intensely increasing the remineralization of dentin surface when compared with normal dentin in vitro.[11]

Tooth pastes were also used to prevent demineralization of minerals from the tooth surface and occlude the opened dentinal tubules specially those types with large amount of fluoride.[12] Tubular occlusion can be also achieved with hydroxyapatite tooth pastes.[13]

Accordingly this research was conducted to enlighten our look towards the effect of some remineralizing agents and their ability to block dentinal tubules, as a result reduce dentin hyper sensitivity

Dentine is a collagenous structure containing approximately 70% inorganic minerals, 20% organic substances and 10% water.[14] Minerals are primarily composed of hydroxyapatite crystals, and the organic substances are mainly Type I collagen (about 90 wt%) and non-collagenous proteins (about 10 wt%).[15] The loss of mineral from enamel surface leads to exposed dentin that causes dental symptoms as pain and sensitivity. Thus, some active ingredients are used which desensitize nerves an enhance dentinal tubal occlusion.[16-17-18]

The procedure in which calcium and phosphate ions are externally provided is known as remineralization; ions precipitate into crystal voids in demineralized hard tooth structure to produce net mineral gain. Fluoride is considered the corner stone in the remineralization process, but their ability to promote net remineralization is limited by the availability of calcium and phosphate ions.[19,20]

Fluoride can produce fluoridated hydroxyapatite or promote transformation of calcium and phosphate ions to fluoroapatite crystals that highly resist acid dissolution. A study conducted LeGeros RZ proved that better result were obtained when 50% of hydroxyl group were replaced by fluoride.[21]

The continuous drop of enamel and dentin pH produces structural changes starting with demineralization, followed by widening of dentinal tubules and increase in the diffusion rate.[22,23]

Tooth pastes are the most commonly used material to treat and prevent hypersensitivity, different tooth pastes have different mode of

action: either physical occlusion of dentinal tubule or nerve depolarization to avoid dentin exposure following acid attack.[24] The contemporary available tooth pastes based on the process of occlusion technology include Sensodyne that is composed of (5%w/w Potassium nitrate, 0.315% Sodium, 1450 ppm fluoride).[25]

Multiple studies have compared the effect of different tooth pastes and their ability to induce the dentinal tubule occlusion and mineralization after demineralization by dietary acid.[26-27] in vitro study by **Absi et al., 1995,**[28] investigated dentine hypersensitivity using EMS in order to define the toothpaste mineral uptake by the dentine surface and the retention of minerals when tested after washing with water or orange juice. All remineralizing agents were seen to leave variable residues on the surface of etched or unetched dentine specimens. Additionally the application of brushing process leaves some smear layer with the closure of previously opened tubules. Washing with water and more particularly orange juice removed most residues and orange juice etched the dentine to open previously closed tubules. They found that only one product with an artificial silica abrasive was resistant to both water and orange juice washings and in a pilot experiment showed some penetration into tubules not seen with another desensitizing product. These findings was suggested that some abrasives may be usefully employed in desensitizing products, but without consideration of erosive factors in the etiology of dentine hypersensitivity recurrences of the condition will be common.

Schiff et al., 2000,[29] evaluated the effect of new dentifrice containing 5.0% potassium nitrate and 0.454% stannous fluoride in a silica base (Colgate Sensitive Maximum Strength) for decreasing dentin hypersensitivity over an 8-wk period, as compared to that provided by a commercially-available antihypersensitivity dentifrice containing 5.0% potassium nitrate and 0.76% sodium monofluorophosphate in a dicalcium phosphate base (Fresh Mint Sensodyne dentifrice). They decided that Colgate Sensitive Maximum Strength dentifrice provided superior levels of control of tactile and air blast sensitivity than did the clinically tested, commercially-available Sensodyne anti-hypersensitivity dentifrice

Gill am and et al., 2002,[30] studied dentine sensitivity (DS) using bioactive and biocompatible glasses which are known to induceosteogenesis in physiological systems. They used tooth paste construction containing a modified bioglass material replacing part of the abrasive silica component. (SEM) as an analyzing tool revealed occluded dentine tubules. They concluded that the inclusion of bioactive glass particles was effective agent for the treatment of dentine sensitivity.

West et al., 2002,[31] examined the surface morphological changes of etched and un etched dentine, and studied the effects of tooth brushing with and without toothpastes. The brushed etched specimens showed that time and the types of treatment were crucial factors on the dentinal tubule occlusion. The artificial silica based paste was significantly superior for all time intervals in blocking the dentine tubules.

An in vitro study conducted by **Prati et al., 2002,** [32] assessed the dentin morphology and permeability after brushing with different toothpastes in the presence and absence of smear layer. They found that dentin permeability was reduced by brushing procedures when the smear layer was absent, but it was increased when the smear layer was present. Toothpaste application reduced dentin permeability when no smear layer was present on the top of the surface, but modified and increased permeability of samples with smear layers. SEM observations demonstrated the presence of dentifrice particles on dentin surfaces and inside dentinal tubules, and this may be responsible for the observed reductions in permeability. They concluded that dentin permeability and morphology are significantly affected by tooth brushing and by the type of dentifrice used.

Arrais and et al., 2003,[33] examined the dentin tubule occlusion usingthree commercial available dentifrices (Sensodyne, Emoform and Sorriso) with Scanning Electron Microscopy. Fifty cervical areas from buccal and lingual surfaces of sound third human molars were used. Enamel was removed to bare the dentin surfaces furthermore was polished with diamond bur. Samples were separated into five groups (n=10): G1-no brushing; G2-brushing without dentifrice; G3-brushing with Sensodyne; G4-brushing with Emoform; G5-brushing with Sorriso. Brushed specimens were treated for 4 minutes per day, for 7 days in a tooth brushing machine. SEM was used for calculation of the amount of occluded tubules, X-ray microanalysis also used. They concluded that the use of all dentifrices occluded tubules more than no brushing and brushing without dentifrices groups.