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The etiology and management of dentinal hypersensitivity

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ABSTRACT

Dentin hypersensitivity involves loss of the tooth hard tissues leaving the dentin exposed with a short sharp pain response whenever it comes in contact with external stimuli. Above the cement-enamel junction (CEJ), loss of enamel causes dentin exposure. Below the CEJ, as soon as the cementum is exposed, it becomes non-viable and is lost, leaving the dentin exposed. When dentin hypersensitivity sets in, the patient feels so uncomfortable that they will avoid taking cold foods or brushing the affected tooth. Dentin hypersensitivity is a common tooth problem, especially with the growing demand for, and frequency of, tooth-whitening procedures. Bleaching-induced tooth sensitivity is becoming more common, although effective management options are available. We searched Google Scholar, Microsoft Academic, ProQuest, Cochrane Library, and Pubmed for information about dentin hypersensitivity. In this article, we have presented the following concepts about the condition: etiology, predisposing factors, signs and symptoms, epidemiology, as well as the correct diagnostic and treatment options for reversing the sensitivity impact and achieving optimal oral health.

INTRODUCTION

Dentistry Today (2021) and Schmidlin et al. (2013), posited that dentin hypersensitivity is a temporary or transient sharp pain of a rapid onset that arises from exposed dentin and cannot be ascribed to any other dental defect or pathology. According to these authors, the pain responds to an external stimulus that would not, under normal circumstances, create pain or discomfort. The cessation of pain is directly related to the removal of the stimulus.

Dentine hypersensitivity is a known dental problem that may present on several teeth or one specific tooth. This is one of the prevalent diseases among the patients who visit the dental clinic. It should be differentiated from other clinical conditions such as dental caries, microleakage, cracked tooth, or fractured restorations with similar symptoms at their different stages of progression (Asnaashari & Moeini, 2013; Liu et al., 2020).

Researchers like Davari et al. (2013) and Liu et al. (2020) stated in their studies that the clinical management of

dentin hypersensitivity is by taking a detailed clinical and dietary history. Different diagnose of the condition from other dental pain conditions and manage etiological and predisposing factors is something to look into seriously.

Since many other conditions are known to give symptoms that are similar to dentine pain, doctors should treat other possible causes of pain before proceeding with any treatment modalities of dentin hypersensitivity. Such conditions may require different treatment options that are different from those of others used for dentin hypersensitivity. Such conditions include chipped enamel, fractured restoration, caries, marginal leakage of restorations, cracked cusps of teeth, and even palate-gingival grooves (Bubteina & Garoushi, 2015). Desensitizing agents, acting by blocking the tubules, effectively relieve the sensitivity effects (Lynch et al., 2012).

Ozen et al. (2009) inferred that dentin hypersensitivity affects all ages. Although dentinal hypersensitivity has a strong correlation with age, the report posited that dentin hypersensitive is frequently seen between the ages of 20 and 50 years, but especially between 20 and 30. Again, dentin hypersensitivity is more frequent in women than in men due to the high quest for tooth whitening (Spleith & Tachou, 2013).

HYPERSENSITIVITY

The phenomenon of dentin hypersensitivity is characterized predominantly by erosion and attrition, corrosion, abrasion, aging, and aggressive tooth brushing, which cause apical displacement of the gingival margins, which exposes the dentin and initiates the lesions. Dentin hypersensitivity occurs when dentin becomes exposed, and tubules are open at the dentin surface. Gingival recession/periodontal tissue loss is the primary way dentin is revealed in the cervical region of the tooth. Once the root is exposed, the protective layer of the cementum is easily removed, resulting in open dentin tubules (Goh et al., 2016; Soares et al., 2021).

Other conditions causing short and sharp pain include caries, chipped teeth, fractured or faulty restorations, specific restorative materials, and cracked tooth syndrome (Dentistry Today, 2011; Liu et al. 2020).

ETIOLOGY

Dentin hypersensitivity sets in when the fluid within the dentinal tubules is subjected to thermal, chemical, tactile, or evaporative stimuli, and the movement of the liquid will stimulate the mechanical receptors which are sensitive to fluid pressure, resulting in the transmission of the impulses to the pulpal nerves, ultimately causing the pain response (Gibson, et al.; 2015; American Dental Association [ADA], 2020; Soares et al. 2021).

