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Dental Sensitivity in Adult and Pediatric Patients

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Abstract

Dentin hypersensitivity has been defined as the short, sharp and severe pain arising from exposed dentin in response to thermal, tactile, evaporative, electrical, osmotic or chemical stimuli. The treatment of dentin hypersensitivity should start with an accurate diagnosis. Differential diagnosis should be made and all other probable causes should be excluded. An often neglected phase of clinical management of dentin hypersensitivity is the identification and treatment of the causative factors. By removing the etiological factors, the condition can be even prevented from occurring or recurring. There are various treatment modalities available, which can be used at home or may be professionally applied, but a gold standart for treatment has not been found yet. The definition, diagnosis, treatment of dentine hypersensitivity and their differences in adults and children will be discussed in this review.

1. Introduction

Dentin sensitivity (DH) is defined as a short-term, sharp and localized pain that occurs in the dentin tissue exposed in response to chemical, thermal, mechanical, osmotic and evaporative stimuli, which can disappear with the disappearance of the stimuli, which cannot be explained by any tooth damage or pathology (Addy, 2002).

2. Diagnosis

Patients with dentine sensitivity apply for short-term, sharp and uncomfortable pain complaints caused by factors such as thermal stimuli, osmotic stimuli, external physical stimuli (Assis et al, 2011). Dentin sensitivity after accurate and careful clinical and radiographic examination can be distinguished from other pathologies. These are problems such as cracks in the posterior teeth, restoration fractures, dental caries, post-operative sensitivity, conditions where congenital enamel-cement combination is open, pulp infections. (Orchardson, & Gillam, 2006). In patients applying for with these problems, pain questioning should be done correctly.

Methods such as air spray, heat tests such as cold water, dental or periodontal examination, percussion test, bite test, occlusion assessment, differential anesthesia test are used in the diagnosis of dentine sensitivity. The most preferred scale for measuring the severity of dentine sensitivity is the Visual Analogue Scale (VAS) and the Verbal Rating Scale (VRS) (Figure 1). On the VAS scale, there is no pain at the left end of the line, and unbearable pain at the right end. The patient is instructed to mark a point on the line to accurately reflect his pain. In the Verbal Assessment Scale, the patient chooses the word that matches the severity of the pain from the list in which the words describing the pain intensity are sequenced (Can, & Dikici, 2015).

3. Treatment Planning in Dentine Sensitivity

Treatment of dentine hypersensitivity is difficult for reasons such as difficulties in determining the severity of pain, exposure of dentin to personal habits and difficulties in changing these habits.

3.1. Materials and Methods Used in the Treatment of Dentin Sensitivity

Dentin sensitivity and densensitizing agents can be classified as home-based agents and clinically applied agents by the dentist, depending on the mode of administration

3.1.1. Home Applicable Agents

Today, home products used to relieve dentine sensitivity are toothpastes, mouthwashes and gel formulations containing potassium salts, strontium salts, fluoride and the like. These agents are reported to reduce the symptoms of dentin sensitivity by blocking the dentin tubules, blocking the neural stimulus, and by blocking the neural response (Ölmez, & Erdemli 2003).

<u>Potassium:</u> The mechanism of action of potassium nitrate is to reduce the excitability of α-fibers of nerves by penetrating potassium ions into tubules. It has been shown that high amounts of potassium ions applied increase the extracellular potassium concentration, thereby depolarizing the nerve membranes and creating a blockade in nerve

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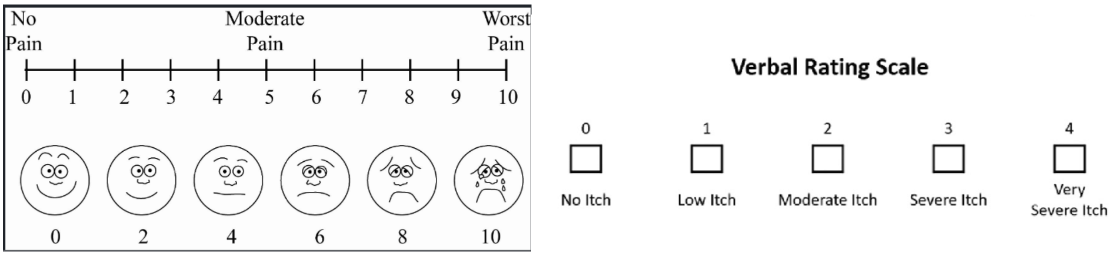

Fig 1. Visual Analogue Scale and Verbal Evaluation Scale

stimulation and action potential propagation (Poulsen, Errboe, Lescay, & Glenny, 2006).

