An Overview Of OTC Dentifrices in The Treatment of Dentinal Hypersensitivity

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Abstract:
The second most common dental condition of concern to patients is dentin hypersensitivity. Removal of cementum or enamel leaves the dentin exposed allowing various stimuli to produce fluid movement through the dentinal tubules. When thermal, tactile, osmotic and mechanical stimuli, such as tooth brushing, sweet and sour foods, and hot or cold beverages/water, are applied to the exposed dentin, patients feel a short sharp pain which is termed dentin hypersensitivity. This review discusses the potent over the counter dentifrices used for treatment of dentin hypersensitivity.

Keywords: Dentin hypersensitivity, potassium nitrate, strontium acetate, stannous fluoride, ProArgin, Novamin

Introduction

Removal of cementum or enamel leaves the dentin exposed allowing various stimuli to produce fluid movement through the dentinal tubules.¹ Dentin hypersensitivity is best defined as a short sharp pain arising from exposed dentin in response to stimuli typically thermal, evaporative, tactile, osmotic, or chemical, and which cannot be ascribed to any other form of dental defect or pathology.² Dentinal hypersensitivity has been shown to peak in 20 to 30 year olds and then rise again when in their 50’s.³ The condition generally involves the facial surfaces of teeth near the cervical aspect and is very common in premolars and canines.⁴ Various therapeutic approaches have been investigated to treat this problem. There are a number of products that have been formulated for either in-office or over-the-counter (OTC) applications. These treatment options may be broadly classified into of the two major approaches: the interruption of the neural response to pain stimuli, or the occlusion of exposed and open tubules to block the hydrodynamic mechanism of pain stimulation.⁵

Diagnosis

The reason for tubules to be exposed or open should be assessed during a visual examination of the teeth as well as a detailed dietary history. Useful diagnostic tools are the air/water syringe (thermal), dental explorer (touch), percussion testing, bite stress tests, and other thermal tests such as an ice cube and assessment of occlusion. A comprehensive dental examination will ultimately rule out other underlying conditions for which sensitivity is a symptom such as cracked tooth, fractured restoration, chipped teeth, dental caries, gingival inflammation, postrestorative sensitivity, marginal leakage, and pulpitis. Excessive intake of dietary acids such as citrus juices and fruits, carbonated drinks, wines, and
The dietary history provided by the patient can assist in identifying the risk factors the patient may have for tooth sensitivity. In addition, other risk factors need to be ruled out during examination such as toothbrush abrasion, chemical erosion, thin enamel, gingival recession, exposed dentin, and eating disorders. The patient can assist in diagnosis by identifying the pain initiating stimulus i.e., thermal, tactile, etc., as well as by describing the nature of pain. The response to stimulus varies from patient to patient. Factors such as individual pain tolerance, emotional state, and environment can contribute to the variety of responses between and among patients.

However, the scientific understanding of dentin hypersensitivity has progressed sufficiently for the dental professional to embrace a comprehensive six-step approach to the management of a patient’s sensitivity: 1) correct diagnosis of dentin hypersensitivity based upon history and clinical examination; 2) differential diagnosis to exclude other conditions giving rise to similar pain symptoms; 3) treatment of all secondary conditions with symptoms similar to dentin hypersensitivity; 4) identification of etiologic and predisposing factors, particularly dietary and oral hygiene habits, that predicate erosion and abrasion; 5) removal or minimization of etiologic and predisposing factors through dietary advice and oral hygiene instruction; and 6) recommendation or provision of treatment based upon individual needs.

Flow chart 1: Treatment strategy of Dentine Hypersensitivity/Root Dentine Sensitivity by Dental Practitioners.
Management
Irrespective of the cause of dentine hypersensitivity, it is important that the relevant advice is provided in order to prevent or minimize further damage to the exposed root surface. This may involve counselling patients with regard to their intake (especially frequency) of acidic fruits and beverages with low pH, particularly in relation to when the teeth are brushed (before/after meals) as well as information on correct brushing procedures (and type of brush). The treatment strategies for dentinal hypersensitivity include nerve desensitization by using potassium nitrate, anti-inflammatory agents (corticosteroids), plugging dentinal tubules (ions/salts: calcium hydroxide, ferrous oxide, potassium oxalate, sodium monofluorophosphate, sodium fluoride, sodium fluoride strannous fluoride combination, stannous fluoride, stronium chloride), protein precipitants (formaldehyde, glutaraldehyde, silver nitrate, stronium chloride hexahydrate), dentine sealers (glass ionomer cements, composites, resins, varnishes, sealants, methyl methacrylate), periodontal soft tissue grafting, crown placement/restorative material, lasers.