There are two major development stages/phases of dentinal hypersensitivity. In the first phase, dentinal tubules, due to loss of enamels (loss of hard tissues by attrition, abrasion, erosion, or abstraction). However, dentinal exposure mainly occurs due to gingival recession and the failure of cementum on the root surface of canines and premolars in the buccal surface. It is worth noting that not all the exposed dentin are sensitive (Davari et al., 2013).

In the second phase, for the exposed dentin to be sensitized, the tubular plugs and the smear layer are removed. Consequently, dentinal tubules and pulp are exposed to the external environment. The plug and smear layer on the surface of exposed dentin is composed of protein and sediments derived from salivary calcium phosphates and seal the dentinal tubules inconsistently and transiently. Davari et al. (2013) further stated that the etiologic factors could be improper tooth brushing, premature occlusal contacts, gingival recession, and the existence of a large amount of exogenous and endogenous acids in diets.

Acidic soft drinks, citrus fruits, and fruit juices, alcoholic beverages, and many herbal teas remove the smear layer after a few minutes of exposure. Further, these acids can reduce the dentin surfaces' ability to resist abrasive forces due to enamel softening resulting in further dentin removal (Liu et al. 2020).

MAJOR PREDISPOSING FACTORS

Tooth Bleaching

Tooth discomfort after critical tooth whitening is a cause for concern, affecting most people and lasting, on average, one to four days. This is because the hydrogen peroxide molecules going through the dental tissues into the pulp are thought to cause sensitivity. As a result, bleaching sensitivity is usually temporary, yet if bleaching is done on people who already have sensitive dentin, the sensitivity can be severe and last a long time. However, extreme caution should be exercised when whitening teeth to avoid

irritation (Dentistry Today, 2006; Splieth & Tachou, 2013; Bersezio, 2018).

Gingival recession

Patients with a good level of oral hygiene standards and those with a low level of oral hygiene standards are at risk for gingival recession. According to many researchers, an insufficient level of oral hygiene is inadequate (Asnaashari & Moeini, 2013; Bubteina & Garoushi, 2015; West et al., 2017; Kara, 2018). Various factors cause a gingival recession in people who maintain proper dental hygiene: overzealous tooth brushing, improper brushing technique, or hard toothbrushes. In addition, It is also generally found on the buccal surfaces of the teeth.

On the other hand, lack of tooth brushing, with consequent accumulation of dental plaque on root surfaces in patients with inadequate oral hygiene, may lead to periodontal complications and migration of the gingivae in the apical direction. By uncovering the cementum and then demineralizing tooth structures, dentine tubule orifices' perforation might compromise, leading to dentin hypersensitivity (Pamir et al. 2007; Chambrone et al. 2012).

Tooth Wear

Bubteina & Garoushi (2015) and West et al. (2017) stated that tooth wear causes cervical dentin exposure in the coronal region of the tooth due to the loss of the enamel and the exposed cementum. The loss of enamel surface and cementum is usually by attrition, abrasion, erosion (Asnaashari & Moeini, 2013).

PEOPLE AT RISK

The studies of Davari et al. (2013), Kara (2018) and Liu et al. (2020), and many others also revealed that individuals who may be at risk for dentin hypersensitivity are:

a) People who suffer from bruxism

b) People who have acidic diet habits

c) Overenthusiastic brushers

d) Periodontally-treated patients

e) Bulimics

f) People with xerostomia

g) High-acid food/drink consumers

h) Older people with gingival recession

i) People who chew, smoke, or snuff tobacco.

SIGNS AND SYMPTOMS

Dentinal hypersensitive results to acute sharp painful response to external stimuli applied to exposed dentin, spontaneous tooth pain without an apparent cause, for example, tooth sensitivity localized to one tooth, more piercing staining on the surface of the teeth, discomfort rather than mild pain. When biting or chewing, a patient may experience pain. So are all signs and symptoms of dentin hypersensitivity (Asnaashari & Moeini, 2013; Liu et al. 2020).

In a bid to prevent the sensitivity effects, some patients avoid taking hot or cold foods or beverages and avoid brushing the sensitive areas, thereby placing them at risk for plaque buildup, calculus formation, and even gingivitis (Gibson et al. 2015).

EPIDEMIOLOGY

According to Orchardson & Gillan (2006), statistics demonstrate that this common condition is a rising complaint among dental patients. There are several data by different authors regarding the prevalence of dentin hypersensitivity, and the results demonstrate the difficulty of diagnosing the condition and accurately reporting prevalence (Cummins, 2009, Splieth &Tachou, 2013; Schmidlin, 2013, Walter, 2018; Zeola, 2019). However, clinical findings cited by Markelene et al. (2019) demonstrate that approximately 1 in 5 people suffer from the condition.