Fluoride: Fluorid collapses on the tooth surfaces, combines with calcium and phosphate ions in saliva, forming fluoroapatite crystals on and in the surface of dentin tubules. Thus, the sensitivity of the dentin is reduced by preventing ion transfer in the dentine fluid. Mouthwash with fluoride raises the level of saliva fluoride immediately after shaking, and this level is maintained for several hours, giving successful results (Civelek, Özel & Çıldır, 2004). The results of the study comparing toothpaste containing boronous fluoride and toothpaste containing potassium salt have been reported to be more effective in reducing DH in 4-8 week evaluations (Ni, He, Chang, & Sun, 2010).

Calcium: Desensitizing pastes containing new chemical agents such as arginine calcium phosphosphate, casein phosphospeptide-amorphous calcium phosphosphate and calcium sodium phosphosilicate bioactive glass have been developed in the last 10 years.

* Arginine calcium phosphate (Pro-Argin): Saliva ensures that calcium and phosphate ions reach the open dentinal tubules and the saliva glycoproteins and calcium phosphosphate settle and act as a gag. Arginine, which is a positively charged amino acid at physiological pH, is buffered with bicarbonate, and calcium carbonate is added to it as a source of calcium, used in the content of toothpaste (Pro-Relief, Colgate-Palmolive).The method has been shown in several studies to be effective in blocking dentin tubules and reducing sensitivity (Schiff et al, 2009).

* Casein phosphospeptide-Amorphous calcium phosphate (CPP-ACP): The peptides and fluoride in CPP-ACP (Tooth Mousse, GC Corporation, Tokyo, Japan) bind to the dentin surface, allowing the minerals that narrow the tubule openings to collapse. When in contact with water, amorphous calcium phosphate (ACP) crystallizes to the enamel and releases slowly from it. When CPP-ACP is applied to the tooth surface, biofilm is bound to bacteria, hydroxyapatite and surrounding soft tissues and functions as a calcium and phosphate reservoir. Amorphous calcium phosphate dissolves in water and decomposes into calcium phosphate ions and becomes usable by the surrounding tissues. Calciumphosphate closes the mouth of dentin tubules and reduces their permeability. It also has a synergistic effect in the presence of fluoride (Bartold, 2006).

* Calcium sodium phosphosilicate bioactive glass (CSPS, Novamin): Bioactive glass was developed as a bone regeneration material, recently produced in

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Table 1: Sensitive toothpastes and their active ingredients (Bozok, 2015)

Toothpaste	Active ingredients
Sensodyn Total Care F	Potassium nitrate %5 Sodium fluoride % 0.31 1450 ppm Triclosan
Sensodyn Multi Action Iso Active	Potassium nitrate %5 Sodium fluoride % 0.23 1450 ppm
Sensodyn Pronamel	Potassium nitrate %5 Sodium fluoride % 0.32 1450 ppm
Sensodyn f	Potassium nitrate %5 Sodium fluoride % 0.306 1400 ppm
Sensodyn mint	Potassium nitrate %5 Sodium fluoride % 0.15 1400 ppm
İpana Pro-expert Clinic Line Sensivity	Potassium nitrate %5 Stannous fluoride 0,454
İpana Pro-sensitive	Potassium nitrate %5 Sodium fluoride % 0.243
Colgate Sensitive	Potassium citrate %5.53 Sodium fluoride % 0.24 1100 ppm
Signal Sensitive Expert	Potassium citrate %5.35 Sodium monofluorophosphate 1450 ppm Hydroxyapatite %2
Sensodyn Rapid Relief	Strontium acetate Sodium flüoride % 0.23 1040 ppm
Colgate Sensitive Pro-Relief	Pro-Argin %0.24 Sodium fluoride 1100 ppm
Sensodyn Mouthwash	Sodium fluoride 230 ppm
Ipana Pro-expert Clinic Line Tooth Enamel Repair	Stannous fluoride 0,454
Ipana Pro-expert Clinic Line Gum Protector	Stannous fluoride 0,454
Parodontax Fluoride	Sodium fluoride 1400 ppm
Clinomyn Fresh Mint for smokers	Sodium monofluorophosphate
Sensodyn Repair and Protection	Novamin Sodium monofluorophosphate %1.06 1450ppm
Elgydium Sensitive Toothpaste	Chlorhexidine digluconate %0.004 Nicomethanol Hydrofluorid 1250 ppm

