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Research Article

Effectiveness of Diode Laser 980nm Versus Sodium Fluoride Varnish in the Treatment of Dentinal Hypersensitivity

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Abstract

Background: *Dentin hypersensitivity is a problem associated with sharp and short duration pain due to many predisposing factors. Many treatments are important in this aspect which are effective as well, among which laser treatment and chemical agents are well known. But scientific study demands continuous advancement and evaluation in order to make more updated knowledge to the researchers, doctors and professionals. This makes the foundation of this study very significant.*

Aim and Objectives: *The primary aim of the study is to review the literature to compare the effectiveness of Diode laser 980 nm versus fluoride varnish in the management of hypersensitivity of dentin.*

Objective of this research study is:

1. *To systematically search, synthesize and critically appraise the available literature for both methods of treatment.*

2. *To determine the effects of the treatment for dentinal hypersensitivity in clinical practice and research.*

Method: *Electronic databases were investigated and explored using specific search methods. Hand searches of applicable reviews and literature were carried out to gain maximum yield from them. The veteran opinion and experts advise for extra helping bits and pieces .Keeping all this in mind specifically the studies' inclusion and exclusion criteria, care was taken to include competent and eligible abstracts of knowledge were added in this review manuscript.*

Results: *The studies and reviews included were evaluated for methodological outcomes with a proper analysis .Many manuscripts were added in the paper starting from basic knowledge including significant causes, anatomical importance for the occurrence of disease, treatment and classification with a focus on laser treatment along with treatment with sodium fluoride varnish for DH. Both treatments were found very effective but synergistic effect of both protocols proved an enhanced efficacy in treating the DH.*

Discussion

The quality research reviews and manuscripts were evaluated for the desired purpose of treatment. It was carefully estimated that continuous study with upgrading technology variation is mandatory in the treatment of cases. It was concluded that all studies were consistent gold standard, however further research is needed in the field of oral dentistry and real benchmarks have to be recorded for enhanced prospects in dentin hypersensitivity treatment protocol.

Abbreviations

- *DH (Dentin Hypersensitivity)*
- *HD (Hypersensitive Dentin)*
- *NaF (Sodium Flouride).*

Introduction

Dentin hypersensitivity that is abbreviated as DH (Karim and Gillam,2013)or it can also be shortened as DHS and also recognized as sensitive dentin or dentin sensitivity (Miglani et al,2010) or cervical sensitivity (Advisory board,2003) and cervical hypersensitivity is a class of dental pain which is very sharp in character and of very short duration, that arise from exposed dentin surfaces in response to some kind of specific stimuli, normally thermal, evaporative, tangible, osmotic, chemical or electrical and which cannot be credited to any other kind of dental disease (Advisory board,2003).

Dentin sensitivity is usual, but here pain is not generally experienced in everyday activities like drinking a cold drink (Turp and Jens 2012). Therefore the term dentin sensitivity and sensitive dentin are used regularly to refer to dental hypersensitivity (Advisory board, 2003). So such terminologies or definitions are used most frequently in the literature, research papers and books.

Dentine tubules must be patent from the dental pulp to the oral environment to experience pain (Absi etal, 1987) which is widely thought to result from stimulus-induced tubular fluid flow and consequent

nocioceptor activation in the pulp or dentine boundary area (Addy, 1987; Addy et al, 2000; Addy et al, 2002). Patients' value or quality of life is frequently distorted as the pain is linked with tangible frequent discomfort (Bekes et al, 2009).Affected individuals manage by modifying behaviors such as avoiding more from chilled food and drink and seeking self or expert treatment(Nicola, 2013).

Definitions

- Dentinal Hypersensitivity is indicated by a sharp pain, which is of a short duration, which arises from exposed dentin surfaces when it is stimulated by thermal, tactile or osmotic stimuli. This pain cannot be related to any other dental disease or condition.

- De-sensitizing Agents are drugs, which alleviate painful sensations occurring in exposed dentin. Some of desensitizing agents are sodium fluoride, stannous fluoride etc. Cervical Sensitivity is synonymous to dentinal hypersensitivity.

- Diode Laser 980nm is a high-energy laser, which has low cost and maintenance rates and is greatly versatile owing to its small size.

- Erosion of tooth is the wearing of tooth enamel due to acidic reactions and this can be a major reason for Hypersensitive Dentin.

- Gingival Recession is an undesirable condition in which the roots are exposed, leading to caries and hysensitivity.

Signs and Symptoms

Hypersensitivity is a very sharp and sudden pain in response to an external stimulus. (Addy and Dowell 1983). The generally and widespread cause is cold (Nicola, 2013) with set up of 70% - 75% of people with hypersensitivity reporting pain upon application of a cold stimulus (Advisory board,2003).There are also other types of stimuli which can also start pain in dentin hypersensitivity. There are different stimuli which may impact teeth as well.

1. Thermal stimulus is very significant, e.g. hot and cold drinks and foods(Petersson,2006) and electrical

2. Mechanical, for example dental probe during dental examination,(Hargreaves,2010)

3. Tooth brushing (Petersson, 2012).

4. Osmotic stimuli such as sugars. (Hargreaves,2010)

5. Another stimulus is evaporation, for example air blast from a dental instrument (Hargreaves, 2010)

6. Chemical exposure to teeth like acids, dietary, gastric, acid etch during dental treatments. (Hargreaves,2010)

Significant Causes

The main cause of DH (Dentin Hypersensitivity) is gingival slump or recession along with revelation of root surfaces, trouncing of the cementum and smear layer and tooth wear (Hargreaves, 2010).We can see receding gums. Receding gums can be a precursor of long-term trauma from needless or dynamic tooth brushing, or brushing with coarse toothpaste (Hargreaves, 2010).

Other less extensive causes are acid decomposition (this is related to gastroesophageal reflux disease, excessive utilization of acidic foods and drinks etc) and periodontal root planning. (White, 2007). Dental bleaching is another recognized root of "Dentin hypersensitivity "or DH (Hargreaves, 2010).

Dentine is a complex structure to observe .Dentine contains many microscopic tubular structures that branch out outwards from the pulp. These dentinal tubules are typically 0.5–2.5 micrometres in diameter. Plasma-like biological fluid is present in the dentinal tubules that can trigger mechanoreceptors present on nerves that are located at the pulpal facet, thereby giving out a pain reaction. This flow can be augmented by cold, air pressure, drying, sugar, sour or stimuli that are acting onto the tooth. A very hot or cold food or drinks, and solid pressure are most common triggers in these individuals with DH.Most experts and veteran on this topic declare that the pain of Dentin

hypersensitivity (DH) is a normal, physiological reaction of the nerves in a healthy, non-inflamed dental pulp in the situation where the insulating layers of gingiva and cementum have been gone (Advisory board, 2003). To disagree with this observation that not all exposed dentin surfaces cause DH (Advisory board,2003), some others suggest that due to the presence of obvious dentinal tubules in areas of oversensitive dentin, there may be increased pain to the pulp, thus causing a state of reversible inflammation (Schmidlin,2012).

Epidemiology

Dentine hypersensitivity (DH) is a general oral pain condition characterized as an intense, transient pain resulting from stimulation of exposed dentine, characteristically in response to chemical, thermal, tactile or osmotic stimuli (Addy, 1983; Ress et al, 2003).

Prevalence with respect to age factor.

Dentin hypersensitivity is a relatively common condition. The reported incidence of DH ranges from 4-74%. Dentists may under-report dentin hypersensitivity due to complexity in diagnosing and overseeing the condition. In common, it is estimated to affect about 10%-15% of the general population to some extent.

Dentine hypersensitivity (DH) manifests as a transitory but stunning oral pain. The incidence is thought to be increasing, mainly in young adults, due to increases in consumption of healthy, however erosive diets. The studies measure a towering prevalence of DH and relative importance of risk factors in 18–35 year old People especially Europeans. (Nicola, 2013).

Prevalence with respect to gender

It may involve people of any age, though those aged 20–50 years are more expected to be affected, with more people affected between ages of 30-40 years of age (Advisory board, 2003 and Flynn, 1985).

Females are slightly more likely to build up dentin hypersensitivity compared to males (Advisory board, 2003).

Prevalence with respect to anatomical position.

The condition is most normally associated with the maxillary and mandibular canine and bicuspid teeth on the facial aspect (Advisory board, 2003).DH has more prevalence with the type and location of teeth involved. (Taani and Awartani, 2001)

Prevalence with respect to type of teeth involved.

Regarding the type of teeth involved, incidence is elevated in canines and premolars the most affected teeth. This is also seen that buccal aspect of cervical area is the normally affected site (Addy, 1987).

Overall, the prevalence of DH was seen high as compared to many available findings, with a well-built, progressive correlation between DH and erosive tooth wear, which is important to differentiate for patient preventive therapies and medical management of DH pain (Nicola, 2013).

Prevalence of the common oral pain condition, dentine hypersensitivity (DH) is high in young adults, however peoples' insight of their pain is less than that of clinical reporting possibly reflect the transient nature of the pain condition and good coping mechanisms. Erosive tooth wear and loss of attachment were strongly associated with high prevalence of DH. Possible risk factors such as erosion from gastric origin and intake of erosive foods were corroborated in this investigation as they are considerably associated with high prevalence (Boiko et al, 2003) of dentine hypersensitivity (Nicola, 2013).

Pathogenesis

Dental Hypersensitivity has a sharp and painful tract in the oral channel. Lesions develop slowly in steps with sharp mode. It has been stated many times in most of literature that DH develops in numerous phases, usually two phases: lesion localization and lesion initiation (Gillam and Orchardson, 2006). Lesion localization takes place by loss of defensive covering (Orchardson and Cadden, 2001) over the dentin, thus revealing it to external environment. It comprises defeat of a protective layer that is enamel via attrition, abrasion, erosion. Another reason for lesion localization is gingival recession which can be due to toothbrush scratch, tooth preparation for crown, unnecessary flossing (Dababneh et al, 1999).

As it is assured before, not all uncovered dentine is sensitive. For DH to occur, the lesion localization has to be initiated. It occurs after the defensive covering of smear layer is disconnected that leads to revelation and opening of dentinal tubules. (Wilchgers and Emart, 1997).

Mechanism

There are several mechanisms by which dentinal sensitivity operates. (Pashley et al, 1986; 1990; 1992; 2000).Three key mechanisms of dentinal sensitivity have been premeditated.

1. Direct innervations theory

This theory narrates that nerve endings go throughout dentine and extend to the dentino-enamel junction. (Irvine, 1988).Straight mechanical stimulation of these nerves will start an action prospective. There are many insufficiency of this mechanism theory. There is need of substantiation that outer dentin, which is characteristically the mainly sensitive element, is innervated. Developmental studies and researches have exposed that the plexus of Rashkow and intratubular nerves do not set up themselves till the tooth has erupted, however, lately erupted tooth is much sensitive (Orchardson and Cadden, 2001).Additionally, pain inducers such as bradykinin not succeed to encourage pain when relate to dentine, and bathing dentine with local anaesthetic solutions does not stop pain, which does so when applied to skin usually.

