ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 2, Issue – 6, November - December - 2019, Page No. : 724 - 731

Comprehensive Review on Management of Dentinal Hypersensitivity- An Enduring Dental Problem

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Type of Publication: Original Research

Conflicts of Interest: Nil

Abstract

Dentinal hypersensitivity (DH) remains as a common dental problem which has a varied etiology. Precise diagnosis of the condition requires understanding the etiology, predisposing factors and the underlying health problems. Based on the etiology the treatment plan should be designed. The management of DH starts with removal of etiology. Various desensitizing agents are available which can be delivered in appropriate medium. Less severe cases can be treated by at home therapy whereas more severe cases involve professional intervention. This article emphasizes the various treatment options in management of DH.

Keywords: Sensitivity, Desensitizing agents, Therapy.

Introduction

Dentinal hypersensitivity (DH) is a pain derived from exposed dentin in response to chemical, thermal, tactile or osmotic stimuli which cannot be explained as arising from any other dental defect or disease[(1)]. The teeth are highly innervated structures. When dentin is exposed, the teeth can become strikingly more sensitive to usually innocuous stimuli such as temperature changes, probing with a sharp instrument and air currents. DH remains as a more prevalent and bothersome disease which can lead to both physical and psychological problems for the patient. Moreover, it can have a negative effect on the person's quality of life, particularly with regards to their selection of diet, maintaining optimal oral hygiene and esthetic aspects[(2)].

Etiology

The etiological factors of DH can be broadly divided into two categories.

Physical

a. Mechanical- Tooth decay, tooth wear due to attrition, abrasion and erosion cracked or fractured teeth, physical trauma, trauma from occlusion, tooth grinding or clenching habits, fractured fillings, enamel chipping, premature contacts, abusive tooth brushing, abrasive tooth paste, marginal leakage around

restorations, certain restorative materials, deep fissures, palatogingival groove and gingival recession.

b. Thermal- Intense heat and/or cold.

c. Electrical- Galvanic currents[2][3]

Chemical

d. Exogenous- carbonated beverages, wines, yogurt, citrus fruits, sugar, pyrophosphates containing tooth pastes, professional hazards (workers in battery manufacturing, wine tasters) and rarely salts.

e. Endogenous- acid from gastroesophageal reflux or regurgitation.[4]

The stimuli which triggers DH includes thermal stimuli such as intense heat and particularly cold, tactile stimuli such as probing the sensitized tooth, nicking the sensitive area with a finger nail, hard brushing, osmotic stimuli, air currents leading to dentinal fluid evaporation.[5][6]

Diagnosis of DH

A thorough clinical history and examination is necessary for precise diagnosis of the condition. The other causes of dental pain should be excluded by checking the pain response of various other conditions. For example, tenderness on percussion denotes pulpitis/periodontal involvement; pain on biting a stick or on release of biting pressure suggests fracture; transillumination and dyes helps in diagnosing fractures and history of recent restorations in relation to the painful area. For diagnosing DH, passing a jet of air or using an exploratory probe on the exposed dentin, in a mesio-distal direction will be helpful in assessing the sensitivity. The severity or degree of pain can be quantified by categorical scale as slight, moderate or severe pain or using a visual analogue scale. [7][8]

Management of DH

Removal of Etiology and rectification

Management of DH should start with removal of the etiological factors and the stimuli which evokes the sensitive episode.

1. Improper tooth brushing- The patient should be taught the right technique of tooth brushing using a model. Hard brushes and highly abrasive tooth powder or pastes should be avoided and advice them to use soft brushes. Explain the patient that lack of brushing will lead to plaque accumulation and gingival recession. [8]
2. Poor oral hygiene- Instruct the patient regarding oral hygiene maintenance and its significance. Educate them about various oral hygiene aids available in the market and suggest the suitable one for them.
3. Debilitating oral habits- The oral habits leading to enamel loss includes bruxism, nail biting, pencil biting, teeth clenching and grinding.[9] Psychological therapy, reminder therapy and occlusal therapy are considered according to the habit involved.
4. Premature contacts- Correct the premature contacts if present.
5. Dental caries and poor fillings- Restore the decayed teeth and poor fillings with a suitable restorative material. Tooth with faulty restorations are more prone for fracture which in turn leads to sensitivity.
6. Gingival recession- Treatment of recession requires careful treatment planning and understanding of the defect to be treated. The exposed root surfaces can be treated by procedures like lateral pedicle grafts, free gingival grafts, connective tissue grafts, etc. Though these procedures cover the exposed dentin, soft tissue grafting for management of sensitivity is not considered as a very predictable treatment strategy.[9]
7. High-acid food/drink consumers and bulimics- Erosive agents remove the enamel and open up the