*ppm : parts per million

the form of toothpaste in the treatment of dentin sensitivity and to provide enamel remineralization. Novamin consists of amorphous calcium-sodium-phosphosilicate, highly reactive in water and physically blocks dentinal tubules due to its fine particle size. In the mouth, sodium in the novamine content is replaced by hydrogen cations, so that calcium phosphate is released. After contact of the material with water, the pH in the environment rises for a short time, allowing the novamine to precipitate the calcium phosphate ions and form a layer. The layer formed during this reaction crystallizes into a hydroxyapatite layer rich in carbonate. The newly formed hydroxyapatite layer with the novamine in

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the environment ensures the mineral surface to be remineralized (Bozok, 2015).

Strontium Salts: Strontium salts are contained in toothpastes and act by precipitating the fluid in the dentin canals. In a study, it is reported that the paste containing 8% strontium acetate and 1040 ppm fluoride (sodium fluoride) is more effective than the paste containing 1450 ppm (Mason et al, 2010). In another study, the paste containing 8% strontium acetate and 1040 ppm sodium fluoride was compared with the paste containing 8% arginine, calcium carbonate and 1450 ppm sodium monofluorophosphate. In the study, the sensitivity to touch and cold was evaluated on the 14th, 28th and 56th days after treatment. Although there is no significant difference between the two groups, it is stated that the paste containing 8% strontium acetate and 1040 ppm sodium fluoride is statistically significantly more effective than the other in removing the sensitivity to touch only on the 56th day. In addition, there are also strontium chloride containing desensitizers (Hughes et al, 2010).

Table 1 shows the components of some of the desensitizing agents mentioned above in toothpastes (Bozok, 2015).

The first preferred treatment of dentine hypersensitivity is desensitizing toothpastes, which are mostly used at home. However, all of these toothpastes have certain levels of abrasion effects within the relative dentin wear range (RDA) of 20 to 120. In a recent study, it has been shown that toothpaste with high RDA values causes greater wear (Arnold, Prange, & Naumova, 2015).

In this context, Table 2 shows the RDA values of the existing toothpastes in the market in the study conducted in 2015.

For the sensitivity associated with dental caries, it draws attention to the increasing use of toothpaste (DTP) with desensitizing properties, especially among children. Toothpaste manufacturers aggressively market DTP with well-designed advertisements.A study shows that even well-educated and informed parents use DTP as a remedy for the sensitivity of tooth decay in their children, and the use of DTP for tooth decay pain is 33%.With the use of these agents, early warning signs are restricted, the progression of the infection and a false sense of treatment appear (Rooban, & Elgovan, 2015).

3.1.2. Clinical Applications

When home methods do not work, clinical applications should be started. Protein Precipitators: Primers are examples of agents containing HEMA / gluteraldehyde. While HEMA is physically blocking the dentin ducts, gluteraldehyde reduces dentin permeability by coagulation of plasma proteins in dentin fluid (Porto, Andrade, Montes, 2009). In a study evaluating the results of gluma with other desensitizers, 5% sodium fluoride (Duraphat, Colgate-Palmolive Co, USA), 2% fluorine iontophoresis, 5% sodium fluoride (Copal Varnish, Cooley & Cooley, USA) were used. At the end of 24 hours, while there was a statistically significant decrease in sensitivity in all groups, A statistically significant decrease was observed only in iontophoresis and Gluma groups after one week (Olusile, Bamise, Oginni, & Dosumu, 2008).

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Table 2: RDA values of toothpastes on the market (Rooban, & Elgovan, 2015).