Furthermore, this sensitivity affects people of all ages; those between the ages of 20 and 50 are more commonly affected, but the condition is most severe between 30 and 40. There is no similar data on the prevalence of dentin hypersensitivity due to the varying sample sizes and conditions of the investigation of each study. Some reported that it is 55% - 75% while others reported 38.75% - 63.6% and 3% - 57%. Dentin hypersensitivity is more prevalent in women due to their dietary habits and a high quest for tooth whitening. In developed nations with a record of high periodontal disease and tooth whitening treatments, patients are more prone to tooth sensitivity (Splieth & Tachou, 2013, Zeola et al., 2019; Soares et al., 2021).

DIAGNOSIS

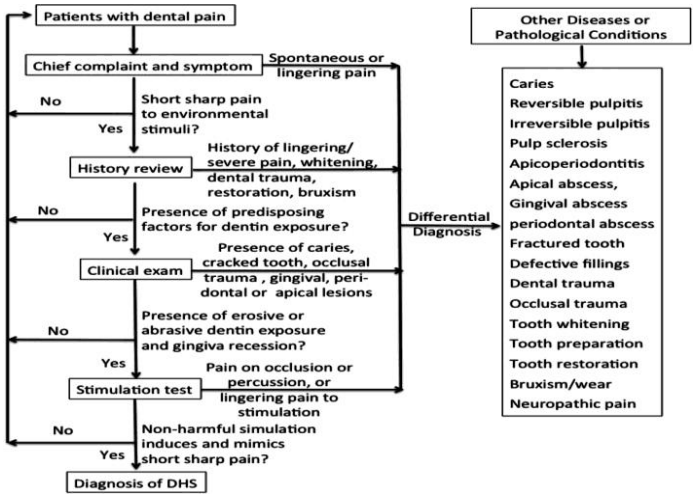
A thorough examination is necessary to diagnose dentin hypersensitivity. This can be achieved through a good clinical history, clinical and radiographic analysis, and questions asked about the tooth brushing technique and diets by the professional are essential to conclude a definitive diagnosis of dentinal hypersensitivity. While carrying out the diagnosis, the following are considered: the character of the pain (sharp, dull, or throbbing pain); how many teeth are affected and where they are located; which part of the tooth causes pain; and the intensity of the pain (Asnaashari & Moeini, 2013; Liu et al. 2020).

Diagnostic tools such as an air-jet/water syringe, an ice cube (thermal tests), a dental explorer (touch), percussion testing, bite stress tests, and occlusion assessment can also be used during the clinical examination. (Miglani et al., 2010; Schmidlin & Sahrmann, 2013, Goh, et al. 2016; Walters, 2018).

According to Kara (2018), Markelene et al. (2019) and Liu et al. (2020), other conditions such as dental caries, pulpitis, cracked tooth syndrome, marginal leakage, fractured restoration, and restoration polymerization shrinkage can cause a degree of dentin sensitivity.

The diagram below explains the diagnostic approach (Liu, et al. 2020).

Figure 1:
The diagnostic approach to dentinal hypersensitivity



Adapted from https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-020-01199-z/figures/1

MANAGEMENT

Liu et al. (2020) in their strategic study of the pathogenesis, diagnosis, and management of dentin hypersensitivity enjoined dental professionals to address any underlying causes of dentin hypersensitivity as the first step in successfully managing the condition. Educating patients about proper oral hygiene habits and the effects that highly acidic foods and beverages can have on their teeth can help them become aware of practices that cause sensitivity.

Once underlying causes are addressed, the next course of action is to determine the most effective course of treatment options, which include both in-office procedures and at-home care, (Borges et al., 2013). This article will highlight the therapies available to manage dentin hypersensitivity.

Generally, the home/self-applied treatment method to be considered are anti-hypersensitivity dentifrices that contain 5% potassium nitrates, such as Sensodyne, Colgate Sensitive Plus Whitening, Pepsodent Sensitivity Expert, RA Thermoseal, and Crest Sensitivity Protection. The dentifrices have been proven effective in relieving dentin hypersensitivity. Clinical trials support the claim of the companies showing that there is a reduction in symptoms in 2 weeks when the dentifrice is used twice daily. A toothpaste that contains potassium nitrate at a concentration of 5% potassium ions can penetrate the length of the dentinal tubule and block repolarization of the nerve fiber to relieve patients' pain. Also, mouthwashes can provide a certain degree of relief from dentin hypersensitivity (Borges, et al, 2012; Eilis, 2012; Majeed, 2015; Bubteina & Garoushi, 2015,).

