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APPROACH TO DIAGNOSING AND MANAGING TOOTH SENSITIVITY IN ADULT PATIENTS

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Abstract

Dentin hypersensitivity (DHS) is a frequently encountered patient complaint that can present with a number of associated factors, including erosion and abrasion. It is characterized by short, sharp pain that arises from exposed dentin in response to various stimuli. The hydrodynamic theory is the most accepted explanation of DHS. Diagnosis of this condition requires an exclusion of other related conditions that lead to similar symptoms, such as periodontal diseases. Accurate diagnosis is important for its appropriate treatment. Despite the numerous methods proposed for treating DHS, a definitive solution to the issue has yet to be identified. Tooth sensitivity can also be a side effect of dental bleaching; however, it often persists even after treatment, highlighting the urgent need for new products that can manage this bleaching-related side effect. The aim of this review is to investigate current diagnostic and management protocols for dentin hypersensitivity and bleaching-induced tooth sensitivity. The diagnostic process of DHS includes chief complaint and illness history, clinical examination, diagnostic tests, and exclusion of other pathologies. There are two available assessment tools for DHS: stimulus-based assessment and response-based assessment. DHS treatment is classified into at-home treatment and in-office treatment, both of which are largely based on brushing techniques and desensitizing toothpastes. Treatment of bleaching-induced tooth sensitivity includes two approaches: reducing the fluid flow in the dentinal tubules by obstructing open dentinal tubules and reducing pulpal nerve excitability through depolarizing the nerve endings. Future studies should focus on establishing standardized diagnostic criteria and optimal treatment protocols for DHS and bleaching-induced tooth sensitivity.

Keywords: Dentin hypersensitivity, tooth sensitivity, hydrodynamic theory, dental bleaching, bleaching-induced tooth sensitivity.

INTRODUCTION

Dentin hypersensitivity (DHS) is one of the most common complaints from patients in dental clinics. It is manifested by short, sharp pain due to dentin exposure to external stimuli, such as thermal, chemical, tactile, or osmotic stimuli, in the absence of overt dental pathology (1). The prevalence of DHS ranges between 11% and 42%, depending on study design and population characteristics (2-5). The etiology of DHS is complex and multifactorial, involving open tubules and dentin exposure. It can be caused by chemical erosion (dietary acids), mechanical abrasion (e.g., aggressive toothbrushing), attrition (dysfunctional habits), or iatrogenic factors (e.g., bleaching, periodontal therapy). The most accepted mechanism of DHS is the hydrodynamic theory, which attributes pain to fluid shifts within exposed dentinal tubules that stimulate mechanoreceptors in the pulp (6, 7).

Other mechanisms include direct innervation, neuroplasticity and sensitivity, odontoblasts acting as a mechanosensory system, and low-threshold algoneurons (6). The direct innervation mechanism suggests that external stimuli directly activate nerve fibers that project into the dentinal tubules (8). The neuroplasticity and sensitivity mechanism involves direct innervation proposing nociceptive plasticity (9). In this mechanism, the sensitization occurs due to altered neurophysiological changes, where pulpal inflammation alters the dentinal sensitivity of A-delta nerve fibers (6). The mechanosensory mechanism suggests that odontoblasts act as sensory cells that detect fluid or thermal stimuli via Transient Receptor Potential and other ion channels, release neurotransmitters such as ATP and glutamate, and thereby help transduce dentinal pain to pulp nerves (10-12).

Diagnosis of DHS could be reached by the exclusion of other conditions that have similar manifestations (13). Currently, there are no universally accepted guidelines for differential diagnosis as well as the selection of reliable treatment modalities for this condition (1). Generally, dentin pain is triggered when air is blown onto a tooth with exposed dentin. The proposed protocols for differential diagnosis of DHS include chief complaint and symptom inquiry, present illness history review, clinical exam and diagnostic testing (1). Once the DHS is diagnosed and prior to the development of a treatment plan, the etiology of DHS must be established. Management of DHS should be done with more conservative strategies first, followed by irreversible dental interventions (14). Treatment of DHS can be classified into at-home treatment and in-office treatment. They involve various approaches, including proper brushing techniques with toothpaste specialized for DHS and topical and local anesthetic agents.