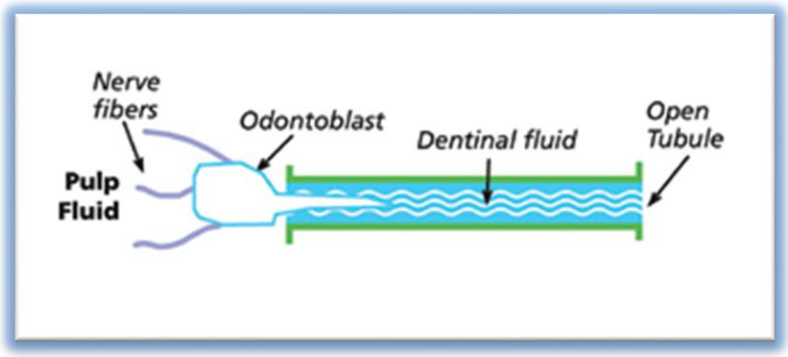


Figure 1: Tubule anatomy. When cementum or enamel covering the dentin is removed or breached, the fluid within the exposed dentinal tubule is able to transmit pain-producing stimuli.

Source: http://www.dentistrytoday.com/aesthetics/129

2. Odontoblast receptor theory

There is another theory of mechanism of action by which DH is observed in teeth. Odontoblast receptor theory observes that Odontoblast act like as receptors by themselves and passes on the signal or signal to a nerve terminal (Rapet al, 1968).But extensively held studies and researches have made known that odontoblasts are medium of forming cells and consequently they are not measured to be emotional cells and no synapses have been established stuck between odontoblasts and nerve terminals. So this speculation also has an excellent weight in determination of the DH.

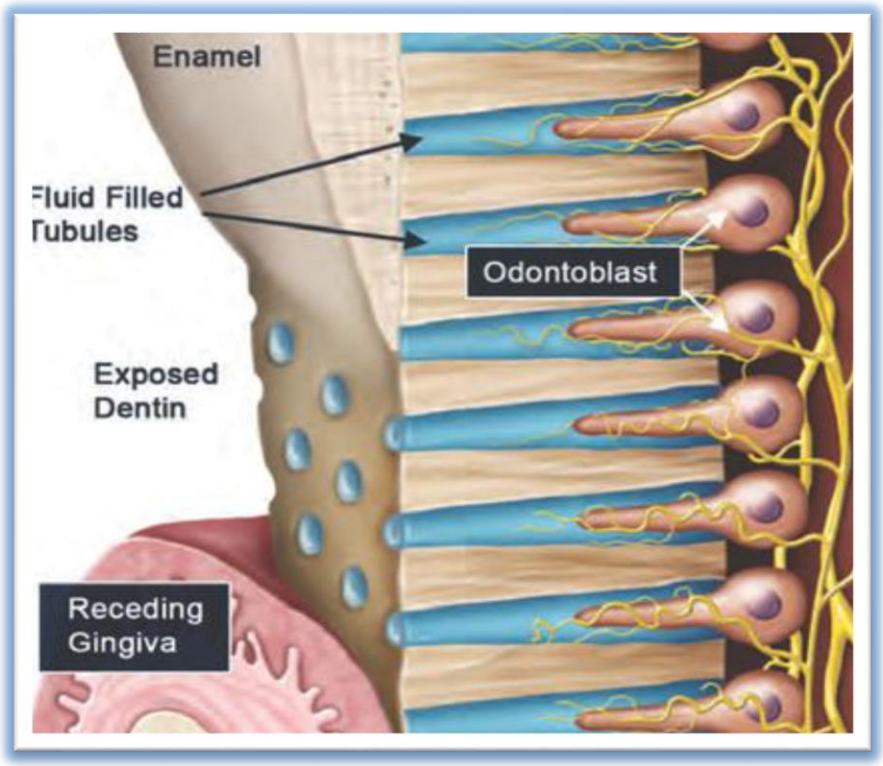


Figure 2: Odontoblast

Source: http://biologicalexceptions.blogspot.com/2014_05_01_archive.html

3. Hydrodynamic theory

Among many theories of dentinal pain and DH, the most pertinent theory is that dentinal pain is due to hydrodynamic mechanism of action i.e., fluid force (Brännströmand Åström, 1964).

Electron microscopic (EM) analysis of "hypersensitive" dentin indicates the existence of widely open dentinal tubules (Absi, 1987).The incidence of wide tubules in oversensitive dentin is constant with the hydrodynamic theory. This theory of action is extensively based on the existence and progress of fluid in the dentinal tubules. This special fluid movement, in turn, activates the nerve endings at the end of dentinal.(Orchardson and Gillam,2006) This is parallel to the commencement of nerve fibers neighbouring the hair by touching and applying pressure to the nearby hairs. The reaction of pulpal nerves depends upon the pressure applied, i.e., strength of stimuli (Orchardson and Gillam,2006).It has been eminent and distinguished that stimuli which tend to move the fluid away from the pulp–dentine complex, formulate additional pain. These stimuli comprise which contribute to this is cooling, drying, evaporation and ultimately application of hypertonic substances (Chidchuangchai et al, 2007).

About more than 70-75%% of patients with DH complain of pain with appliance of cold stimuli allegedly said, a reduced pain in the tooth. (Chidchuangchai et al, 2007). In spite of the fact that fluid progress inside the dentinal tubules induces pain, it must be renowned that not all exposed dentine is sensitive. As said before, the "hypersensitive" dentin has more generally open tubules as compared with "non-sensitive" dentine. The wider tubules increase the fluid movement and thus the pain response becom

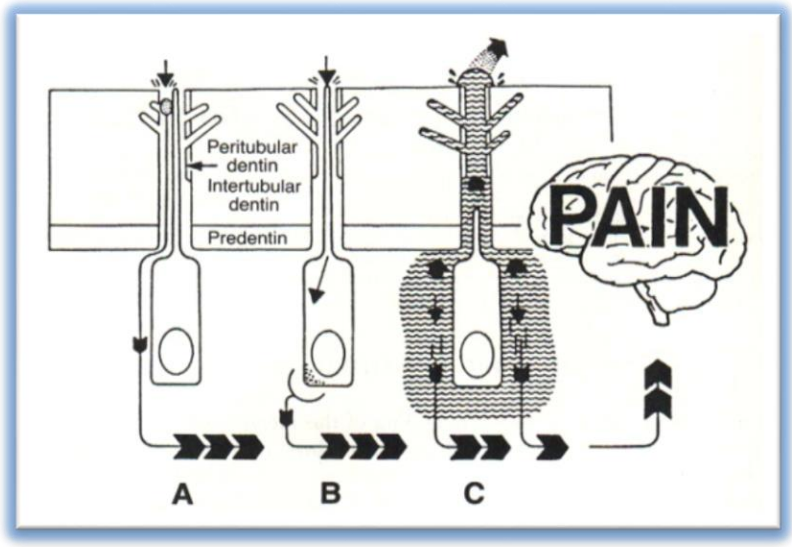


Figure 3: Vitality and sensitivity of dentines further prominent (Absi, 1987 and Rimondini, 1995).

Source: http://up.edu.ps/ocw/repositories/pdf-archive/MGDS2106101t17830112008/body.html

Anatomy (dentine pulp complex)

Dentine is an intricate structure (Parti et al,1999,2001,2002,2003) which is very significant to observe appropriately. Until you understand the complex, you are not able to recognize the whole mechanism. Dentine is sheltered and restricted by hard tissues such as enamel. Dentin is a vital tissue comprises of dentinal tubules, and is logically sensitive because of extensions of odontoblasts and dentine complex (Orchardson and Cadden, 2001). Yet dentin and pulp are microscopically (Yoshiyama et al, 1990) dissimilar, their origin is from the same precursor (Orchardson and Cadden, 2001). Pulp is associated to dentine; any reaction (physiological or pathological) in these tissues will also manipulate the other. Dentin consists of small canals that are termed as dentinal tubules. These tubules engaged by odontoblastic processes (Orchardson and Cadden, 2001).The odontoblastic processes can enlarge through the complete thickness of dentin (from pulp to enamel junction). The odontoblastic processes are fundamentally the extensions, which are the principal cells of pulp dentin complex (Orchardson and Cadden, 2001).The odontoblastic processes are surrounded by dentinal fluid inside the tubules. The dentinal fluid is a kind of fluid that forms approximately 20%-22% of total volume of dentin (Orchardson and Cadden, 2001).It is particularly filtrate of blood from the pulp via dentinal tubules and a communication medium between the pulp. (Arrais et al, 2006) It is observed that laser has direct impact on dentin complex (not all).

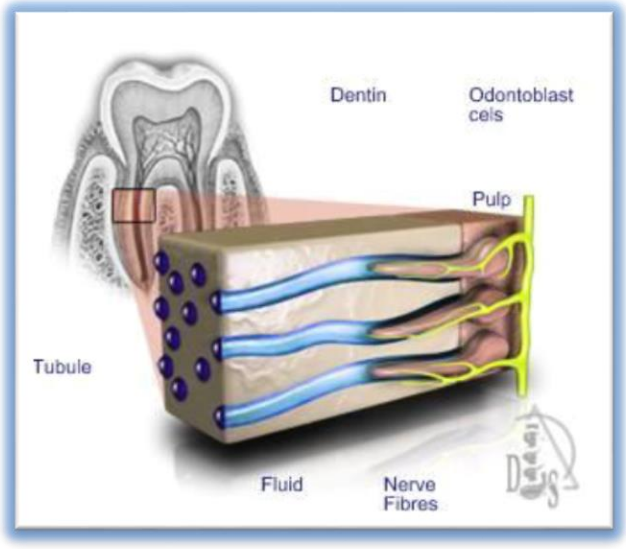


Figure 4: Anatomy of Dentin

Source: http://www.toothandtips.com/tooth-sensitivity/

Morphology of Dentin (Microscopically)

The morphology of dentin plex can be best observed (Prate et al, 1999; 2002; 2003) in this excellent piece of study. The morphological alterations (Rap et al,1968) of odontoblasts and pulp tissue was determined with the safety parameters of 980-nm diode laser in the treatment of dentin hypersensitivity (DH) (Ying et al,2013).In a study trial, twenty extracted human third molars were selected to prepare dentin discs. Each dentin disc was divided into four areas and was irradiated by diode laser underneath different parameters.

1	Group A: control group, 0 J/cm²
2	Group B: 2 W/CW (continuous mode) 166 J/cm²
3	Group C: 3W/CW, 250 J/cm²
4	Group D: 4W/CW, 333 J/cm².
5	Group E: control group, 0 J/cm²
6	Group F: 2.0 W/CW, 166 J/cm².

The morphological changes of the dentin surfaces and odontoblasts were examined with scanning electron microscopy (SEM), and the morphological changes of the dental pulp tissue were seen with an upright microscope.