dentinal tubules. After taking a detailed history, whether the erosive acid is exogenous or endogenous will be determined. In case if the exogenous acids are responsible, advice the patient to reduce the intake of such foods. Advice the patient to take milk or water after consuming acidic drinks to neutralize the acid effect. Recommend using a straw to sip the drink instead of swishing it around the teeth. If the condition is associated with eating disorder, it can be diagnosed by noticing the erosion on palatal surfaces of the maxillary anteriors. If endogenous acids are found to be responsible, refer the patient to a medical practitioner for expert management of the underlying disease. Dental management of such condition includes fabrication of an occlusal splint to cover the affected area and to prevent the teeth in contact with the acids. Also, instruct the patient to avoid brushing at least for 2 hours after consuming acidic drinks to prevent agonist effect of acidic erosion on tooth brush abrasion.[2][8]

8. Bleaching of teeth- Dental bleaching leads to enamel demineralization, there by leading to sensitivity. Therefore, it is not advisable to recommend the usage of bleaching for the patients with DH. Post bleaching sensitivity can be treated with desensitizing gels.

Therapy

Therapy for DH is based on the extent and severity of the condition. Mild to moderate generalized sensitivity can be treated at home. For isolated cases, therapy should be delivered professionally. In more severe and difficult cases consideration should be given to root canal therapy.

Desensitizing agents

Desensitizing agents plays a major role in treating DH efficiently. Grossman suggested the following requirements for a satisfactory desensitizing material:

1. Should not irritate the pulp
2. Relatively painless upon application
3. Easily applied
4. Rapid in action
5. Effective for a long time
6. Should not produce staining effects
7. Consistently effective.[9]

Desensitizing agents according to mode of action

1. **Nerve desensitizers**

a. **Potassium nitrate (KNO_3):** It is a chemical compound used in dentistry as a desensitizing agent. It acts to reduce tooth sensitivity by decreasing the ability of nerve fibers in the dental pulp to repolarize after an initial depolarization due to pain sensation. It is available in two forms of aqueous solution and adhesive gel. In two methods, the potassium nitrate desensitizing agents can be used. One is tray application prior to the whitening agent and the other is incorporation into the whitening agent gel.[10]

2. **Agents causing protein precipitation**

a. **Strontium chloride (SrCl2)-** The exact mechanism by which strontium chloride acts is unclear. It is believed that the exchange of strontium ions with calcium in the dentin, leads to the formation of strontium apatite complex, subsequently resulting in re-crystallization. The widely available form is 10% SrCl2 which is used as the desensitizing agent. SrCl2 formulations are available in the market in the form of varnishes and dentifrices.[9][6] The other agents which act by protein precipitation are Zinc chloride, Silver nitrate, Gluteraldehyde.

3. **Dentinal tubule pluggers**

a. **Calcium hydroxide**- Ca(OH)2 has been commonly used for the management of hypersensitivity particularly following root planning. It functions by probably blocking the dentinal tubules or by promoting the peritubular dentin formation.[9] Calcium

hydroxide paste is applied for 3 to 5 minutes through the burnishing with a wooden stick or rubber tip. The other calcium containing agents which act by same mechanism are Calcium phosphate and Calcium carbonate.[6]

b. **Fluorides-** Traditionally, fluorides have been used for prevention of caries which acts by remineralization of dentin. They are used also as a desensitizing agent. Fluorides react with dentinal fluids which are rich in calcium and phosphate ions. Topical application of fluoride leads to formation of calcium fluoride inside the dentinal tubules and clogs up there. Generally, 2% **Sodium fluoride** is used in dentifrices and in professional applications. Formulations of fluoride used to treat DH are sodium fluoride, stannous fluoride, sodium mono fluorophosphates, fluorosilicates and fluoride with iontophoresis.[8] **Stannous fluoride** acts by formation of calcium fluoride precipitates inside tubules with a only disadvantage of staining the tooth surfaces.[10] **Sodium mono fluorophosphate** is an inorganic compound odorless, colorless, and water-soluble. It is generally used in toothpastes, now replacing stannous fluoride. **Fluorosilicates** forms calcium phosphates precipitates from saliva. On long term basis, fluoride has a limited effectiveness in managing DH, because it is lost fairly rapidly from the teeth by action of saliva and mechanical acts.[9] **Iontophoresis with sodium fluoride** uses electric current which aids in increased ion diffusion. **Ammonium hexafluorosilicate** leads to precipitation of a mixture of calcium fluoride and fluoridated apatite which further leads to continuous occlusion of dentinal tubules. Precipitates containing predominant fluoridated apatite can form stable crystals deposited deep inside the dentinal tubules. These crystals are resistant to removal from brushing, action of saliva and dietary substances.[4]