RDA	Toothpast Name	RDA	Toothpast Name
4	Toothbrush with plain water	100	Sensodyne Tartar Control Whitening
7	Plain baking soda	101	Natural White
8	Arm & Hammer Tooth Powder	103	Arm & Hammer Sensation
15	Weleda Salt Toothpaste	104	Sensodyne Extra Whitening
30	Elmex Sensitive Plus	106	Arm & Hammer Advance White
30	Weleda Tooth Products	107	Crest Sensitivity Protection
34	ProNamel by Sensodyne	107	Sensodyne Full Protection Whitening
35	Arm & Hammer Dental Care	110	Crest Regular
42	Arm & Hammer Advanced Whitening / Peroxide	110	Prevident 5000 Booster
45	Weleda Calendula Toothpaste	110	Colgate Herbal
45	Weleda Pink Toothpaste with Ratanhia	113	Aquafresh Whitening
45	Oxyfresh	117	Arm & Hammer Advance White Gel
48	Arm & Hammer Dental Care Sensitive	117	Arm & Hammer Sensation Tartar Control
49	Tom's of Maine Sensitive	120	Close Up with Baking Soda
52	Arm & Hammer Peroxicare Regular	124	Crest Sensitivity Whitening + Scope
53	Rembrandt Original	124	Colgate Whitening
53	CloSYS	130	Crest Extra Whitening
54	Arm & Hammer Sensitive + Whitening	133	Ultra Brite
54	Arm & Hammer Dental Care PM Bold Mint	140	Crest Pro Health Night
57	Tom's of Maine Childrens Toothpaste	142	Colgate Total Whitening
63	Colgate Sensitive Enamel Protect	145	Crest Pro Health Enamel Shield
63	Rembrandt Mint	145	Ultra Brite Advanced Whitening
65	ClinPro	150	Pepsodent
68	Colgate Regular	152	Crest Sensitive Whitening
70	Colgate Total	155	Crest Pro Health
70	Arm & Hammer Advance White Sensitive	160	Colgate Total Advanced Fresh
70	Colgate 2-in-1 Fresh Mint	162	Crest Pro Health Whitening
78	Biotene	165	Colgate Tartar Control
79	Sensodyne	168	Arm & Hammer Dental Care PM Fresh Mint
80	Close Up	176	Nature's Gate paste
83	Colgate Sensitive Max Strength	200	Colgate 2-in-1 Tartar Control / Whitening

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Table 2 (continued): RDA values of toothpastes on the market (Rooban, & Elgovan, 2015).

RDA	Toothpast Name	RDA	Toothpast Name
84	Tom's of Maine	200	FDA upper limit
85	Dentisse	250	ADA upper limit
87	Nature's Gate		
90	Sensodyne Fresh Mint		
91	Aquafresh Sensitive		
92	Sensodyne Cool Gel		
93	Tom's of Maine		**The RDA Table**
94	Rembrandt Plus	**0-70**	Low Abrasive
94	Sensodyne Fresh Impact	**71-100**	Medium Abradive
95	Oxyfresh with Fluoride	**101-150**	Highly Abrasive
100	Sensodyne Original	**151-250**	Regarded as Harmful Limit

*The date from this chart was compiled from various sources including independent research and company literature.

Agents Blocking the Dentin Tubules: Calcium ions bind free protein radicals in calcium hydroxide application and block the dentin ducts by increasing the calcium hydroxide mineralization.

However, many applications are required to maintain its effect and it is thought to have a toxic effect on gingival tissues (Bartold, 2006). In desensitizers containing oxalate, acidic oxalate provides the release of calcium ions from the dentin surface and insoluble calcium oxalate crystals are formed. These crystals block the dentin ducts and prevent the flow of fluid in the ducts and do not allow painful stimuli to pass to the nerve receptors (Sezgin, & Tarım, 2012)

In a review of 12 studies evaluating oxalate-containing desensitizers, it was concluded that 3% monohydrogen mono-potassium oxalate had beneficial effects and was the first agent to be preferred in the treatment of oxalate (Cunha-Cruz, Stout, Heaton, & Wataha, 2011).Varnishes with fluorides usually contain 5% sodium fluoride.

Propolis is a resinous substance collected from various plant sources and is one of the most valuable bee products. In a study where propolis was tested in individuals with DH for 4 weeks, high satisfaction was reported with a decrease in sensitivity in 85% of the subjects. In another in vitro SEM study, propolis has been shown to block the dentin tubules (Almas, Mahmoud, Dahman, 2001). In a study, the effectiveness of propolis was compared with fluoride gel (APF) and it was reported that propolis showed similar results with fluoride in dentin sensitivity (Toker, Özan, Özdemir, & Değer, 2008).

Iontophoresis: Iontophoresis is the application of a certain drug through an electric current to a localized area, it is generally used in combination with sodium fluoride in the treatment of dentine sensitivity. It is argued that iontophoresis causes the formation of

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reparative dentin and causes paresthesia, and also creates a blockade by providing precipitation of the formed calcium fluoride. It was found that the fluorine concentration in teeth treated with iontophoresis was 2 times higher than that in the teeth where fluorine was applied topically. In a study, they compared iontophoresis combined with APF gel with a dentin bonding agent (Scotchbond, 3M ESPE, USA).The areas where the materials were applied were examined immediately after the treatments were applied and 2 weeks later. While both treatment methods are effective in relieving sensitivity, there was no statistically significant difference between the two groups in the evaluation made immediately after treatment, ionophoresis is reported to be statistically significantly more effective in de-sensitization than adhesion in the examination performed 2 weeks later (Aparna, Setty, Thakur, 2010).