Dentinal tubules can be entirely blocked by 980-nm diode laser, regardless of the parameter setting (Ying et al, 2013).But the diode laser (with settings of 2.0 W and 980-nm) sealed dentin tubules efficiently, and no significant morphological alterations of the pulp and odontoblasts were observed after irradiation. Hence it was proved and seen that irradiation with 980-nm diode laser may be effective for routine clinical treatment of DH (Ying et al,2013) with 2.0W/CW (166 J/cm²) due to its rapid sealing and its safety to the odontoblasts and pulp tissue.

Figure (1-10): **Microscopic view of Dentin Surface**

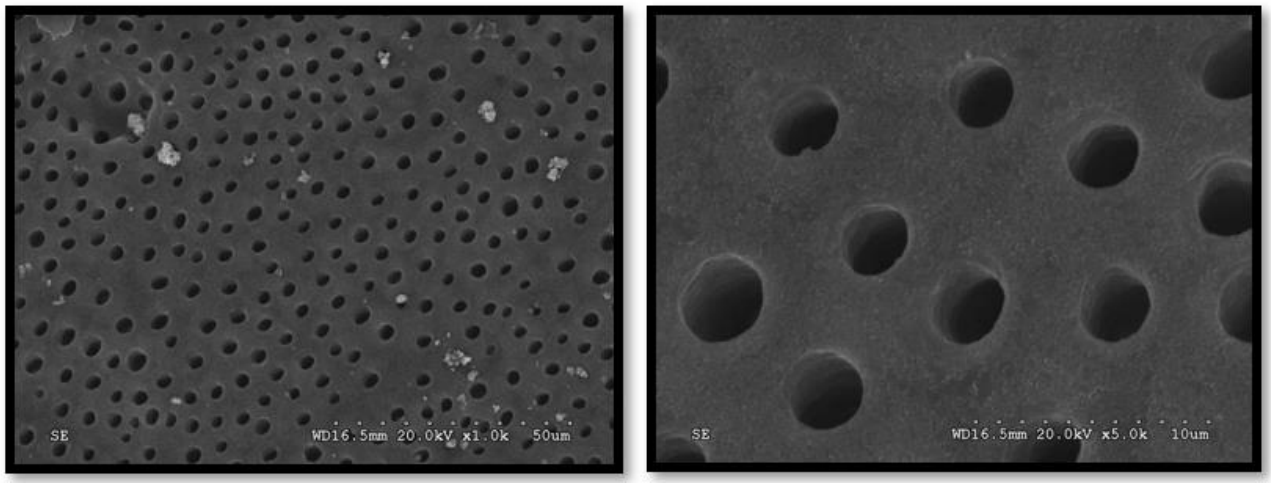


Figure 1. SEM micrograph of dentin surface without laser treatment. (a) A homogeneous surface with visible dentine tubules (×1000) (b) The diameters of the dentin tubules were 2 μm to 5 μm, and the intervals were 3 μm to 8 μm (×5000).

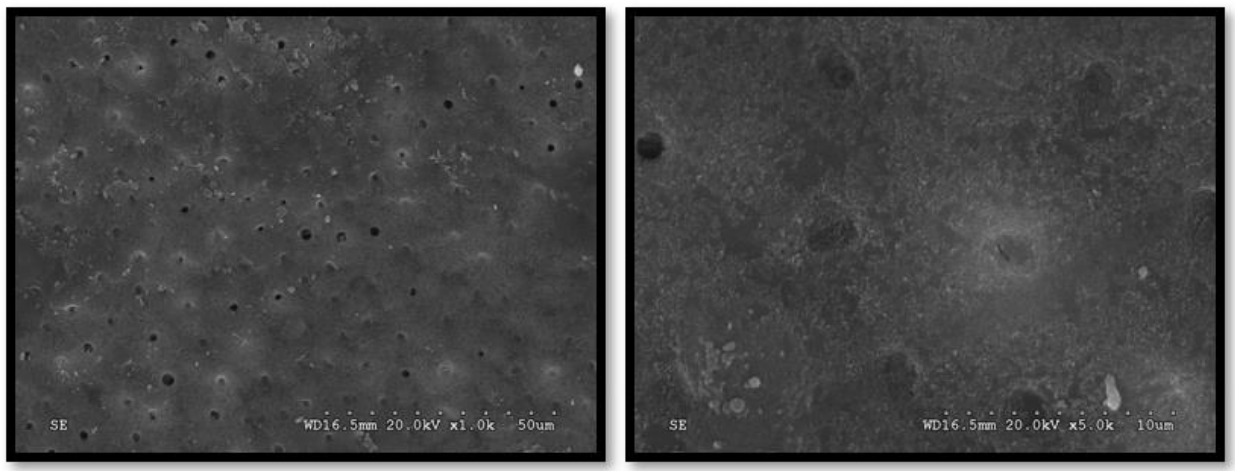


Figure 2. SEM micrograph of dentin surface after 2 W/CW (166 J/cm²) of 980-nm diode laser treatment. (a) Little or no open tubules were observed (×1000). (b) Melting areas were present on the specimens' surfaces, without fissures or craters (×5000)

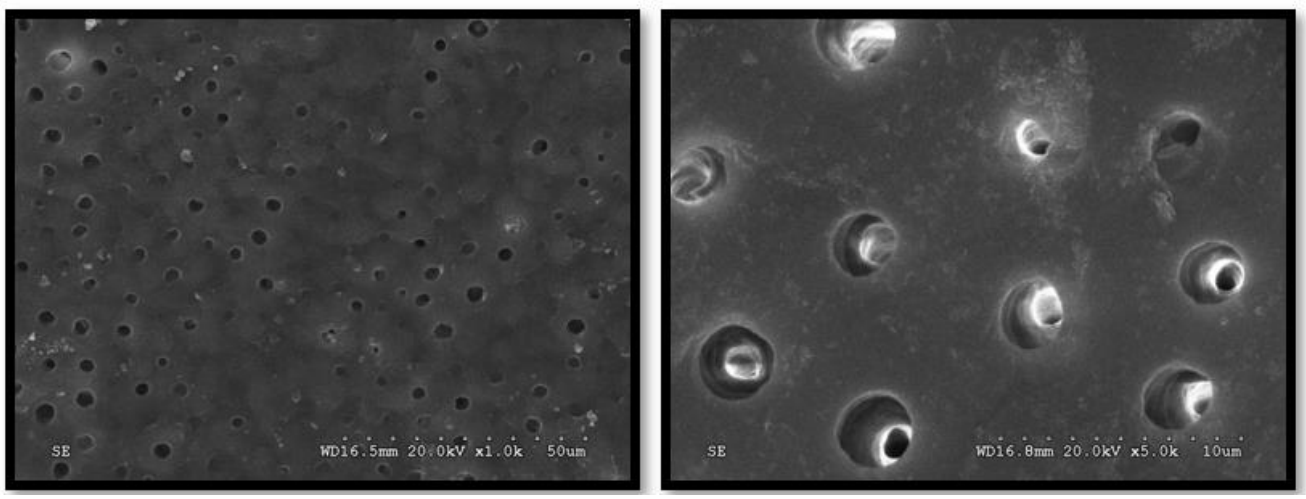


Figure 3. SEM micrograph of dentin surface after 3 W/CW (250 J/cm²) of 980-nm diode laser treatment. (a) The melting degree of the dentin surface was strengthened (×1000). (b) Double layer structures of tubules were observed (×5000).

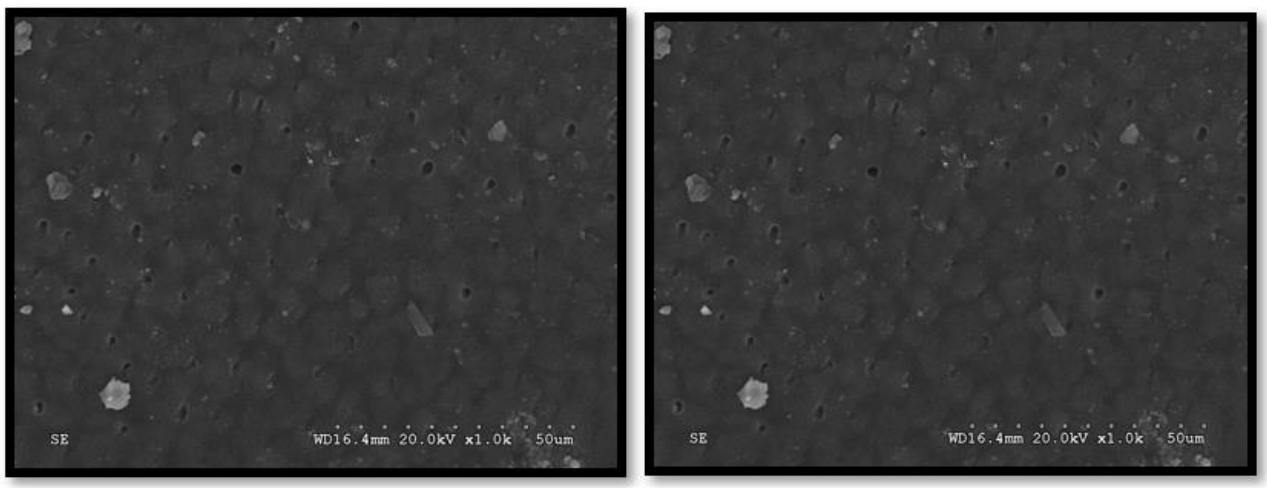


Figure 4. SEM micrograph of dentin surface after 4 W/CW (333 J/cm²) of 980-nm diode laser treatment. (a) The overwhelming majority of dentin tubules were sealed by melting dentin (×1000). (b) The dentin surfaces were covered by homogeneous and melted dentin, without exposure of dentinal tubules (×5000)

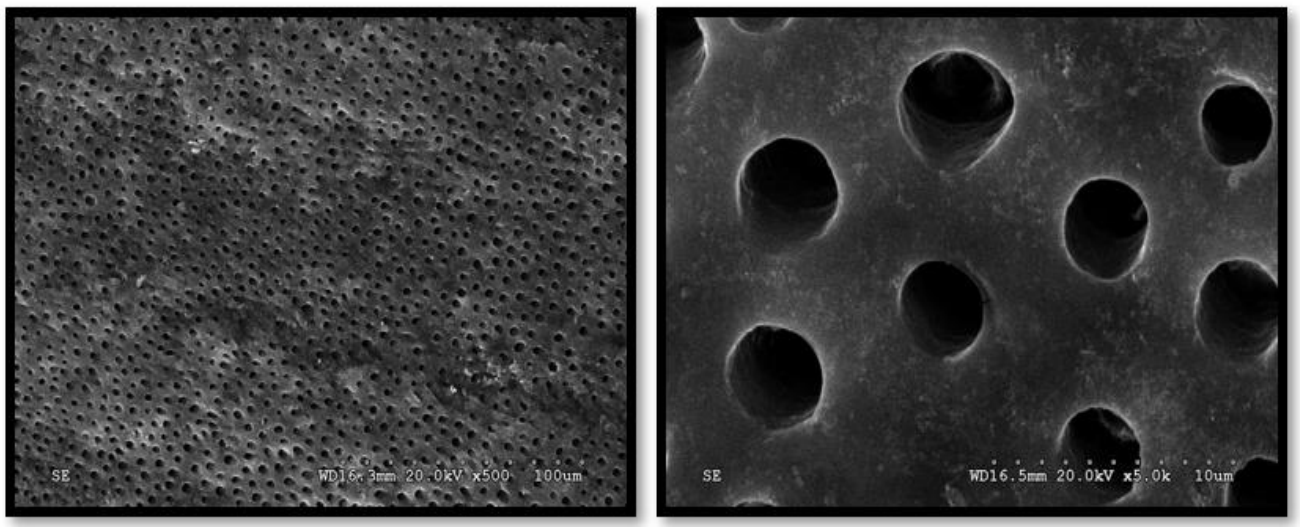


Figure 5. SEM micrograph of dentin surface without laser treatment. (a) Homogeneous surface with visible dentin tubules (×500). (b)Dentin tubules were round or oval, and the diameters were 2 μm to 5 μm, with intervals of 3 μm to 8 μm (×5000).