c. **Potassium oxalate** Oxalate produce desensitizing by deposition of calcium oxalate crystals on the surface of dentin. It reacts with calcium of dentine & leads to deposition of calcium oxalate crystals on the surface of dentine & / or inside its tubules. The surface of the tooth can be etched to increase the effectiveness of oxalate. This results in a better sealing as compared with an intact smear layer. It has been shown that the effect of oxalates on DH diminishes over a period of time. [11][4]

d. **Bioactive glasses-** Bioglass stimulate bone formation. It is employed to fill the osseous defects during periodontal surgery. Its main component is silicate which acts as a nucleus for precipitation of calcium and phosphate. This forms an apatite layer which leads to occlusion of dentinal tubules. [2]

e. **Gluteraldehyde-** Gluteraldehyde causes coagulation of the proteins inside the dentinal tubules. It reacts with the serum albumin in the dentinal fluid, causing its precipitation.[12] Moreover, gluteraldehyde is an efficient fixative of flocculating agent and form a coagulation ‘plug’ inside the dentinal tubules.

At home therapy

At home therapy can be provided in the form of tooth dentifrices, tooth pastes, mouth washes and chewing gums. Majority of the desensitizing tooth pastes contain potassium salts (potassium nitrate, potassium chloride, potassium citrate), sodium fluoride, strontium chloride, dibasic sodium citrate, formaldehyde, sodium monofluorophosphate and stannous fluoride.[8] Recently several desensitizing agents are designed for various reasons such as,

1. To promote the formation of calcium and phosphate containing positively charged molecule on the dentine surface and within the tubules.
2. To decrease stimulus-evoked pain by decreasing the excitability of 'A' fibers, which surround the odontoblasts.
3. To reverse some of the effects of mechanical and acid damage on the dentine surface.[13]

The recent formulation of tooth pastes and powders contain 8% arginine, calcium carbonate and 1450 ppm fluoride which work by establishing an alkaline environment, lead to the precipitation of more salivary calcium and phosphate on the surface and inside the dentinal tubules. Patient should be taught the correct brushing technique and also advised to use the tooth brush with soft bristles.

Mouthwashes which contain potassium nitrate and fluoride are found to reduce sensitivity.[2] Chewing gums containing Recaldent Calcium pyro phosphate (CPP) - Amorphous calcium phosphate (ACP) is found to be effective to reduce post-bleaching tooth sensitivity. [12]

Review the results of 'at home' desensitizing therapy after every 3 to 4 weeks. If there is no relief, 'In office' therapy should be carried out.

In office therapy

The profession therapy can be provided according to the defect. It includes dentin adhesive sealers, restorations, LASERs, Heal ozone treatment, Iantophoresis, homeopathic medications and placebos.

1. **Dentin adhesive sealers-** The dentin adhesive sealers seal the dentinal tubules by forming a hybrid layer. The sealers can be in the form of dentin bonding agents, fluoride varnishes, oxalic acid and resins.

a. Fluoride varnishes- Varnishes are commonly used in professional in-office management of DH. They promote formation of a water-proof film.[6] Fluoride varnishes are highly effective when combined with acids and allows penetration of ions. It allows slow & continuous release of fluoride. Hence it can act as a vehicle for fluoride.[4] Calcium fluoride combines with hydroxyl apatite crystals in tooth surface and forms fluorapatite which gets deposited on the tooth surface. Copal varnish is applied to cover exposed dentine. Chlorhexidine- containing varnish forms a mechanical barrier around tooth surface after drying. They help in reducing sensitivity and in providing an antibacterial & antiplaque action.[11] But its effect is for short term and it needs to be applied several times. It is not recommended for long term management of DH. Removal of smear layer is advocated to increase its efficacy. [2]

b. Dentin bonding agents- The conventional dentin bonding agents removes the smear layer, etches the dentinal surface and forms deep dentinal resin tags inside the dentinal tubules. This layer which is formed of dentin and resin tags has been termed as hybrid layer. It efficiently seals the dentinal tubules and prevents DH. Novel bonding agents modify the smear layer and incorporate it in into the hybrid layer. Recently, some dentin bonding agents have been introduced in the market with the sole purpose of treating DH.[4]

c. Oxalates- The oxalates (such as 6% ferric oxalate, 30% dipotassium oxalate and 3% monohydrogen-monopotassium oxalate) are gaining popularity in treating DH. It is now considered an inexpensive, easy and well-tolerated way of managing sensitivity.[9] 30% potassium oxalate had shown 98% reduction in dentinal permeability. It was found that topical application of 3% potassium oxalate effectively reduced DH after periodontal therapy.[4] Oxalates reacts with calcium in dentin, leading to deposition of

calcium oxalate crystals on the dentinal surface and its tubules.[11] However, findings have indicated that treatment of DH with oxalate remains for a short time. The surface of the tooth can be etched for an effective result. Other disadvantage of potassium oxalate is that it can lead to some digestive disorders, hence long term treatments should be avoided.[2]