Tooth sensitivity due to bleaching is another condition, which affects an average of 70% of patients during and after the procedure (15-18). This dental bleaching-induced tooth sensitivity is the result of the inflammatory response of the pulp tissue to the action of hydrogen peroxide during the bleaching process. Although various treatments for dental bleaching-induced tooth sensitivity, such as topical desensitizing agents and dentinal tubule-occluding agents, have been introduced, tooth hypersensitivity often persists, highlighting the urgent need for new products that can manage this bleaching-related side effect. This review aims to discuss current diagnostic and management practices in dentin hypersensitivity, as well as the advances in the management of bleaching-induced tooth sensitivity.

METHODS

A comprehensive literature search was conducted in Medline (via PubMed), Scopus, and Web of Science databases up to December 6, 2025. Medical Subject Headings (MeSH) and relevant free-text keywords were used to identify synonyms. Boolean operators (AND', OR') were applied to combine search terms in alignment with guidance from the Cochrane Handbook for Systematic Reviews of Interventions. Key search terms included: "Tooth sensitivity" OR "Dentin hypersensitivity" AND "Diagnosis" AND "Management". Summaries and duplicates of the found studies were exported and removed by EndNoteX8. Any study that discusses approaches to diagnosing and managing dentin hypersensitivity and bleaching-induced tooth sensitivity and published in peer-reviewed journals was included. All languages are included. Full-text articles, case series, and abstracts with the related topics are included. Case reports, comments, and letters were excluded.

DISCUSSION

Diagnosis of Dentin Hypersensitivity

Dentin hypersensitivity is a diagnosis of exclusion, where other related conditions must be excluded first (1). This is critical to determine appropriate and effective treatment. There are a number of other conditions, such as cracked teeth, defective or fractured restorations, tooth whitening, dental trauma, gingivitis, and periodontal disease, that lead to dentin exposure, dental pulp hyperemia, dental nerve sensitization and neuropathy, inducing short sharp pain even with only minor provocation, similar to DHS (2). These conditions need, therefore, to be distinguished from DHS (19). The diagnostic process of DHS includes chief complaint and illness history, clinical examination, diagnostic tests, and exclusion of other pathologies **(Figure 1)**.

The chief complaint and illness history can give a lead for the diagnosis of DHS, but it can be misleading for inexperienced practitioners (1). The chief complaint of DHS is transient sharp pain following various stimuli that disappears immediately after removal of the external stimulus (1). Clinical examination of DHS should begin with identifying the presence of exposed dentin by visual/tactile examination of the teeth and documenting it by site in the patient record (1). The clinical examination of DHS can be performed through two distinct approaches (3): stimulus-based assessment, where sensitivity can be assessed based on the strength of the stimulus required to induce pain, and response-based assessment, where a subjective evaluation of the pain provoked by a specified stimulus is conducted (20, 21).

Response-based methods assess the immediate pain reaction after delivering a standardized, reliable, and reproducible stimulus (3). In this method, the stimulus remains constant while the patient's response varies. Employing an air current for a specific duration is an example of this approach, during which the examiner isolates adjacent teeth using their fingers; then a stream of air with a pressure of 60 ± 5 psi and a temperature of 21 ± 1 °C is directed perpendicularly to the tooth under examination from a distance of one centimeter for a duration of one second (3). Immediately after the stimulus, the patient assesses the pain using a visual analog scale, marking a point along a continuum that ranges from no pain to the maximum imaginable pain (22).

In the stimulus-based assessment of dentin sensitivity, the intensity of stimulus varies, and a probe is adjusted to exert forces on the tooth in increments of 10 g, employing an electronic device for control (23-25). Thereafter, the patient is directed to indicate the point at which they initially experience pain subsequent to the probe stimulation, and the applied force is recorded. Disadvantages of these methods include the time-intensive nature, the possibility that

repeated stimulation alters sensitivity, and that anticipation of pain related to the stimulus can shape the intensity of the response (26).