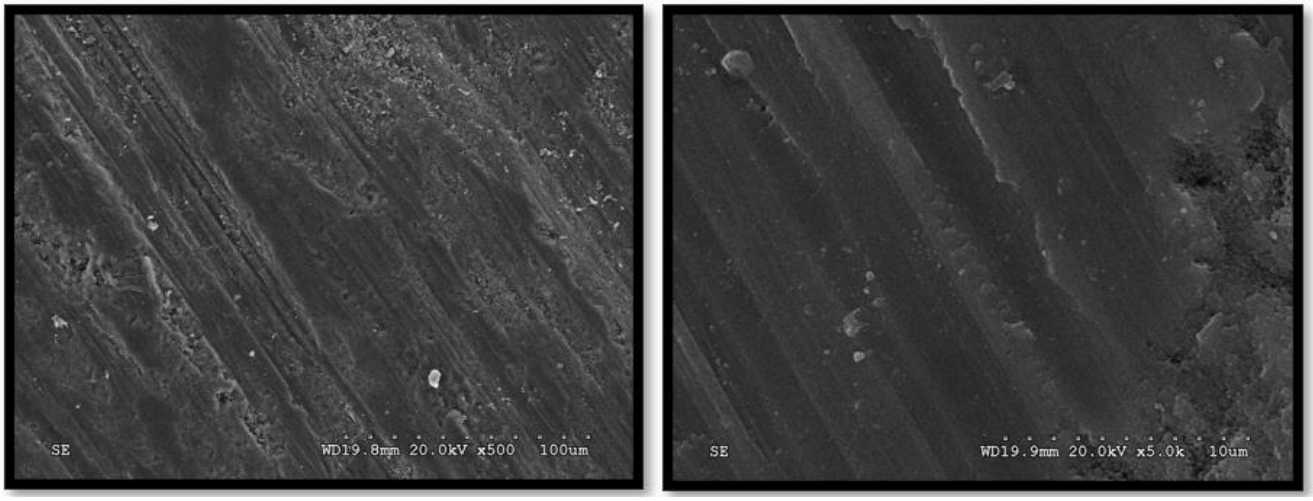


Figure 6. SEM micrograph of dentin surface after 2.0 W/CW (166 J/ cm²) of 980-nm diode laser treatment. (a) A homogeneous surface covered by melting dentin, without exposure of dentinal tubules (×500). (b) No opened dentin tubules were found. (×5000).

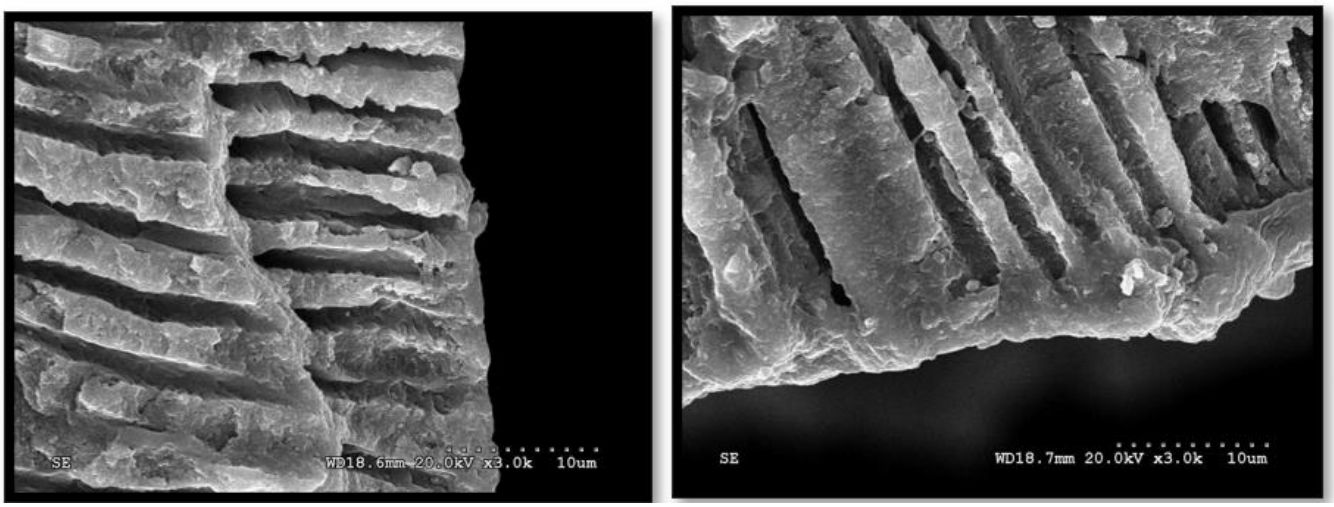


Figure 7. SEM micrograph of longitudinal section parallel to the direction of the dentinal tubules' alignment. (a) SEM micrograph of control group; the dentinal tubules were open (×3000). (b) SEM micrograph of dentin after 2.0 W/CW (166 J/cm²) of 980-nm diode laser treatment. The sealing depth of the melted dentin reached 8 mm (×3000).

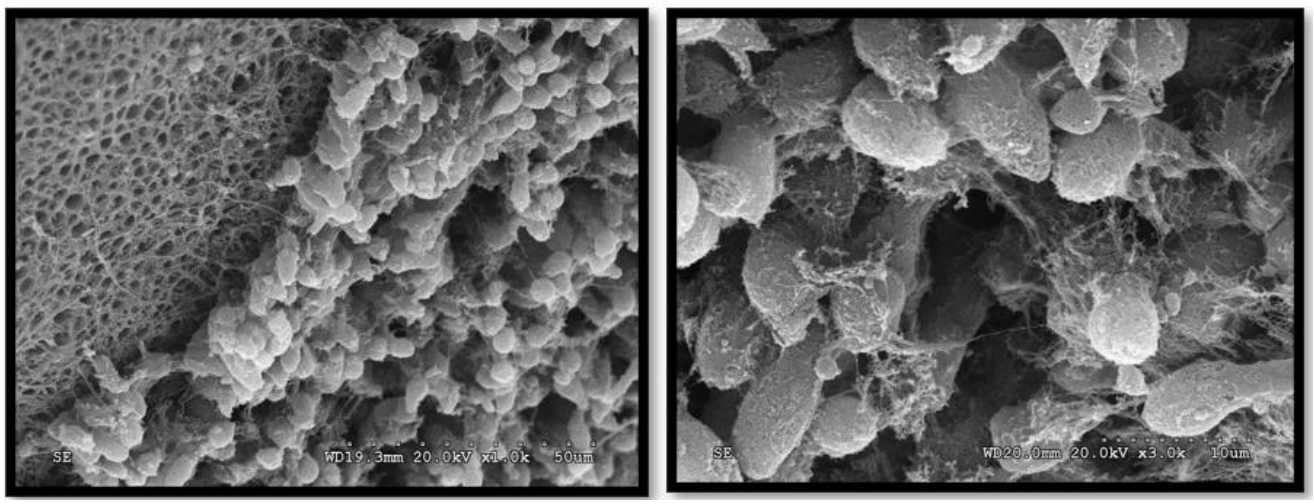


Figure 8. SEM micrograph of odontoblasts in the control group. (a) SEM micrography revealed the integrity of the odontoblast cell-layer and opened dentinal tubules (×1000). (b) The well-preserved morphology of the odontoblast cells (×3000).

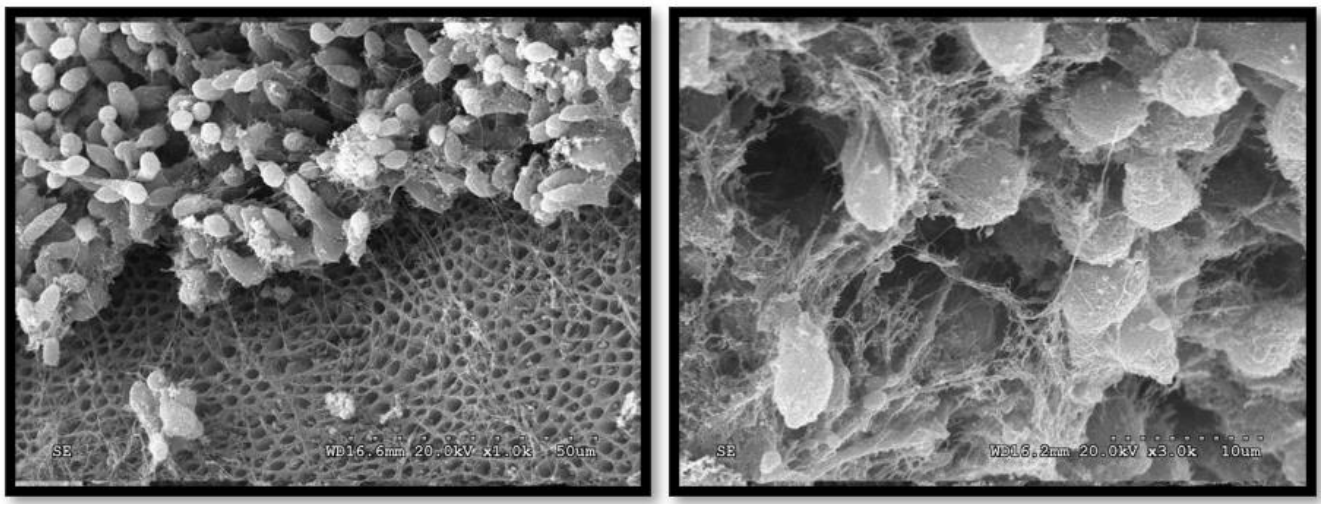


Figure 9. SEM micrograph of odontoblasts after 2.0 W/CW (166 J/cm²) of 980-nm diode laser treatment.