Restorations

a. **GIC and Composite resins-** These resins are commonly used in treatment of DH. GIC has ability to release fluoride and forms chemical bonding with the tooth. Composites can effectively reduce DH by forming a hybrid layer. Besides management of DH, they are used to reestablish the esthetics and functions of the tooth structure. [6][2]

b. **Portland cement-** Calcium derived from Portland cement can help in the management of dentinal hypersensitivity was shown by some authors. By the process of remineralisation it helps to occlude the dentinal tubules, thereby reducing DH. [14]

c. **Casein phosphopeptide- amorphous calcium phosphate-** Recently milk protein casein has been used to develop a remineralizing agent. The casein phosphopeptide (CPP) contains phosphoseryl sequences which get attached and stabilized with amorphous calcium phosphate (ACP).[11] The stabilized CPP–ACP prevents the dissolution of calcium and phosphate ions and maintains a supersaturated solution of bio-available calcium and phosphates. It can effectively remineralize the enamel subsurface lesions. By virtue of its remineralizing capacity, it has also been proposed by the manufacturers that it can also help in prevention and treatment of DH.[4]

LASERs

Lasers can be used in the successful management of DH. Different mechanisms of action have been proposed for the effect of lasers on the dentin and on reducing DH. They include:

1. Occlusion through coagulation of the proteins in the fluid inside the dentinal tubules.
2. Occlusion of tubules through partial sub-melting.
3. Discharging of internal tubular nerve.[2]

It has also been proposed that lasers block the movement of fluid inside the dentinal tubules by coagulating the proteins.

Nd:YAG laser works by occlusion of dentinal tubules. **Er:YAG** laser and **Co_2** lasers are proven as an effective treatment of DH. [11][4]

Low intensity LASERs- Unless other treatments of DH which alter the exposed dentin surface, the low intensity LASERs produce laser-induced changes to neural transmission networks in the dental pulp. GaA1As and HeNe lasers are the commonly used low intensity lasers. So far, there has been no report of adverse reactions or pulp damage in the studies. Thus the use of laser in treatment of DH is both logical and acceptable. [6]

2. **Heal ozone treatment-** In this treatment, the ozone penetrates the dentinal tubules which are exposed and eliminates bacterial contamination. This allows mineral ingress and consequent sealing of the dentine tubules. [7]
3. **Iantophoresis-** Iantophoresis is the process of bringing in ionic drugs into the tooth surface. It involves a source of direct current applied with a charged drug mostly fluorides on to the tooth surface. [6] Application of electric current into dentin leads to the formation of reparative dentine and also increases ion diffusion. It's believed that the electrical current alters the sensory mechanism of pain conduction and

produces paresthesia. Following fluoride iontophoresis, the rise in fluoride concentration in the dentinal tubules leads to microprecipitation of calcium fluoride. This block hydrodynamically mediated pain-inducing stimuli.[9]

4. **Homeopathic medications-** The herbal solutions for reducing DH includes **Plantago major** and **Propolis.** These agents are available in the form of toothpastes, varnishes and gels. [8][15]
5. **Placebos-** Providing treatment with placebos instead of any actual treatment seems to give a positive result in many patients. This ‘‘placebo effect’’ is observed in many of the clinical and pain therapy studies. A reduction in DH of about 20 to 60% is commonly observed with the use of placebos, especially as dentifrices. Several behavioral factors are hypothesized as contributing to this placebo effect in dentistry. The positive motivational behavioral responses may activate the central pain inhibiting system, which can transform the peripheral painful stimuli through the release of endorphin.[6] Patients who are participating in oral health product trials may brush their teeth better than they would normally. This is called as the ‘‘Hawthorne effect’’ where subjects will dedicate more effort to an activity that is being observed by the examiners. [13]

Conclusion

Dentinal hypersensitivity is a common and considerable dental problem which can be successfully managed. The dental practitioner should first identify the etiology or the predisposing factor of DH. A thorough history should be taken to ensure the possible reasons for DH before planning the treatment. According to the clinical condition and severity, the treatment strategy of the DH varies. Patients should be taught the various means of prevention of DH. Selfcare management can be planned according to the severity and later supplemented with professional interventions if required.

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