Lasers: Lasers used in sensitivity treatment can be grouped into two main groups; low power helium-neon (He-Ne) and Gallium Aluminum Arsenid (GaAlAs) (diode) lasers and medium power Nd: YAG, Er: YAG and CO2 lasers (Attar, & Korkmaz, 2006).

Restorative Treatment: Restoration of the tooth with composites and glass ionomer cements can be preferred in treatment due to the reasons such as the regionally applied materials are not effective in dentin hypersensitivity, high tissue loss, aesthetics and high caries risk (Attar, & Korkmaz, 2006).

4. Dentin Sensitivity and Treatments in Pediatric Patients

Although many studies have been published on the prevalence, etiology, and treatment of dentine sensitivity, most have focused on their occurrence in adolescents and adults. In children, DH has been associated with reflux, bulimia-associated erosion, orthodontic treatment, postoperative hypersensitivity and amelogenesis have been associated with developmental disorders such as imperfecta, dentinogenesis imperfecta, hypomineralization, molar incision hypoplasia (MIH). There are not many studies on DH in children without developmental dental defects (Souza-e-Silva, Parisotto, Steiner-Oliveira, Gaviao, & Nobre-dos-Santos, 2010).

In a study, clinical and salivary factors associated with DH are evaluated in children. While the presence of DH was detected in 41% of the children participating in the study, this was not observed in 59%. It is observed that children who show signs of dental erosion have a higher DH prevalence than children who do not. No dietary habits and DH showed a significant relationship. Considering the parameters of Saliva, children with higher salivary flow are reported to have lower DH prevalence. However, other salivary parameters do not show a significant relationship with DH (Shitsuka, Mendes, Corrêa, & Leite, 2015).

The term molar incisor hypomineralization (MIH) can be defined as the clinical picture of systemic origin enamel hypomineralization that affects one or more first permanent molars. It is thought that MIH, whose etiology is not fully known, is a genetic disease and is caused by childhood diseases. Patients affected by MIH bring many clinical problems such as rapid wear, enamel loss, increased caries sensitivity, loss of fillings and most importantly, severe hypersensitivity often causes discomfort. In these patients, hot, cold or sweet drinks / meals, tooth

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brushing and even air flow cause sensitivity. However, the cause of hypersensitivity is still not fully understood (Fagrell, 2011).

In such patients, protective measures protocols include the application of other topical fluoride varnishes as well as oral hygiene with fluoride toothpaste. Also, CPP-ACP oral care products are recommended for remineralization and desensitization. Although there is currently no evidence to support the treatment of MIH-affected teeth, all these products have been proven to reduce sensitivity (Lygidakis, 2010).

In a study, children with at least 1 hypersensitive molar tooth affected by MIH were included in the study and each child was applied a desensitizing paste (Elmex sensitive professional desensitizing paste) containing 8% arginine and calcium carbonate with a single office application. Then, for 8 weeks, it is said to brush twice with a desensitizing toothpaste containing 8% arginine, 1450 ppm fluoride calcium carbonate (Elmex sensitive professional toothpaste).A significant increase is observed in the scores obtained immediately after the treatment and scores obtained after 1 week, while a significant decrease is reported in the 8th week. While there was a clinical improvement before and after treatment, no statistically significant difference was found (Bekes, Heinzelmann, Lettner, & Schaller, 2017).

In a study, the effect of desensitizing agents and ozone added to these agents on hypersensitivity to MIH was evaluated. In the study, 3 main groups (Fluoride, CPP-ACP, CPP-ACP with fluoride) and 6 subgroups (with and without ozone) were created by separating these main groups. Among the materials used, CPP-ACP was found to be more effective in reducing sensitivity and it was stated that the use of ozone prolongs the effect of this material (Özgül, Saat, Sönmez, & Oz, 2013).

5. Result

Considering individual risk factors and multiple etiological causes in dentine sensitivity cases, clinical studies and evidence-based studies are needed to establish correct and clear treatment protocols.

Conflicts of interest

The author declares no conflicts of interest related to this study

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