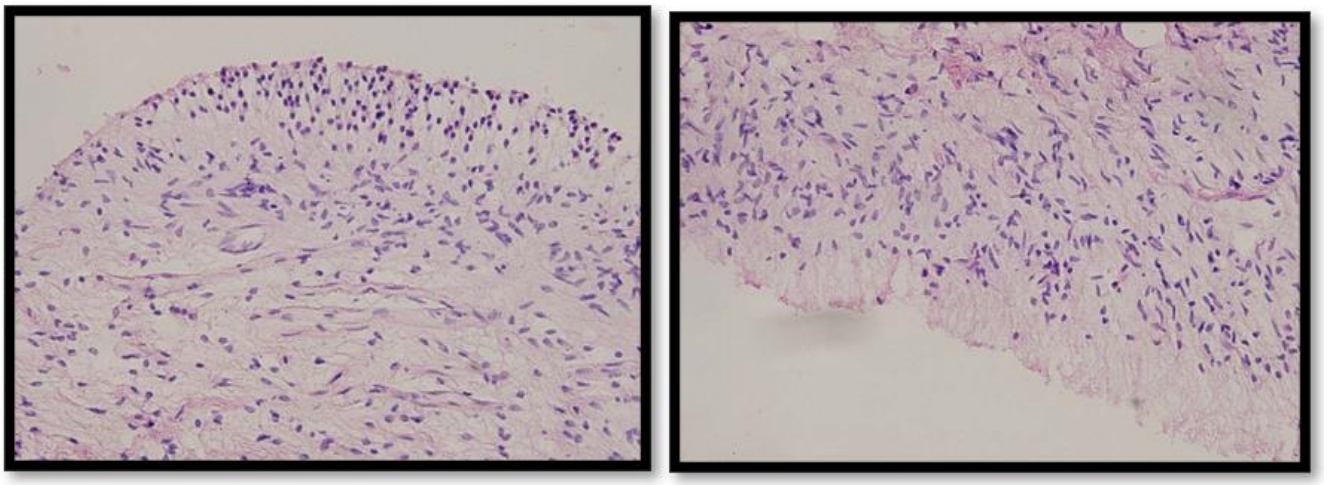


Figure 10. Micrograph of pulp tissue after HE staining. (a) Micrograph of pulp tissue in the control group (×200).(b) Micrograph of pulp tissue after 2.0 W/CW (166 J/cm²) of 980-nm diode laser treatment (×200).

Source: Ying Liu1, Jie Gao1,Yan Gao2, Shuaimei XU, Xueling Zhan, Buling Wu;2013,In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser; J Lasers Med Sci; 4(3):111

Clinical review of possible etiological factors

There are potentially several and diverse aetiological and predisposing factors (Chestnutt et al, 1998) to dentine hypersensitivity. Risk factors and pre disposing factors leading to DH pain are contentious, though many have been recognized. (Bartold et al, 2006)

1- Gingival recession, exposing root dentine, has been revealed to be connected with oral hygiene practices (Addy, 2002 and 2005)

2- Reports show that 60%-70% of people suffering from DH. brush more than twice every day (Gillam,2002 and Addy,2005)

3- Many studies have also confirmed that tooth brushing with rough toothpaste can guide to dentine surface wear (MacDonald et al, 2010) revealing dentine tubules (Addy, 2005).However, some studies disclose the findings that toothbrush itself has little or no effects on dental hard tissues. Even toothpaste on a toothbrush alone causes nearly no enamel abrasion and merely clinically insignificant effects on dentine. (Absi, 1987). However when combined with erosive agents, tissue loss from tooth brushing with toothpaste is increased enormously(Sebnem et al,2009).Traumatic brushing due to the poor position of vestibular zed teeth, which makes them more subject to brushing disturbance, or by extreme force or even lack of brushing with consequent accumulation of dental plaque, causing gingival inflammation which may direct to periodontal complications and migration of the gingiva in the apical direction, exposing the cementum and then the root dentin (Suge, 2006) .Extreme passion in performing oral hygiene measures is also pointed out as being accountable for the manifestation of pain (Mayhew,1998;Taani and Awartani,2001)

4- Dentine hypersensitivity (DH) may arise as a consequence of loss of enamel and /or root surface denudation (Coleman et al, 2000) with exposure of fundamental dentine. Enamel loss as a part of tooth wear can result from attrition, abrasion. (Medical Subject Headings,2013).

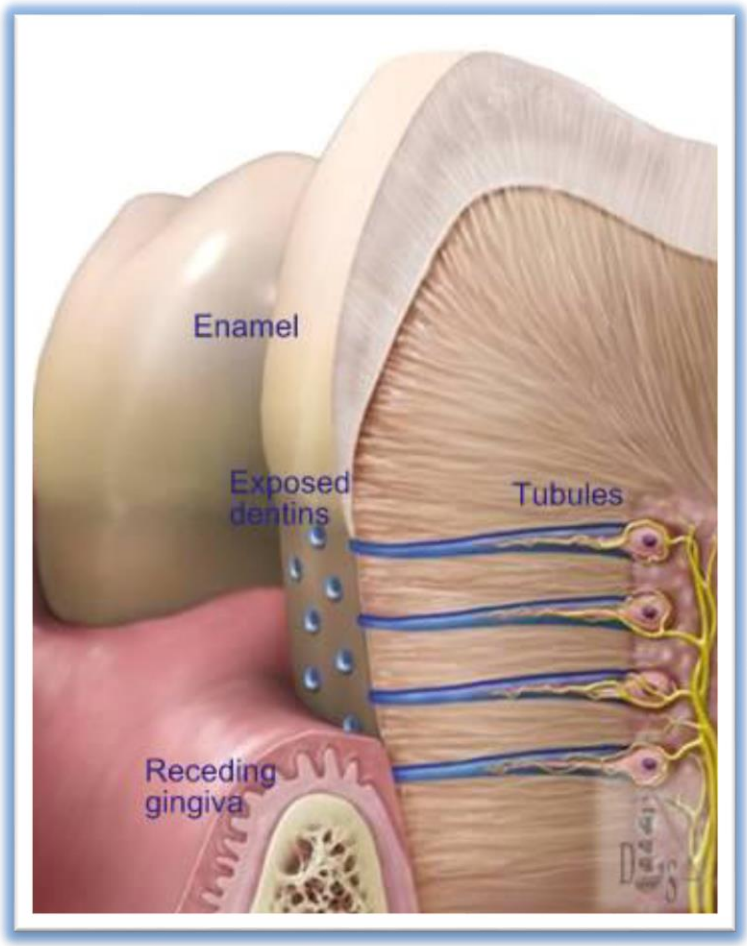


Figure 6: Etiology and Mechanism of Action in Hypersensitive Dentin

Source: http://springhilldentalnlr.blogspot.com/2012/01/youve-got-to-be-less-sensitive-about.html

5- Tooth wear has typically been divided into attrition, erosion and abrasion, in realism it is a recipe of these but often with differing proportional effects. Attrition explains the wear of teeth at sites of direct contact between teeth (Smith, 1989).Attrition is linked with occlusal function and can be overstated by habits or para functional activity such as bruxism. Thus bruxism was found to be the sole cause of pathological tooth wear in 11% of referred tooth wear cases and was a causal factor in two-thirds of the joint aetiology cases.(Smith, 1989)

Abrasion explains the wear of teeth caused by objects other than another tooth (Smith, 1989), examples include toothbrush or toothpaste abrasion and the diversity of facets which can be caused by pipe smoking or other related habits. Characteristic toothbrush abrasion lesions are side dependent, for example being greater on the left-side in right-handed. (Grossman, 1978)

6- Abrasion from chewing, the crushing of bones between the teeth (Kerr,1988) and chewing (Flynn et al, 1985)tobacco were supposed to direct to abrasion of teeth (Morris et al,1999)

7- Periodontal disease along with treatment are both been correlated with DH, a systematic review reported that sensitivity occurs in around half of patients subsequent to scaling and root planning (Troil, 2002). Patients with a low level of oral hygiene have a high degree of periodontal tissue destruction, loss of supporting bone tissue and root exposure (Mayhew, 1998). Root exposure is linked to DH and it can be irritated by the action of acids secreted by bacteria capable of opening the dentinal tubules. (Wilchgers, 1997). Periodontal therapy has been connected with DH due to the revelation of dentinal tubules after the removal of supra and/or sub gingival calculi. Another issue is the removal of dental cementum which covers the root or the root dentin itself during periodontal scraping (Pashley,1996)

8- Additionally, canines and premolars are most affected (Gandolfi et al, 2008)because of their position within the dental arch where they obtain the most attention during tooth cleaning(Addy,1987) (Gangarosa and Park,1978)

9- Nonbacterial acids in the diet, chemical products, medication, drugs or endogenous acids from reflux or regurgitation of stomach acid; that is, substances with low pH escort to the loss of dental structure by chemical dissolution without bacterial involvement. This process is termed as erosion and this produces a more soft enamel zone (Eisenburger, 2002). In the cervical area, the thinner enamel may be slowly dissolved and dentin becomes exposed to the oral environment (Osborne, 1999). The acid environment can also open the dentinal tubules even more, leading to greater sensitivity. Furthermore, this process can be linked with abrasion, chiefly in the cases of an acidic diet or gastric reflux associated with brushing performed instantly after these processes (Wilchgers and Emert,1997)

10- Extreme occlusal forces have been linked to tooth deformation and flexion, resulting in fracture of the enamel crystals in the cervical region, contributing to the exposure of coronal dentin, and in more harsh cases, of coronal and root dentin (Osborne,1999)

11- Abfraction is not unswervingly linked to the diet, periodontal disease or abrasion. Though, it can be a predisposing aspect to DH .

12- Physiological factors The increase in the number of teeth with root exposure is obvious, as age increases Dental extrusion, in the absence of an antagonist tooth results in root exposure, which may lead to DH (Wilchgers and Emert,1997)

Diagnosis

The diagnosis of Dentin Hypersensitivity or DH can be tough. It is a diagnosis that must be ruled out for all other pains. A systematic patient history and clinical assessments are obligator(Addy,2005).The experts must conduct the test .The examination includes a special test called as "pain provocation test" by blasting air from a dental instrument onto the susceptible area, or tender scratching with a probe. If a negative end result for the pain provocation test occurs, no action for dentinal hypersensitivity is indicated and some other diagnosis should be seen.

Inflammation of the dental pulp (pulpitis) produces true hypersensitivity of the nerves in the dental pulp (Advisory Board, 2003). Pulpitis can be both reversible and irreversible. Pulpitis is known as irreversible when pulpal inflammation shall irreversibly progress to pulpal and reversible when the pulp is still able of returning to a healthy, non-inflamed condition, though classically dental handling is requisite for this. Irreversible pulpitis is readily discernible from DH. There is feebly localized pain which is distress by thermal stimuli and which continues after the stimulus is detached. There is also characteristically impulsive pain without any stimulus. Reversible pulpitis cannot be so easily differentiated from DH, although naturally there will be a few clear sign which designates pulpitis. In distinction to pulpitis, the pain of DH is short and prickly (Dababneh et al, 1999.

