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Be sensitive: Towards sensitive tooth

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Abstract

Dentinal hypersensitivity is one of the most common problems impacting on the patient's everyday activities. There are various treatment options available which can be used at home or may be professionally applied. But there are no universally accepted guidelines for reliable treatment that provides immediate relief with long lasting effect. Available desensitizing agents provide only temporary relief. The search is on which has led to invention of products that provides advantage of being more effective and convenient to use. Thus, the aim of the short review is to provide information about the advances like site-targeted Strips layered with an oxalate-containing gel, compact handheld laser emitting toothbrush, propolis varnish, sodium tripolyphosphate and arginine containing tooth paste which holds a promising future in management of dentinal hypersensitivity.

Keywords: Dentinal hypersensitivity; Low Level Laser Toothbrush, Sensi-Stop Strips, Propolis, Sodium tripolyphosphate, Arginine.

Introduction

Dentinal hypersensitivity (DH) is a very common clinical condition and becoming more prevalent. It is mainly caused by an osmotic, tactile, chemical, thermal or evaporative stimulus which causes the movement of dental fluid within the tubules. According to Holland et al, DH is defined as a "short, sharp pain arising from exposed dentin in response to stimuli, which are usually thermal, evaporative, tactile, and osmotic or chemical that usually cannot be attributed to any other form, dental defect or pathology." Usually, the pain is localized and of short duration[1]. Pain of the DH is differ from pulpal pain, which is protracted, dull, aching, poorly localized, and lasts longer than the applied stimulus. There are number of theories of which Brannstrom hydrodynamic theory is most widely accepted [2,3].

DH is capable of affecting the oral care of any individual; and more prevalent in the age group of 20–50 years and approximately 1%–98% of the population[3,4]. It has been stated that DH develops in two phases: (1) Lesion localization: It occurs due to exposure of dentin which

leads to exposing it to external environment. Factors for lesion localization includes acidogenic diets, destructive habits, poor tooth brushing techniques, erosion, abrasion, abfraction, attrition, bruxism, bleaching, medication, aging, genetic conditions, gingival recession and periodontal disease or procedures. (2) Lesion initiation: It occurs after the protective covering of cementum and smear layer is removed. All of these conditions exposed dentinal tubules, which creates an environment in which stimuli cause dentinal tubular fluid movement that activates nerve fibers, causing DH. DH can be localized or generalized and may affect a variety of tooth surface either together or individually[5].

Treatment

DH lacks a clinically proven efficient treatment modality which could be termed as the gold standard. Various forms of desensitizers are available and it is often best to use a combination of different desensitizers. Recent advancements such as lasers should be tried to obtain to maximize the effect. If desensitizers cannot relieve the pain, then restorative materials may be used to seal the dentin. Root canal therapy should be the last choice of treatment[6].

Management Strategy

Management of DH is to make correct differential diagnosis; the description of pain by the patient must be assessed carefully. Pain of the DH short, sharp arising from exposed dentin in response to stimuli which is differs from pulpal pain. For patients who are suffering from DH, dentists can provide valuable advice to prevent or reduce the clinical symptoms. The most commonly treatments include anti-inflammatory agents, protein precipitants, tubule-occluding agents and tubule sealants. The most conservative approach should be implemented initially, with more aggressive treatments suggested if relief is not achieved[1].

Canadian Advisory Board proposed diagnosis and management of DH which can be classified as localized or generalized. An isolated, in-office approach can be adopted for the localized form, whereas the use of home-care products for generalized forms[7]. At home desensitizing products include mouthwashes, toothpastes and chewing gums. In-office desensitizing products can be found in the form of varnishes, gels, solutions, resin sealants, glass ionomers and dentin adhesives. In-office desensitizing treatments also include more sophisticated laser techniques. Among the numerous treatment options, the most frequently used are nerve desensitization, covering or plugging of the tubules or a combination of both, especially in cases with minimal or no tooth loss (i.e. no obvious erosive defects or gingival recession). The active compounds found in desensitization products could either block the openings of dentinal tubules or might directly desensitize the pulpal nerves[4].

Potassium nitrate

Potassium salts were thought to decrease the excitability of pulpal nerves and result in a reduction in DH. Claire Hall et al (2019) suggested that twice-daily use of a 3% potassium nitrate mouthrinse, adjunctive to tooth brushing with fluoride toothpaste, provided significant improvements in DH compared with fluoride toothpaste alone[8].

Formaldehyde or Glutaraldehyde

The proposed mechanism for glutaraldehyde involves the reaction with serum albumin in dentinal tubule fluid, leading to precipitate formation within tubules, and subsequent narrowing or blocking of the tubules. These agents should be used with extreme caution, as they are strong tissue fixatives[9].