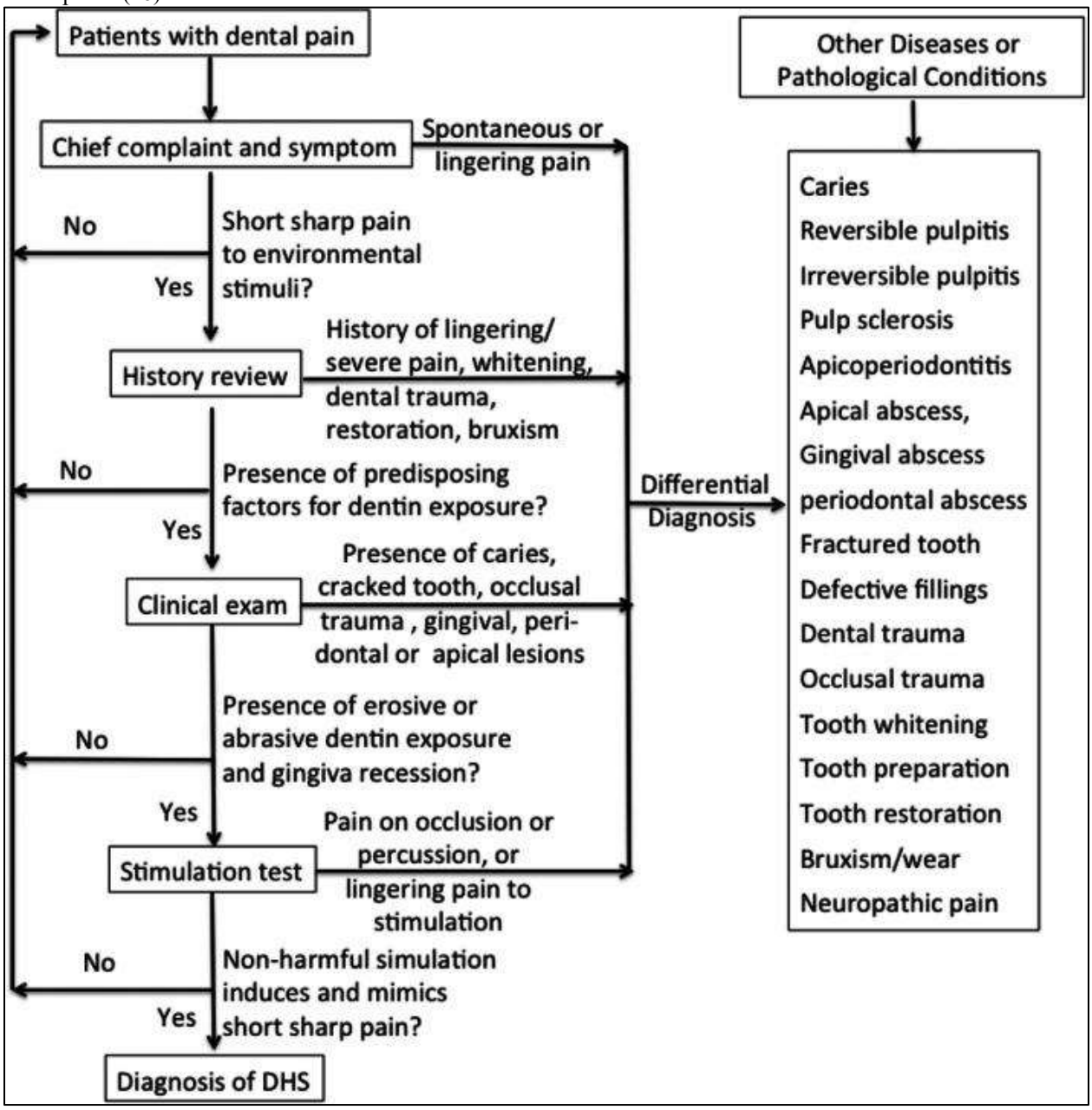

Figure 1. Flow chart for differential diagnosis of dentin hypersensitivity (1).