Treatment

There is no universally established, gold-standard treatment which reliably relieves the pain of dental hypersensitivity in the long term (Orchardson and Gillam,2000) and consequently many treatments have been recommended which have varying degrees of effectiveness when scientifically studied (Karim and Gillam,2013). Usually, they can be divided into in-office (i.e. planned to be applied by a dental therapist) or treatments which may be carried out at home, obtainable over-the-counter by prescription (Karim and Gillam,2013)OTC products are more suited for generalized, mild to moderate dentin hypersensitivity connected with several teeth, and in-office treatments for localized, severe DH associated with one or two teeth (Karim and Gillam,2013).Non-invasive, simple treatments which may be carried out at home must be attempted before in-office procedures are carried out (Karim and Gillam,2013)

The supposed mechanism of action of these treatments (Davari et al,2013) is either occlusion of dentin tubules (e.g. resins, varnishes, toothpastes) or desensitization of nerve fibers (White et al, 2007) or blocking the neural transmission (Thrash et al, 1994)(e.g. potassium chloride, potassium citrate, potassium nitrate) (Karim and Gillam,2013).

Classification of Treatment

It is liable to state that hypersensitive dentin is a demanding condition (Suge et al, 2008) that involves precise approaches (Dondi,et al,2002) and a multidisciplinary treatment ,(Dowell and Addy,1983).All therapies has its own advantages and disadvantages at the same time when compared with baseline, independently of their different modes of action.(Cecilia and Aranha, 2009).

Treatment and clinical management of DH has been disturbed (Ferrari et al, 1999) into following steps depending upon mode of transmission and method of action. (See Table 1).

I. Mode of administration

1. At home desensitizing agents
2. In-office treatment

II. Mode of action

Desensitizing agents can be classified based on their mode of action:

1. Nerve desensitization by Potassium nitrate

2. Protein precipitation by various agents like

1) Gluteraldehyde
2) Silver nitrate
3) Zinc chloride
4) Strontium chloride hexahydrate

3. Plugging dentinal tubules by

1) Sodium fluoride
2) Stannous fluoride
3) Strontium chloride

4) Potassium oxalate

5) Calcium phosphate

6) Calcium carbonate

7) Bio active glasses (SiO2–P2O5–CaO–Na2O)

4. Dentine adhesive sealers by

1) Fluoride varnishes

2) Oxalic acid and resin

3) Glass ionomer cements

4) Composites

5) Dentin bonding agents

5. Lasers:

1) Neodymium:yttrium aluminum garnet (Nd-YAG) laser

2) GaAlAs (galium-aluminium-arsenide laser)

3) Erbium-YAG laser

6. Homeopathic medication

1) Propolis

DH Therapy at home:

Usually, the therapy for management of DH is chiefly aimed at occluding the dentinal tubules or building coagulates inside the tubules (Orchardson, 2006).Patients are frequently given over-the-counter desensitizing agents. These “at home” agents comprise toothpastes, mouthwashes and chewing gums (Orchardson, 2006). Most of the toothpastes contain potassium salts, sodium fluoride, strontium chloride, dibasic sodium citrate, formaldehyde, sodium monofluorphosphate and stannous fluoride. Potassium salts take steps by diffusion along the dentinal tubules and lessening the excitability of the nerve fibers by jamming the axonic action.(Markowitz,1991).Many researches and studies have shown the efficiency of potassium salts (Fischer et al, 1992) in controlling the DH.(Adyy et al,2006)

It has been shown that toothpastes (5% Potassium nitrate + 0.45% Stannous) considerably condensed the DH. Toothpastes containing potassium nitrate and fluorides have been made known to trim down

post-bleaching sensitivity. The desensitizing toothpastes should be used with the help of a toothbrush with soft bristles (Suge et al, 2006). Patients should be advised to use minimal amount of water to put off the dilution of the active agent. Along with these agents, mouthwashes and chewing gums (containing potassium nitrate, sodium fluoride or potassium citrate) are also recommended (Gillam and Orchardson, 2006).

The results of "at-home" desensitizing therapy should be reviewed after every 4 weeks. If there is no aid in DH, then other therapy is advised.

DH therapy by "In-office desensitizing agents":

This kind of therapy is very important than in house therapy (Sowinski et al, 2000; 2001). This involves professional hand treatment for the cases. The in-office desensitizing therapy should provide an instant relief from DH. The in-office desensitizing agents can be classified,

- The materials which undergo a setting reaction (e.g. glass ionomer cement, composites etc)
- The materials which do not undergo a setting reaction (e.g. varnishes, oxalates etc).

Use of Fluorides:

Fluorides have been used as preventive material which may help in remineralisation of enamel or dentin (Paine et al,1998).Many clinical trials have revealed that application of fluoride solution (Corona et al,2003) can reduce the DH.(Morris et al,1999).Fluorides reduce the dentinal permeability by precipitation of calcium fluoride crystals in the dentinal tubules (Orchardson and Gillam2006). These crystals are partly insoluble in saliva. Granules precipitate in the peritubular dentin after relevance of fluorides. (Kern, 1988).

A variety of fluoride formulations (Singal et al,2006)are used to care for DH (include sodium fluoride, stannous fluoride, sodium monofluorophosphate, fluorosilicates and fluoride) combined with iontophoresis (Orchardson and Gillam2006)Sodium fluoride has been used in dentifrices or may be professional applied in a concentration of 2%. The precipitates formed by sodium fluoride may be (mechanically) removed by saliva. Some authors and scientists have suggested the use of ionotophoresis along with sodium fluoride. (Kern, 1988).

A clinical study has shown that 0.4% stannous fluoride along with 0.717% of fluoride can provide an immediate affect after a 5 minute professional application.(Thrash et al,1994) Stannous fluoride acts in a similar fashion as that of sodium fluoride, i.e., formation of calcium fluoride precipitates within tubules. Studies have revealed that stannous fluoride may form insoluble precipitates over the uncovered dentine. (Morris et al, 1999)

Fluorosilicates take action by development of precipitates of calcium phosphates from saliva. Thus, Ammonium hexafluorosilicate is widely used as an active and good desensitizing agent. It can show you a continuous result of dentinal tubule occlusion via precipitation of a combination of calcium fluoride and fluoridated apatite. (Suge, 2008:2006).

Oxalates:

These oxalates have ability to reduce dentinal permeability and occlude dentinal tubules. (Tay et al, 2003)Studies have shown that about 30% percent potassium oxalate had exposed a 98% reduction in dentinal permeability(Pillon et al,2004).Similarly, a topical application of three percent potassium oxalate condensed DH (Pillon et al,2004) and minimize the sensitivity of reaction (Sauro et al, 2006)

Adhesive Materials:

Adhesive systems are able to provide a durable and long-lasting dentine desensitizing effect. The adhesive (resins) can seal the dentinal tubules efficiently by forming a hybrid layer. (Duran and Sengun, 2004).

There are available many studies and researches that have shown adhesives positive impact on the management of DH. (Addy, 2002).

Bioglass:

It has been reported that a formulation of bioglass can promote infiltration and remineralisation of dentinal tubules. These bio glass forms a strong layer, which occludes the dentinal tubules.

Portland cement:

It helps to occlude the dentinal tubules by method of remineralisation (Orchardson and Cadden, 2001)

Laser (light amplification by stimulated emission of radiations):

It has been revealed that lasers can be used in the effective management of DH. (Kimura et al, 2000). There are different thoughts about the working of laser in treatment of DH. This is important to sate here that laser have improved results in treatment of DH. You can observe a high degree of sensitivity and treatment results with laser (low level) (Corona, 2003).

Laser therapy has been recommended (Kimura et al. 2000) to treat DH with effectiveness between 5.2% and 100%, depending on the type of laser and parameters used. It is established fact that lasers are more effective than other treatments, although the effectiveness diminishes in severe DH. This is also known that (McCarthy et al, 1997) reduction in DH may be the consequence of alteration of the root dentinal surface, actually occluding the dentinal tubules.

A. Some researchers showed that Nd–YAG laser application occluded the dentinal tubules. (McCarthy et al, 1997)

B. Some studies suggested that GaAlA laser is thought to act by affecting the neural transmission in the dentinal tubules.(Corona et al,2003)

C. The mechanism of laser treatment for DH is not well explained (Kimura et al, 2000).It is also suggested that it may occur through coagulation and protein precipitation of the plasma in the dentinal fluid or by alteration of the nerve fibre activity.

D. One theory propose that lasers coagulate the proteins inside the dentinal tubules and block the movement of fluid.(McCarthy and Gillam,1997)

E. This can be stated that low-level GaAlAs laser and NaF varnish showed similar overall performance and provided a decrease in cervical dentine hypersensitivity. Low-level laser showed improved results for treating teeth with higher degree of sensitivity. (Corona et al,2003)

Classification of desensitizing agents on the basis of physical and chemical properties:

If we arrange topical desensitizing agents on the foundation of their chemical and physical properties, then they will be as under (Scherman and Jacobson, 1992) (See Table 2)

Chemical agents:

Various chemical agents are being used in treatment of DH with effective results (Schmidlin and Sahrmann, 2012). Some of these are as under;

1. Corticosteroids
2. Silver nitrate
3. Strontium chloride
4. Formaldehyde
5. Calcium hydroxide
6. Potassium nitrate
7. Fluorides
8. Sodium citrate
9. Iontophoresis with 2% Sodium fluoride
10. Potassium oxalate.

Physical Agents:

Physical agents that are being used ion treatment are as under;

1. Composites
2. Resins
3. Varnishes
4. Sealants
5. Soft tissues
6. Glass ionomer cements
7. Lasers

Recent Progress in the Treatment of DH:

1. The application of a calcium silicate paste derived from Portland cement, which was shown to be effective in tubular occlusion and reduction of dentin permeability, and may be indicated for the treatment of DH.

2. Useful treatment must be preceded by appropriate diagnosis recognized after the exclusion of any other possible causes of the pain. It is important to manage the cases economically, rapidly and eternally.