Strontium-containing dentifrices

The strontium salts like acetate or chloride, penetrate the tubules & occlude them. This reduces the DH by

preventing the fluid movement. Saeki K et al (2016) suggested that strontium acetate have the ability to occlude dentinal tubules[10].

Fluorides

Fluoride ions decrease the dentinal permeability by precipitation of calcium fluoride crystals inside the dentinal tubules. The improvement with fluoride appears to be due to an increase in the resistance of dentin to acid decalcification as well as due to precipitations in the exposed dentinal tubules. Various fluoride formulations are used to treat DH. These include sodium fluoride, stannous fluoride, sodium mono-fluorophosphate, fluorosilicates and fluoride combined with iontophoresis[11, 12].

Casein phosphopeptide –amrphous calcium phosphate

It is water based topical cream, sugar free with bioavailable calcium and phosphate, in the form of casein phosphopeptides-amorphous calcium phosphates (CPP-ACP; GC Tooth Mousse) [12]. Studies reported that it neutralize acids from acidogenic bacteria and from other sources. Casein phosphopeptide-amorphous calcium phosphate fluoride, (CPP-ACPF; GC Tooth Mousse Plus) a complex derived from the milk protein with fluoride addition has been introduced as a remineralizing agent. CPP-ACPF promotes deposition of high concentrations of calcium, phosphate and fluoride ions occluding the dentinal tubules and reduces the DH[13].

CPP–ACP combined with sodium tripolyphosphate (TPP)

Recent studies suggested that CPP–ACP has been used for remineralization of enamel. Unfortunately, CPP–ACP is rarely used for remineralization of dentin, as intrafibrillar remineralization of dentin using CPP–ACP is challenging. Zhou et al (2020) found that CPP–ACP combined with sodium tripolyphosphate (TPP) has a good remineralization effect on demineralized dentin slices and it is superior compared to CPP–ACP alone (TPP used as an additive in the food industry and act as a biomimetic analog of dentin matrix protein-1). TPP was used to phosphorylate dentin collagen fibrils to increase collagen surface crystallization and induce collagen mineralization[14].

Oxalates

Oxalate produce desensitizing by deposition of calcium oxalate crystals on the surface of dentin. It reacts with calcium of dentin and leads to deposition of calcium oxalate crystals on the surface of dentin & / or inside its tubules. Ugur Erdemir (2016) found that mouthwash containing 1.4% potassium oxalate (Listerine Advanced Defense Sensitive; Johnson&Johnson, NJ, USA) reduced dentin permeability by 100% [3].

Sensi-Stop Strips

Sensi-Stop Strips (Procter & Gamble, Cincinnati, Ohio USA) containing oxalate crystals have been shown to provide immediate relief from DH after a single use. These strips are applied to the exact location of exposed dentinal surface for maximum effectiveness. Burt SM (2014) found that one strip applied for 10 minutes brings immediate relief that lasts for up to one month[15]. (Figure - 1)

Figure 1: Sensi-Stop Strips, Procter & Gamble, Cincinnati, Ohio USA[15]

Calcium sodium phosphosilicate

Calcium sodium phosphosilicate bioactive glass containing tooth pastes have been shown to significantly reduce DH. NovaMin: is the brand name of the bioactive glass which consists of 45% SiO_2, 24.5% Na_2O, 24.5% CaO and 6% P_2O_5. It delivers an ionic form of calcium, phosphorus, silica, and sodium which are necessary for bone and tooth mineralization. When these particles are exposed to water, they release mineral ions that become available for the natural remineralization process[16].

Beta Tricalcium Phosphate

Some authors have shown that beta tricalcium phosphate derived from Portland cement can help in the management of DH. Naoum SJ et al (2015) found that addition of beta tricalcium phosphate (Clinpro Tooth Crème; 3M ESPE, St. Paul, MN, USA) twice daily for brushing can be as effective to reduce DH as twice daily brushing using Sensodyne Total Care (GlaxoSmithKline, Sydney, NSW, Australia) [17]. P Usai (2020) found that Teethmate Desensitizer (Kuraray Noritake Dental Inc., Tokyo, Japan) occludes the dentinal tubules by deposition of hydroxyapatite crystals and reduces the DH. Teethmate Desensitizer comes in forms of power and liquid, powder consist Tetra-calcium phosphate, dicalcium phosphate anhydrous, liquid consists water with preservative[2].

Varnishes

Varnishes contain copal; rosin, is used to cover exposed dentin. They help other materials to increase their therapeutic effect. Fluoride varnishes (Duraphat 5% F: Colgate-Palmolive (UK) Ltd,) releases fluoride ion slowly and continuously which are deposited on the tooth surface, resulting in the formation of fluorapatite. Chlorhexidine-containing varnish (Cervitec Plus: Ivoclar Vivadent) forms a mechanical barrier after drying. This reduces sensitivity and provides an antibacterial and antiplaque action[1, 18]. Propolis: a natural resinous substance collected by bees, it has antibacterial agent (tt-farnesol) and inhibitor of glycosyl transferase (apigen); it has a positive effect in the control of DH. It is studied that flavonoids present as a component of propolis, are the main active and reactive agents capable of stimulating reparative dentin formation. It was found that Propolis occluded the dentinal tubules in periodontally involved and recession teeth[13]. Kripal K et al (2019) suggested that Propolis varnish can be an acceptable alternative treatment for patients who are apprehensive toward surgical approach[19].