Treatment of Dentin Hypersensitivity

Treatment of dentin hypersensitivity should start with accurate diagnosis and identification and removal of etiological and predisposing factors **(Figure 2)** (3). Both brushing and dietary habits should be identified since they can have a significant impact on erosion and abrasion. Additionally, any coexisting conditions that lead to similar symptoms should be initially managed (3). Treatment of dentin hypersensitivity is classified into at-home treatment, in-office treatment, and mixed treatment. At-home treatment involves instructions for patients to utilize specialized toothpastes and mouthwashes designed to effectively alleviate sensitivity (27-29). These instructions should include proper brushing techniques and cautions against the use of abrasive toothpaste (such as whitening dentifrices) and firm toothbrushes (30). Furthermore, patients should be instructed to avoid excessive brushing force and to abstain from brushing for at least one hour after consuming acidic foods or beverages (3). These approaches function by either impeding nerve impulse transmission or blocking dentin tubules.

In order to develop effective toothpaste for dentin hypersensitivity, various substances have been introduced and examined (31). These substances include potassium salts, sodium fluoride, stannous fluoride, arginine, nano-hydroxyapatite, bioactive glasses, casein phosphopeptide, amorphous calcium phosphate (CPP-ACP), and strontium

chloride **(Table 1)**. If dentin hypersensitivity remains after 2-4 weeks of using specialized toothpaste or mouthwashes, patients should move on to the second treatment phase, which consists of professional care provided at the dentist's clinic (3).

Table1. At-Home Treatments for Dentin Hypersensitivity (3).

Active Agents	Form	Mechanism of Action	Duration of Therapy
Potassium salts (32)	Toothpaste–mouthwash	Impeding nerve impulse transmission	2 times daily for 2–4 weeks
Sodium fluoride (33)	Toothpaste–mouthwash	Occlusion of dentin tubules	2 times daily for 2–4 weeks
Stannous fluoride (34)	Toothpaste–gel	Occlusion of dentin tubules	2 times daily up to 2 weeks
Arginine (35)	Toothpaste–mouthwash	Occlusion of dentin tubules	2 times daily for 2–4 weeks
Hydroxyapatite or nano-hydroxyapatite (36)	Toothpaste–mouthwash	Occlusion of dentin tubules	2 times daily for 2–4 weeks
Bioactive glass (37)	Toothpaste–mouthwash	Occlusion of dentin tubules	2 times daily for 2–4 weeks
CPP-ACP (38)	Toothpaste–mousse	Occlusion of dentin tubules	2 times daily for 2–4 weeks
Strontium chloride (39)	Toothpaste–mouthwash	Occlusion of dentin tubules	2 times daily for 2–4 weeks

Similar to at-home treatment, in-office treatment methods are classified into methods that hinder nerve impulse transmission and methods that occlude dentin tubules. Therapeutic agents that hinder the transmission of the nerve impulses include potassium salts (most commonly KNO3) and low-level laser therapies (40), while therapeutic agents that occlude the dentin tubules include sodium fluoride, silver diamine fluoride, adhesive agents, air abrasion with bioactive glass particles, Portland cement, oxalate salts, and laser irradiation treatments **(Table 2)** (33, 37). Although in-office procedures can offer rapid symptom relief, sustained control of dentin hypersensitivity may necessitate further home-based measures.

Table 2. In-Office Treatments of Dentin Hypersensitivity (3).

Active Agents	Form	Mechanism of Action	Duration of Therapy
Potassium salts (40)	Gel	Impeding nerve impulse transmission	2–3 times during a two-week period
Low-level laser irradiation (LLLT) (41)	Irradiation	Impeding nerve impulse transmission	Case-sensitive
Sodium fluoride (42)	Varnish or gel	Occlusion of dentin tubules	Once
Silver diamine fluoride (SDF) (43)	Solution	Occlusion of dentin tubules	Once
Adhesive agents (44)	Solution	Occlusion of dentin tubules	Once

Active Agents	Form	Mechanism of Action	Duration of Therapy
Bioactive glass powder (42)	Air abrasion	Occlusion of dentin tubules	Once
Portland cement (45)	Paste	Occlusion of dentin tubules	Once
Oxalate salts (46)	Gel or solution	Occlusion of dentin tubules	Once
Laser irradiation (47)	Irradiation	Occlusion of dentin tubules	Once