Historically, desensitizing therapies have been classified depending upon whether they are available over-the-counter (OTC) or applied In-Office (P); based on their chemical or physical properties and more recently as to whether they are reversible or non-reversible in nature. Generally speaking, these products may be in the form of dentifrices or gels and mouth rinses or in the form of topically applied agents such as resins, varnishes, primers, dentine bonding agents as well as periodontal grafting procedures and laser application. According to Pashley, In-Office restorative products are broadly defined as those treatment products that do not polymerize such as varnishes and precipitants and those agents that undergo setting or polymerization reactions such as conventional and resin-reinforced glass ionomer cements and adhesive resin primers.

Potassium Salts:
The vast majority of desensitizing toothpastes contain 2% potassium ion to “numb” the pain of dentin hypersensitivity. Atleast 10% of the toothpastes available in the market today for management of dentin hypersensitivity are based on potassium salts. The reason for this is that potassium salts have been shown to interrupt the neural response to pain stimuli, and are clinically proven to provide relief from the pain of dentin hypersensitivity. These ions have a direct impact on nerve excitability. By increasing the potassium ion concentration adjacent to the dentinal nerve terminals, there is depolarization and activation of nerve fibres. A prolonged period of depolarization results in inactivation of the action potential. Divalent cation solutions stabilize the nerve membrane without changing the membrane potential. Most potassium-based toothpastes contain other ingredients to provide additional benefits, such as fluoride for cavity protection, antibacterial ingredients for plaque and gingivitis control, and crystal inhibitors and high cleaning abrasives for tartar control and whitening, respectively.

Strontium Salts: Strontium-based toothpaste occludes dentin tubules and it was the first tubule blocking agent used in toothpaste, being introduced under the brand name Sensodyne® approximately fifty years ago. Because of its incompatibility with fluoride, the product was fluoride free. The present strontium based pastes also contain fluoride, and to make the strontium salt compatible with fluoride, strontium acetate in 8% concentration is used. A toothpaste containing 8% strontium acetate and 1040 ppm available fluoride as sodium fluoride in a silica base is marketed as Sensodyne
Rapid Repair®. Mason et al investigated the ability of strontium based toothpaste to that of a control containing 1450 ppm fluoride alone. The results of the study suggested that strontium based toothpastes may be more effective in relieving sensitivity immediately compared to fluoride based toothpastes. Hughes et al compared the efficacy of strontium acetate toothpaste to that of 8% Arginine toothpaste and concluded that there is no significant difference in efficacy between the strontium acetate toothpaste and the Arginine based toothpaste.

**Stannous Salts:**
Stannous fluoride has a long history of use in oral care products for protection against caries, pathogenic bacteria, plaque, gingivitis, hypersensitivity and breath malodor. Chemical precipitation of stannous ions occludes the dentinal tubules, thus preventing the stimulation of free nerve endings. Stannous fluoride 0.454% has been clinically shown to reduce hypersensitivity in various product forms. A dentifrice formulation combines stannous fluoride with sodium hexametaphosphate (SHMP) and silica (Crest R Pro Health) provides a broad range of additional therapeutic and cosmetic benefits in addition to the control of dentin hypersensitivity. Advancements in dentifrice technology has made it possible to combine stabilized stannous fluoride with SHMP which has substantial anticalculus and extrinsic whitening effect and delivers the advantage of each individual ingredient.

Pro Argin Technology and the role of Saliva in the Natural Process of Tubule Occlusion.
Saliva contains calcium and phosphate ions and can contribute to the formation of mineral deposits within exposed dentinal tubules. In nature, saliva forms a surface-protective layer of glycoprotein with calcium and phosphate that slowly induces dentin occlusion and tubule plugging, and results in sustained relief of dentin hypersensitivity over the long term. Based on pioneering research on this natural process by Kleinberg, a new technology comprising 8.0% arginine and calcium carbonate, known as Pro-Argin, has been developed and validated as both an in-office desensitizing treatment, as well as a daily-use toothpaste. The Arginine component triggers physical adherence of the calcium carbonate to the exposed dentin surface and the inner surface of the dentinal tubules. This then induces deposition of calcium and phosphate rich material on the dentin surface and occludes within the dentinal tubules.