Adhesive material

Dental adhesives and resin sealants forms physical barrier over the exposed dentinal tubules prevents fluid flow within dentinal tubules by outside stimuli. The action of glass ionomers in management of DH can also lead to occlusion of open dentinal tubules by precipitating a hydroxycarbonate apatite layer over the previously patent tubule openings. Newer bonding agent modify smear layer and incorporate it into hybrid layer, recently some bonding agent have been introduced in the market for treatment of DH like Gluma desensitizer[3, 9, 11].

Restorative materials

Direct restoration of hard tissue defects should provide an alternative treatment for DH. For erosion or abrasion related DH, it is believed that direct restoration with resin based composite or glass ionomer and indirect restoration with a crown or a veneer should provide effective long-lasting treatment for DH[5].

Periodontal surgery

Periodontal surgical procedures including guided tissue regeneration, coronally advanced flap surgery, connective tissue grafting, and free gingival graft treatments have been proposed for the treatment of DH related to gingival recession. These procedures may cover exposed dentinal tubules, but are not very predictable in terms of efficacy to cover root surface[4].

Arginine

Recent research suggests that arginine (Colgate Sensitive Pro-Relief, Colgate Palmolive Company USA) is a positively charged amino-acid which occurs naturally in saliva which attracts towards the negatively charged dentin surfaces and creates alkaline environment. This alkaline environment would enhance the formation of calcium, phosphate, arginine, and carbonate complex leading to remineralization of patent tubules. Studies also suggest that the effects of arginine-containing toothpaste exhibited a superior therapeutic effect compared to toothpastes containing other desensitizing components.[12, 16, 20].

Lasers

There are various types of lasers used in the treatment of hypersensitivity including neodymium-yttriumaluminum-garnet (Nd:YAG), erbium (Er):YAG, carbon dioxide (CO_2), helium-neon (He-Ne) and gallium-aluminum-arsenide (GaAlAs). Various studies shown that lasers can be used in the effective management of DH. Nd-YAG laser application occluded the dentinal tubules. GaA1As laser are affecting the neural transmission in the dentinal tubules. It has also been proposed that laser coagulate the protein inside the dentinal tubules and block the movement of fluid[21, 22].

Recently, low level laser has been presented as a new method to treat DH. Low level diode laser is one of them. Diode lasers are semi-conductive creates lots of wavelengths in visible and infrared regions, and emits continuously or by pulse. In dentistry, 655-810-980 nm wavelengths lasers are widely used[23]. Ko Y et al (2014) concluded that the use of the low-level laser emitting toothbrush (Medical & Human Technology Co. Ltd South Korea) is a safe and effective treatment option for the management of DH[24]. (Figure-2)

Figure 2: Low level laser emitting toothbrush, Medical & Human Technology Co. Ltd South Korea[24]

Photobiomodulation (PBM) involves noninvasive application of red (600–700 nm) and near-infrared light (700–950 nm). It is increasingly used in dentistry due to its anti-inflammatory, analgesic and bio-stimulant effects. PBM reduces the action potential velocity of C and Aδ fibers decreasing pain. Also, PBM increases the odontoblasts tertiary dentin production obliterating dentinal tubules and reducing DH[25].

Improved material science with the aid of nano-technology has found a role to play in the treatment of DH. The incorporation of nano-particles in composite resins, and fluoro-aluminosilicate glass has given rise to a new class of materials with improved resistance to abrasion. The use of nano-composites and nano-ionomers to treat cervical DH with structural tooth loss as a result of abrasion may better be able to withstand the abrasive effects of toothpastes, and thus prolong treatment efficiency over time[2, 10].

Conclusion

The ultimate goal in the treatment of DH is the immediate and permanent relief of pain. It is a very common dental problem which can be successfully treated by a wide variety of procedures, agents and formulations applied

over exposed dentinal tubules. It is clear that some products appear to be more effective than others. Products that developed for self application at home such as stannous fluoride, sodium fluoride, strontium chloride, potassium nitrate, and sodium mono-fluorophosphate have been extensively studied and shown to beneficial for patients suffering from dentinal hypersensitivity. The recent advancement to cure DH discussed in this article such as Low level laser; and Sensi-Stop strips should be advised for patients with a combination of in-office and at-home products to achieve successful outcomes. Professionals should identify the causative factors so that prevention can also be included in the treatment plan.

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