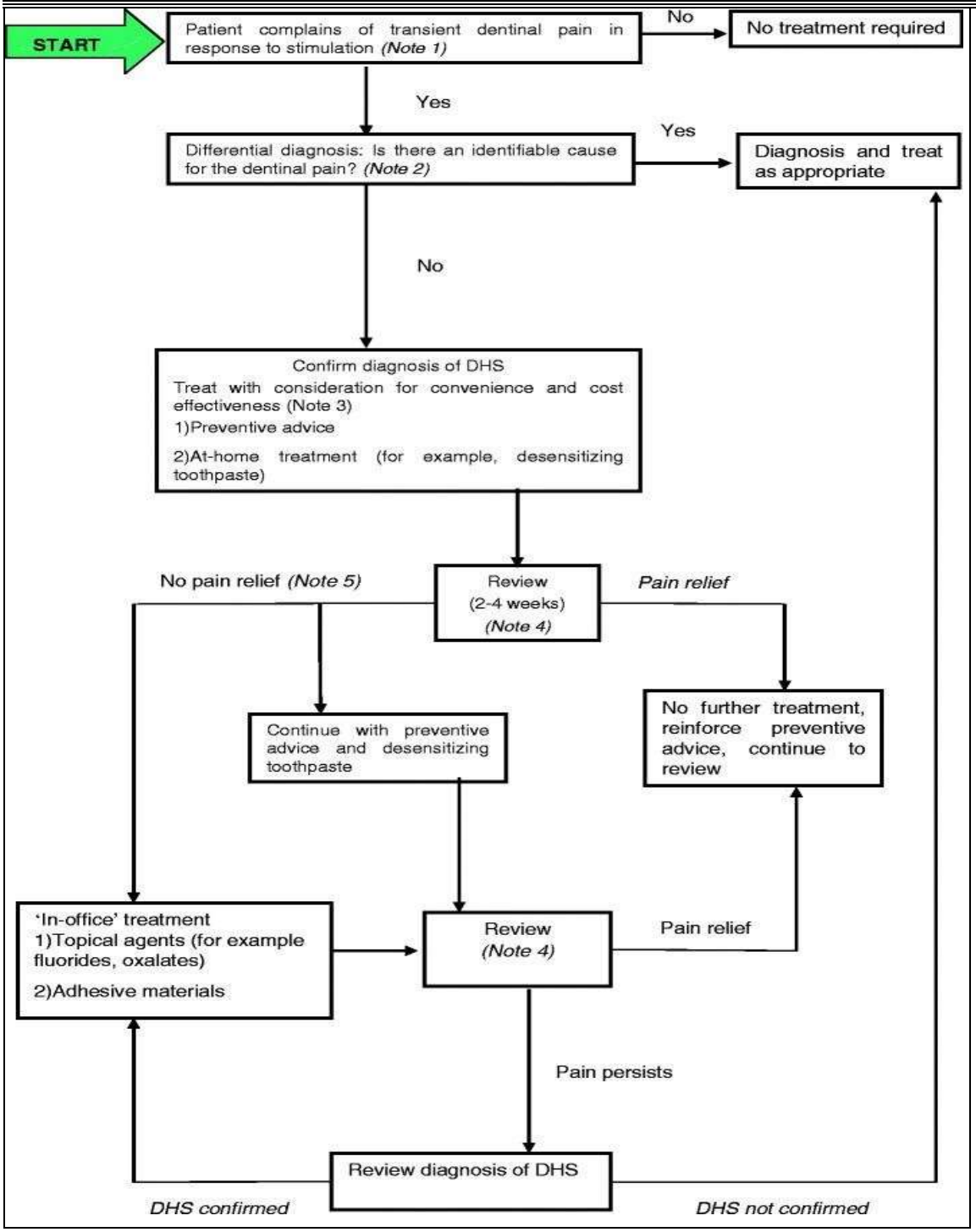

Figure 2. Flowchart for the clinical management of dentin hypersensitivity (48).