Borges et al. (2012) supported other researchers' studies (Sgolastra et al. 2012; Bubteina & Garoushi, 2015) with the assertion that home use dentifrices, professional/office desensitizing agents, and laser are the available treatment approaches for occlusion of the open tubules or inactivate the nerves.

The following desensitizing agents are very effective in the treatment of dentin hypersensitivity, strontium chloride, oxalate desensitizers (e.g., Calcium Oxalate), Potassium Nitrate, Varnishes and Adhesive systems (e.g., Composite resins, GIC), Calcium hydroxide, Fluoride compounds (e.g., Stannous fluoride, 5% Sodium fluoride varnish) and others (Borges et al., 2015; Bubteina & Garoushi, (2015).

The studies of Miglani et al. (2010), Borges et al. (2015), and Bastos-Bitencourt (2021) extensively explained classification and the mechanisms of action of the desensitizing agents, while Gallob et al. (2017) and Onwubu et al. (2019) who used the Logistic Enamel Mineralization Model and Randomized Exploratory Clinical Evaluation, respectively, to check the enamel remineralization process, using dentifrices asserted that Sensodyne, Colgate desensitizing and other dentifrices are effective in the management of dentin hypersensitivity in agreement with Shah & Bajaj (2019), who used Scanning Electron Microscope to confirm the efficacy of the healing process initiated by hydroxyapatite crystals.

Chambrone et al. (2012) explained, exhaustively, that Complete Root Coverage (CRC) is a practical treatment approach for Recession Type Defects (RTD) which adopts root coverage as a means of resolution and decrease of tactile and thermal root hypersensitivity and prevention of root abrasion.

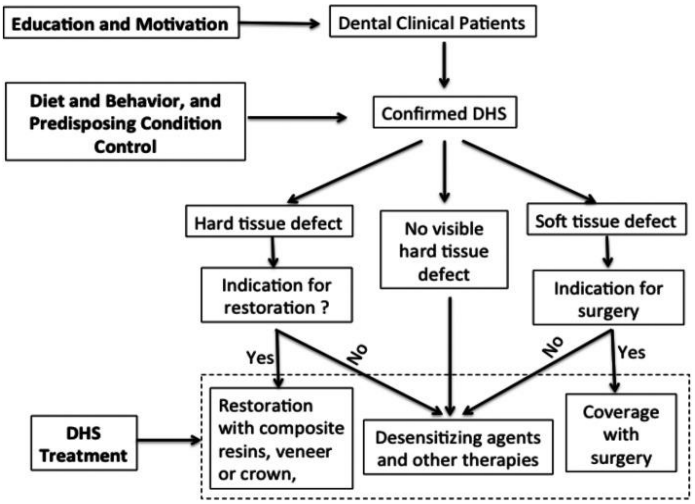
In cases of irreversible pulpitis, patients may require removal of the pulp and root canal therapy (RCT) or even tooth extraction (Dentistry Today, 2011).

West et al. (2013) and Liu et al. (2020) stated that in addition to periodontal patients and those undergoing professional tooth whitening procedures, other groups at risk for dentin hypersensitivity include those who exhibit gingival recession due to aggressive oral hygiene habits, consumers of high-acid food and drink, patients with parafunctional patterns, and patients suffering from xerostomia.

According to a study done by Shiau (2012), the right track of preventive and management strategies for dentinal hypersensitivity can be a combination of 2 or more of the therapies stated above.

The diagram below shows the management strategies for dentin hypersensitivity (Liu, et al. 2020).

Figure 2:
The management strategies for dentin hypersensitivity



Adopted from: https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-020-01199-z/figures/2

CONCLUSION

Dentinal hypersensitivity is a common condition that affects many dental patients. Patients with dentinal hypersensitivity symptoms should be examined and given suitable treatment(s) to alleviate the sensitivity response. The patients should also be advised to adopt habits such as the proper tooth brushing techniques, dietary control, and routine dental visits to reduce the susceptibility to dentin hypersensitivity. Lastly, sensitized dentifrices are an excellent first line of defense against mild hypersensitivity, and they can be augmented with one or even both in-office treatments, if necessary.

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