3. The accessibility of a wide variety of treatments could be a sign that there is still no perfect desensitizing agent for the treatment of DH, or that it is hard to treat, irrespective of the options of available treatments. Even with the large number of studies published, it was still not likely to reach a accord about a product that represents the gold standard in the treatment of DH (Scherman,199)

Advantages of laser treatment

Laser treatment of DH is very discussed and known topic in the area of dentistry. There are many advantages and disadvantages. This also depends on multiple factors as well like decision of surgeons to use laser treatment, site of DH, severity of cases, predisposing factors, etiologic, acuteness or chronic state of condition etc. Much has been studied but much more to be study yet. We have here compiled some of common advantages and disadvantage of laser therapy. (Sgolastra, 2011)

1. Lasers treatment is superior than conventional methods of treatment

Lasers treatments are superior to topical desensitizing agents (while comparing laser therapy and other topical desensitizing agents, such as fluoride varnish, dentine bonding agents) but to note that this superiority was minor. (Sgolastra, 2011)

2. Laser therapy has clinical advantage

While in treatment of DH, Laser therapy has a minor clinical gain over topical medicaments. (Sgolastra, 2011)

3. Quick pain and inflammation reduction

In DH, Laser therapy is able to reduce DH-related pain (Sgolstra, 2011)

4. Advantage of Low Level Laser Vs High Level Laser

Low-power laser therapy is a suitable treatment scheme to promote biomodulatory effects, diminish pain and decrease inflammatory processes. Its employ has been broadly accepted and approved due to satisfactory results reported. In contrast, the effects of high-power lasers, such as the carbon dioxide, Nd: YAG, Er: YAG and Er, Cr: YSGG lasers are connected to an augment in surface temperature which can effect in the absolute closure of dentinal tubules after recrystallization of the dentinal surface. (Cecilia and Aranha, 2012; Bartold, 2006).

5. Advantages of use of laser with chemical agents:

The combination use of laser irradiation with many chemical agents such as sodium fluoride and stannous fluoride may augment treatment efficiency by more than twenty (20) % over that of laser treatment alone. (Romeo et al, 2012)

6. Combination of (Nd: YAG laser) and chemical agents (5% NaF varnish):

Combination of Nd: YAG laser and 5% NaF varnish showed better results when compared to each treatment alone. (Asnaashari et al, 2013)

7. Advantage of Diode laser with Fluoride:

The combination of the GaAlAs laser (830 nm wavelength) with fluoridation enhances action efficiency by more than 20% over that of laser treatment only. Most dentinal tubule orifices were occluded after treatment by Nd: YAG laser irradiation followed by topical sodium fluoride (Santaellaet al, 2004)

8. Laser therapy in reducing DH pain:

Laser therapy can decrease DH-related pain, but the proof for its effectiveness is weak.

9. Synergetic effect of Stannous fluoride and Diode laser:

Diode laser is a helpful device for DH management and adding of stannous fluoride has synergistic effect on laser efficiency. (Rajeev et al, 2013)

10. Advancement of laser technology is more rapid than conventional :

Advancement and rapid development of laser skill and technology and its rising utilization in dentistry has given a supplementary therapeutic option for the treatment of DH.

Diverse types of low (He-Ne, diode) and middle output power (CO2, Nd: YAG) lasers have been experienced for the diminution of DH but available studies are not sufficient to give any ultimate decisive remarks. (Gerschman et al, 1994).

11. Combination therapy Vs single agent therapy :

Combination of diverse types of laser with chemical agents (such as sodium fluoride and stannous

fluoride) have been analyzed with promising results and it was noted that effectiveness has been found more than 20% over the laser treatment only .Adding of fluoride has synergistic effect on laser desensitization. (Sebnem et al, 2009)

12. Laser treatment is rapid with long lasting effect:

Many treatments and mode of treatment are available amongst which laser seems to be more valuable, and has rapid and lasting effect.

When satisfactory oral hygiene is maintained laser treatment plays vital role in reduction of sensitivity which is common problem to patient and dentist and causes painful distress. (Rajeev et al, 2011).

Disadvantages of Laser therapy

1. Controversial Effectiveness of laser treatment:

The studies on effectiveness of laser treatment in reducing dentinal hypersensitivity (DH) are still controversial. Researches on laser therapy may reduce DH-related pain, but the proof for its effectiveness is quite weak still. (Sgolastra et al, 2011)

2. High Cost of laser therapy:

DH laser treatment has disadvantages of having high cost, (Orchardson and Gillam, 2006 and Sgolastra, 2011)

3. Complexity of use:

Different lasers have different specifications to use, different wavelength and different temperature. So this is complex to use in most of cases. (Orchardson and Gillam, 2006)

4. Decreasing effectiveness over time:

With passage of time efficiency of laser therapy will decrease. (Orchardson and Gillam 2006)

5. Limited its clinical utility:

Clinical utility of lasers is diminished with passage of time. (Orchardson and Gillam 2006)

6. Weak efficacy of laser treatment:

Efficacy of laser treatment for DH therapy is controversial. (Sgolastra et al, 2011)

7. Controversial theories of working with lasers:

Mechanism of action of laser treatment for DH therapy is very controversial (Sgolastra et al, 2011)

8. Lasers have weak effectiveness :

Laser therapy can reduce DH-related pain, but the evidence for its effectiveness is weak (Sgolastra et al, 2011)

9. Thermal Threshold of Laser is a limitation:

Studies and researches have addressed the safety of using laser for treating DH. One such study found the impact of thermal threshold, if temperature increase within the pulp remains below 5_C, then no pulp damage is evident .This thermal threshold is commonly not exceeded when the energy and power settings of the laser remain in described ranges. (Kimura et al, 2000)

10. Laser treatment is transitory in some cases :

According to some studies and references, laser treatment looks to be transient, though, and the sensitivity returns in time. The mechanism of reappearance is unknown. As laser effects are considered to be due to the effects of sealing of dentinal tubules, nerve analgesia or placebo effect. The sealing effect is considered to be hard-wearing, while nerve analgesia or a placebo effect is not so much durable. (Orchardson and Gilliam, 2006).

Sodium Fluoride use in DH

Sodium Fluoride has positive impact on DH treatment (Paine et al, 1998).There is many articles on the efficiency of fluorides in lessening DH. Fluorides precipitate calcium fluoride crystals inside dentinal tubules, and thus decrease dentinal permeability (Miglani et al, 2010). These crystals are more or less insoluble. Sodium fluoride with a 2 % concentration is used in the office. (Minkoff and Axelrod, 1987) The precipitate which is formed by sodium fluoride can easily be removed by the saliva or mechanical scrubbing. Therefore, acid has been added to the formula so that the resultant acidulated sodium fluoride can form precipitates deep in the tubules (Porto et al, 2009)

Fluorides and fluorosilicates may be used in with iontophoresis, which through electrical current can enhance ionic diffusion (Miglani et al, 2010).

Sodium Fluoride Vs 980nm Diode Laser:

	Sodium Fluoride	980nm Diode Laser
	Mechanism of action Fluorides precipitate calcium fluoride crystals inside dentinal tubules, and thus decrease dentinal permeability Sodium fluoride with a 2 % concentration is used in the office. The precipitate which is formed by sodium fluoride can easily be removed by the saliva or mechanical scrubbing. Therefore, acid has been added to the formula so that the resultant acidulated sodium fluoride can form precipitates deep in the tubules (Porto *et al*, 2009). Fluorides and fluorosilicates may be used in with iontophoresis, which through electrical current can enhance ionic diffusion (Miglani *et a*l, 2010	Mechanism of action Many mechanisms of action have been proposed for laser, its effect on the dentine and its effect on reducing DH. They include Occlusion through coagulation of the proteins of the fluid inside the dentinal tubules Occlusion of tubules through partial sub-melting Discharging of internal tubular nerve
	Effective when alone used	More effective when alone used (than Sodium Fluoride)
	Show good result in combination with laser at specific parameters	Show good result in combination with laser at specific parameters
	However, its effect remains for a short period of time and it needs to be applied several times	This may not give 100 % result in severe cases of DH
	A variety of fluoride formulations are used to care for DH (include sodium fluoride, stannous fluoride, sodium monofluorophosphate, fluorosilicates and fluoride) combined with iontophoresis	Many types of diode lasers are used (low power and high power lasers) with multiple specifications

Methods

Search and Review Strategy:

The search was taken in the period of August 2014 to October 2014. Language used for the search and researching method was English. No other language was opted for this rationale.

1. Various electronic data base references were used to find out the relevant data. Electronic data was used with great care and responsibility. THE LITERATURE SEARCH was taken using Google scholar and pubmed at the Unige University Library of the Genoa University, Italy.

2. The initial results and search was limited but then it was expanded to many other aspects in order to analyze and evaluate attributes and protocols related to DH treatment with diversification. Although the focus was to present authentic data on two treatment protocols but various other methods of treatment were studied as well. This enabled and facilitated comprehensive searching of research material with least probability of overlooking potentially insignificant researches and literature.

3. Hand searches were also made to expand the circle of research.

4. Additional efforts were made for citation from references available in reviews and articles.

Criteria for inclusion and exclusion of studies:

Criteria for Inclusion:

1. According to the subject- Dentinal Hypersensitivity

2. Thesis Statement (overall text selection is within the central theme of the subject, and body of the article should be in relation with the subject)

3. Publication Dates (I choose the more recent journals, from 1990-2013)

4. Literature Research Sequence (Search engines, data compilations, journals, articles, theses).

5. English Language literature were preferred and used for this literature review

6. My literature review will focus on clinical review and evaluation

7. Articles chosen were of scientific and academic value without marketing purpose from companies

8. Content sharing (some subjects or articles can be found more than one time in different search engine)

9. Specific review study was taken from 1990-2013 for latest available research papers .

Criteria for Exclusion:

1. Studies before 1990 were not used in methodological review.
2. Mild power diode laser
3. Clinical evaluation research papers were selected
4. Evaluation study of laser and sodium fluoride varnish were included (Clinical)
5. Literature or review other than English language was excluded

Data Extraction and analysis:

Data was reviewed from the selected studies with relevance of topic .Data of each table was studied and analyzed separately with description of each step. Analysis was done properly in description of studies. Based on description of studies strategic conclusive evidence was gathered in order to compile conclusion and recommendation. Each study was associated with potential drawbacks and credible recommendation. Each selected table was analyzed individually with reference.