Bleaching-induced tooth sensitivity

Teeth bleaching is a common practice aimed at achieving a whiter and more aesthetically pleasing smile. It is considered a safe procedure and rarely leads to any complications; however, it may result in post-treatment tooth sensitivity causing significant discomfort (49, 50). It is believed that reversible pulpitis is the cause of tooth sensitivity associated with tooth bleaching. Carbamide and hydrogen peroxide are the most used bleaching agents. In-office bleaching typically employs higher hydrogen peroxide concentrations (20–40%), whereas home-based bleaching relies on carbamide peroxide concentrations of 10–20% or hydrogen peroxide levels of approximately 3.35–7% (49). Peroxide-based bleaching agents induce an oxidative response that leads to the formation of free radicals, which rapidly penetrate the dental element towards the pulp region, resulting in intratubular dentin fluid movement, exciting or sensitizing nocioceptors, and pulp damage (51-54). Furthermore, when peroxide is used in high concentrations and long contact times with dental structure, it elevates sensitivity levels (15).

Although different light activation systems had no impact on the whitening outcome, they may affect patient experiences of tooth sensitivity (55). In their systematic review and meta-analysis, Moran et al. aimed to compare the risk and intensity of bleaching-induced tooth sensitivity associated with different light sources (56). The results of the study suggest that bleaching-induced tooth sensitivity is neither exacerbated nor minimized by light activation with any type of light source (56). The level of free radicals generated by both high- and low-concentration in-office bleaching agents is sufficient to penetrate the pulp chamber, leading to cellular damage and transient sensitivity (57). Treatment of bleaching-induced tooth sensitivity includes two approaches: reducing the fluid flow in the dentinal tubules by obstructing open dentinal tubules and reducing pulpal nerve excitability through depolarizing the nerve endings. These treatment approaches are commonly applied by using desensitizing toothpastes and reducing post-bleaching pain and sensitivity. Various agents, such as strontium chloride, have been examined as desensitizing agents for post-bleaching tooth sensitivity. These agents precipitate and obstruct dentinal tubules and can be effective in nerve desensitization (58). Thus, some dentists recommend using desensitizing toothpastes a few days before bleaching, between sessions, and afterward, with the aim of minimizing the procedure's undesirable effects. Desensitizing toothpastes have shown promising results in reducing postoperative pain; however, results regarding their effectiveness in reducing post-bleaching tooth sensitivity are inconsistent (51, 59-61). Multiple studies have investigated clinical alternatives to reduce this tooth sensitivity, such as non-steroidal analgesics, anti-inflammatories, corticoids, opioids, topical desensitizers (based on potassium nitrate or fluoride), reduction of product concentration, and use of different bleaching protocols.

Clinical Implications

The exclusion of other related conditions is the most important step in the diagnosis process of dentin hypersensitivity. Conditions such as cracked teeth, defective or fractured restorations, tooth whitening, dental trauma, gingivitis, and periodontal disease must be excluded first, as they lead to symptoms similar to DHS. Chief complaint and illness history, clinical examination, and diagnostic tests are also critical for DHS diagnosis. The clinical examination and assessment of DHS can be performed through two distinct approaches: stimulus-based assessment and response-based assessment. A mixed at-home and in-office treatment can be effective in the treatment of DHS. This mixed treatment should include instructions for proper brushing techniques and cautions against the use of abrasive toothpaste and firm toothbrushes. Desensitizing toothpastes including desensitizing agents, such as potassium salts, sodium fluoride, stannous fluoride, arginine, nano-hydroxyapatite, bioactive glasses, casein phosphopeptide, CPP-ACP, and strontium chloride, are recommended. Tooth sensitivity is a possible side effect of dental bleaching. Peroxide-based bleaching agents have a role in this condition by inducing an oxidative response. Treatment of bleaching-induced tooth sensitivity includes two approaches: reducing the fluid flow in the dentinal tubules by obstructing open dentinal tubules and reducing pulpal nerve excitability through depolarizing the nerve endings.

CONCLUSION

Dentin hypersensitivity is a diagnosis of exclusion that requires open tubules and dentin exposure. Diagnosis of DHS is a process that involves chief complaint and illness history, clinical examination, diagnostic tests (stimulus-based assessment and response-based assessment), and exclusion of other pathologies. Treatment of this condition includes at-home treatment, in-office treatment, or mixed treatment. Future studies should focus on establishing standardized diagnostic criteria and optimal treatment protocols for DHS.

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