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CALCIUM SODIUM PHOSPHOSILICATE : A PROMISING DESENSITIZING AGENT

[1] Ramoji Rao M.V. [1] Professor and Head
[2] Swathi D. [2]Intern

[1,2] *Drs. Sudha & Nageswara Rao Siddhartha Institute of Dental Sciences, Chinnaoutpalli, Gannavaram, Vijayawada, Andhra Pradesh– 521286.*

ABSTRACT

Dentinal hypersensitivity is a common and chronic condition affecting the teeth in a stable percentage of population. Success with treatment of this condition has been limited at best. A new dentifrice containing Calcium Sodium Phosphosilicate material has been developed that results in a significant amount of tubule occlusion reducing tooth hypersensitivity. In this article, Calcium Sodium Phosphosilicate containing dentifrice, which is showing promise is analyzed, based on evidences.

KEY WORDS **:** Hypersensitivity, Dentinal tubule, Calcium sodium Phosphosilicate

INTRODUCTION

Dentine Hypersensitivity is short, sharp pain arising from exposed dentine. It occurs typically in response to chemical, thermal or osmotic stimuli and cannot be explained arising from any other dental defects or pathology [1]. Hypersensitivity is a common problem and estimates vary widely as to its prevalence. Some reports estimate that approximately 20% to 40% of adults suffer from dentine hypersensitivity. The incidence of tooth hypersensitivity increases with age and is attributed to the general increase in exposed root surfaces of the teeth from periodontal diseases, toothbrush abrasion, or cyclic loading fatigue of the thin enamel near the cementoenamel junction [2-4].

Mechanism of Hypersensitivity

The currently accepted theory for tooth hypersensitivity is the hydrodynamic theory proposed by Brannstrom [5-6]. This theory was based on the belief that open dentinal tubules allow fluid flow through the tubules, which excites the nerve endings in the dental pulp. Clinical replicas of sensitive teeth viewed under a Scanning Electron Microscope (SEM) reveal varying number of open or partially occluded dentinal tubules[7]. These studies have also shown that in patients with dentin hypersensitivity, there are a greater number of tubules per area and the diameter of the tubules is greater than in patients with no sensitivity [8- 9].

Home Management of Hypersensitivity

There are two basic approaches to the treatment and prevention of dentinal hypersensitivity. The first approach is to treat the tooth with a chemical agent that penetrates into the dentinal tubules and depolarizes the nerve synapse, which reduces sensitivity by preventing the conduction of pain impulses (e.g. potassium nitrate)[10-11]. The second approach is to treat the tooth with a chemical or physical agent (e.g., potassium oxalate, ferric oxalate, strontium chloride) that creates a deposition layer and mechanically occludes dentinal tubules, reducing sensitivity by prevention of pulpal fluid flow[12-14]. Although both approaches are effective at reducing or eliminating hypersensitivity, the duration of relief is highly variable. Hypersensitivity usually reappears due to toothbrush abrasion, the presence of acid challenges in the mouth, and/or degradation of the coating material [12,15-20]. Therefore, there is a need in the dental field for a material that chemically reacts with the surface of dentin, intimately adhere to tooth structure and significantly reduce the possibility of reopening dentinal tubules.

Calcium Sodium Phosphosilicate

Calcium Sodium Phosphosilicate is a bio-active glass in the class of highly biocompatible materials that were originally developed as bone

regenerative materials[21]. These materials are reactive when exposed to body fluids, and deposit hydroxycarbonate apatite, a mineral that is chemically similar to the mineral in enamel and dentin [21-22]. When incorporated into a dentifrice, particles are deposited onto the dentin surface to mechanically occlude dentinal tubules.

Mode of Action of Calcium Sodium Phosphosilicate

The physical occlusion of Calcium Sodium Phosphosilicate particles begins when the material is subjected to an aqueous environment. Sodium ions (Na^+) in the particles immediately begin to exchange with hydrogen cations (H^+ or H_3O^+) [21]. This rapid release of ions allows Calcium (Ca^{2+}) ions in the particles structure, as well as Phosphate (PO_4^{3-}) ions to be released from the material. This initial series of reactions occur within seconds of exposure, and the release of the calcium and phosphate ions continues as long as the particles are exposed to the aqueous environment. A localized, transient increase in pH occurs during the initial exposure of the material due to the release of sodium. This increase in pH helps to precipitate the calcium and phosphate ions from the Calcium Sodium Phosphosilicate particle, along with calcium and phosphorus found in saliva, to form a calcium phosphate (Ca-P) layer. As the particle reactions continues and the deposition of calcium and phosphorus complexes continue, this layer crystallizes into hydroxycarbonate apatite which is chemically and structurally equivalent to biological apatite [23]. The combination of the residual Calcium Sodium Phosphosilicate particles and the hydroxycarbonate apatite layer results in the physical occlusion of dentinal tubules, which relieves hypersensitivity.

Calcium Sodium Phosphosilicate - Evidences from Studies

Calcium Sodium Phosphosilicate products have received approval from the Food and Drug Administration. Numerous studies have focused on the decrease of sensitivity following the occlusion of open dentinal tubules. Most of these studies have used Scanning Electron Microscope to show the patent tubules before treatment and the occluded tubules after treatment [2]. A clinical study from China,[24] comparing 5% Calcium Sodium Phosphosilicate - containing toothpaste to a Strontium Chloride positive control, showed that Calcium Sodium Phosphosilicate - containing toothpaste performs as well as or better than the positive control with respect to rapid relief of tooth hypersensitivity after two weeks and six weeks of daily use [24].

Leonard Litkowski[25] evaluated bioglass as dentrifrice ingredient capable of reducing tooth hypersensitivity through a mechanism of tubule occlusion. In his clinical study with cold air and tactile measures, showed significant reductions from baseline for test and control groups. The formulation with 7.5% Calcium Sodium Phosphosilicate significantly outperformed the control [25].

In 2006, Burwell compared the use of DenShield, a dentifrice consisting of Calcium Sodium Phosphosilicate, with GC Tooth Mousse (containing Recaladent – caseinophosphopeptides-colloidal amorphous calcium phosphate) on bovine root surfaces in a pH-cycling model. After 10 days, the number of occluded dentinal tubules (as observed on SEM) was greater with DenShield than with the Tooth Mousse [26].

CONCLUSION

Current information supports blocking of dentinal tubules (either long term or short term) results in relief of sensitivity. This is in concurrence with Brannstrom's theory of hydrodynamic fluid movement in the tubules causing sensitivity (Brannstrom, 1963). All studies with Calcium Sodium Phosphosilicate containing dentifrices consistently showed that they are capable of significantly reducing hypersensitivity. Though these results are promising, further clinical trials are necessary to prove that Calcium Sodium Phosphosilicate is an ideal desensitizing agent.

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Corresponding Author

Dr. M.V.Ramoji Rao
Professor and Head
Drs. Sudha & Nageswara Rao Siddhartha Institute of Dental Sciences
Chinnaoutpalli,
Gannavaram – 521286,
Andhrapradesh.
Ph.No. +919848021426, Fax No. 08676-257368,
sidsprincipal@yahoo.co.in