The in-office desensitizing paste with Pro-Argin technology has been clinically proven to provide instant sensitivity relief when applied with a prophy cup after professional cleaning procedures, and that the benefit of a single treatment lasts for at least 28 days. Further, this desensitizing paste has been clinically proven to provide instant relief of dentin hypersensitivity when applied using the same procedure prior to dental prophylaxis. The desensitizing toothpaste (Colgate Sensitive Pro Relief) combines the innovative Pro-Argin technology with fluoride to provide a significant advance in the everyday treatment of dentin hypersensitivity. Docimo et al. in an eight-week clinical study, compared the efficacy of three commercially available toothpastes on dentin hypersensitivity reduction and concluded that if Colgate Sensitive Pro-Relief Toothpaste, is used twice daily, significantly reduces dentin hypersensitivity, and is significantly more effective in reducing dentin hypersensitivity than Sensodyne Rapid Relief Toothpaste and Crest Cavity Protection Toothpaste.

NovaMin Technology:
The focus of present research is on treatment of underlying cause of dentin hypersensitivity and not merely symptomatic management in the form of tubule occlusion or nerve desensitization.
Increasing the mineral density of the exposed dentin surface can make it more resistant to erosion and abrasion or alternatively sealing the open dentinal tubules with calcium and phosphate containing dentin like substance can achieve this aim. NovaMin is amorphous Sodium Calcium Phosphosilicate (CSP) that was developed as a fine particulate to occlude dentin tubules. When subjected to an aqueous environmental release calcium and phosphate ions and a transient localized increase in pH occurs that cause precipitation of Calcium and Phosphate ions to form a calcium phosphate layer. This complex crystallizes into Hydroxyapatite layer and physically occludes the tubules thereby relieving dentin Hypersensitivity. 5% CSP is not only significantly effective in treatment of dentin hypersensitivity but can also maintain its effects even after discontinuation. Also both fluoridated and non fluoridated prophylaxis pastes containing CSPS (NovaMin) provided a significant reduction of dentin hypersensitivity up to at least 28 days. This may be achieved by two methods - increasing the mineral density of the dentin surface making it possible to improve its resistance to wear by both acid erosion and abrasion. Second, plugging and sealing open tubules with a calcium and phosphate containing dentin-like substance, which would block diffusion through the tubules into the dentin sub-surface, thereby increasing acid resistance. This “biomimetic: approach will make the dentin non-sensitive and sclerotic. More recently, calcium phosphor silicates, have been shown to have the potential to release calcium and phosphate on exposure to an aqueous environment. Bioactive glass particles in a specially formulated dentifrice were also shown to occlude dentin tubules, offering substantial relief of sensitivity. The commercially available bioactive glass based toothpaste is NovaMin. Some examples of desensitizing dentifrices that carry the American Dental Association (ADA) Seal of Acceptance for prevention of tooth sensitivity are Crest Pro-Health Toothpaste, Crest ProHealth Night Toothpaste, Crest ProHealth Whitening Toothpaste and Sensodyne Fresh Impact Toothpaste. A few fluoride desensitizing products (e.g. Gel-Kam 0.4% SnF2) sold through a dental professional also carry the seal. There are several other dentifrices available over-the-counter for consumers to purchase that also claim they reduce tooth sensitivity that do not carry the ADA seal. In addition, the literature mentions fluoride, gels, varnishes and sealants as a possible treatment for dentinal hypersensitivity.

Conclusion
Dentin hypersensitivity may be considered an enigma. The pain is of a sharp nature and patients approach the dentist for permanent relief. The advantages of using an OTC product readily available for the treatment of dentin hypersensitivity by the consumer compared with attending a practitioner for treatment include ease of access, expense, etc. One disadvantage is that OTC desensitizing products may take up to 2–4 weeks to relieve symptoms whereas in theory a practitioner-applied therapy ideally may provide immediate relief of discomfort.

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