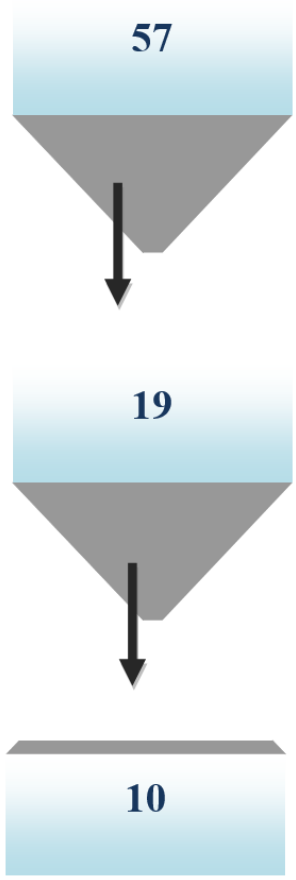
Characteristics of selected studies:

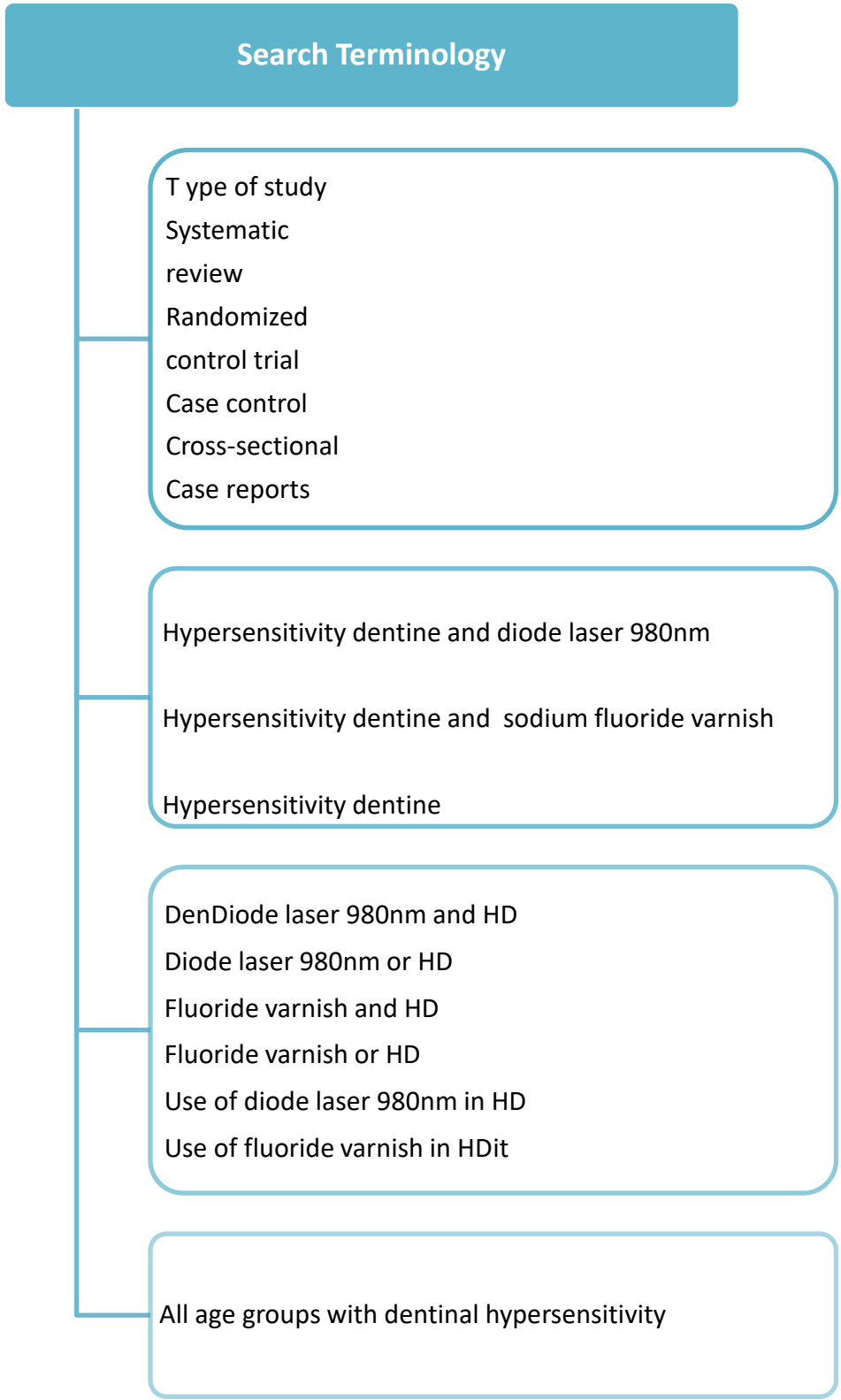
1. Each study was selected from a quality and renowned source (see Table)
2. Appropriate key word search methodology was used for searching the literature.
3. More than 1200 various sources of literature were evaluated and with proper evaluation, elimination and inclusion criteria, 57 studies were found more relevant to the studies.
4. Out of selected studies, 19 were shortlisted and among these, 10 were included in the analysis of the study of this review.

Keywords used

The keywords used for Pub Med scholar were:

keyword	Result (2000-2003)	After elimination
Diode Laser 980nm and HD	**1**	**1**
Diode Laser 980nm or HD	**1,232**	**5**
Fluoride varnish and HD	**27**	**4**
Fluoride varnish or HD	**843**	**4**
Use of Diode Laser 980nm in HD	**1**	**1**
Use of Fluoride varnish 980nm in HD	**27**	**5**




Search Terminology
T ype of study
Systematic
review
Randomized
control trial
Case control
Cross-sectional
Case reports
Hypersensitivity dentine and diode laser 980nm
Hypersensitivity dentine and sodium fluoride varnish
Hypersensitivity dentine
DenDiode laser 980nm and HD
Diode laser 980nm or HD
Fluoride varnish and HD
Fluoride varnish or HD
Use of diode laser 980nm in HD
Use of fluoride varnish in HDit
All age groups with dentinal hypersensitivity

Description of Studies

In this section we shall include those studies which are included specifically in the review. We will put an individual attention to each topic separately.

1- In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser (Ying et al, 2013)

The study was conducted;

To evaluate the ultra structural changes of dentin that is undergone irradiated with 980-nm diode laser in diverse parameters. The associated objective with this study was to observe the morphological changes in morphology of dentin complex (of odontoblasts and pulp tissue) to conclude the safety parameters of 980-nm diode laser.

In thus current study, 20 extracted human 3rd molars were particular to prepare dentin discs. Each dentin disc was divided into 4 areas and was treated by 980-nm diode laser under different parameters. The morphological changes of the dentin surfaces and odontoblasts were observed with scanning electron microscopy (SEM), and the morphological changes of the dental pulp tissue irradiated by laser were observed with an erect or upright microscope.

Overview of Results:

Usage and treatment with 980-nm diode laser may be helpful for routine clinical treatment of DH, and 2.0W/CW (166 J/cm^2) was an appropriate energy factor due to its rapid sealing of the exposed dentin tubules and its safety to the odontoblasts and pulp tissue

Treatment of DH with 980nm Diode is very effective in short and long run. In the study aftereffect of using laser radiations shown that 980nm diode is much safer in use for DH patients

Possible drawback:

Although the study has considerable results and observation which were quite sufficient for knowledge yet there are drawbacks or limitation of studies as well.

1. More studies are required to observe the ultra structural changes after short duration of laser used as well as after a long time.

2. Safety impact should be considered as important one in laser usage in general.

3. Safety of laser in different parameters must also be studied along with cure of patient.

2- An Evaluation of the 980nm GaAlAs High-Level Diode Laser in the Treatment of Dentine Hypersensitive (Miron et al, 2007)

The study was conducted to assess and analyze the efficiency of the 980nm high-level diode laser in minimizing dentinal hypersensitivity to hypersensitive teeth.

In thus current study, twelve patients were selected for this trial with at least two single-rooted teeth affected by cervical dentinal hypersensitivity.

One tooth was treated with laser diode (980 nm; 0.5 W; 30 s. exposure time; 19 J per exposure) while.

The second tooth was considered witness and was irradiated with a guiding beam of the diode.

Overview of Results:

High-level 980 nm GaAlAs diode laser therapy produces a clinical reduction of pain sensitivity. In this initial study it showed that the treatment was efficient and effective for the treatment of DH in patients with sensitive teeth

Treatment of DH with 980nm Diode is very effective in short and long run. It is shown that 980nm diode is much safer in use for DH patients.

Possible drawback;

Although the study has considerable results and observation which were quite sufficient for knowledge yet there are drawbacks or limitation of studies as well.

1. More studies are required to observe long term positive or negative impact of lasers usage in DH patients

2. Safety impact should be considered as important aspect of all laser diode being used in oral procedures

3- Treatment of Dentine Hypersensitivity by Diode Laser (Romeo et al, 2012)

This study makes an important note on comparison of the efficiency of GaAlAs diode laser alone and with the use of (Naf) sodium fluoride gel in treatment of Dentin Hypersensitivity patients.

In thus current study, the trial was done on 10 patients (8 F/2 M, age 25 to 60) and 115 teeth.

Teeth were arbitrarily divided into three groups:

1. G1 (34 teeth) treated by 1.25% NaF;

2. G2 (33 teeth) lased at 0.5 W PW (T on 100 m and T off 100 ms), fluence 62.2 J/cm2 in defocused mode with a 320 μ fiber. Each tooth received three 1′ applications

3. G3 (48 teeth) received NaF gel plus laser at same G2 parameters

Overview of Results:

Diode laser is a useful device for DH treatment if used alone and mainly if used with NaF gel.Treatment of DH with 980nm Diode is very effective in short and long run.

Highest and quick response was observed in G3 while G2 showed a comparatively good response than G1 in short duration

Possible drawback:

Although the study has considerable results and observation which were quite sufficient for knowledge yet there are drawbacks or limitation of studies as well.

1. More studies are required to observe comparative study of diode laser and Sodium Fluoride at diverse parameters

2. Using different parameters of diode laser and Sodium Fluoride safety of tissue should also be observed.

4- Efficacy of 980 nm diode laser as an adjunct to fluoride in the management of dentinal hypersensitivity: A controlled, prospective clinical study (Ranjan et al, 2013)

The trial was conducted to assess and contrast the clinical efficiency of diode laser alone and with topical 2% fluoride gel in the management of dentinalhypersensitivity.

In thus current study, 30 Subjects (14 males and 16 females, age 19-70 years), contributing 534 teeth with dentin hypersensitivity (DH) were trialed by air stimuli and measured by verbal rating scale (VRS). For each patient, the sensitive sites were randomly divided into

Group 1(G1) (267 teeth), treated by application of 2% fluoride gel followed by application of GaAlAs diode laser (Sunny Germany, 980 nm, 2W, 25 Hz) in continuous mode and

Group 2 (G2) (267 teeth), was subjected to only diode laser at the same parameters as in G1.

VRS recordings were assessed. Both the groups have shown significant reduction in DH after the laser irradiation but reduction in DH was more evident in G1 than G2.

Overview of Results:

Diode laser is a useful device for DH treatment if used alone and mainly if used in synergism with F gel.Treatment of DH with 980nm Diode is very effective for treating DH in patients.

Highest and quick response was evident in G1 while G2 showed a comparatively lower response than G1. So, this confirms our assumption that diode laser 980 nm shows good results in synergism with fluoride solution.

Possible drawback:

Although the study has considerable results and observation which were quite sufficient for knowledge yet there are drawbacks or limitation of studies as well. More studies are required to observe comparative study of diode laser and Fluoride at diverse parameters.

5- Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity (Coronoa et al, 2003)

The study was conducted toassess the use of low-level gallium–aluminium– arsenide laser and sodium fluoride varnish in the treatment of cervical dentine hypersensitivity.

In the study trial, twelve patients, with at least two sensitive teeth were selected.

1. A total of 60 teeth were included in the trial.
2. Prior to desensitizing treatment, dentine hypersensitivity was assessed by a thermal stimulus and patients' response to the examination was considered to be a control.
3. The laser (15 mW, 4 J/cm2) was irradiated on contact mode and fluoride varnish was applied at cervical region.
4. The efficiency of the treatments was assessed at three examination periods, immediately after first application, 15 and 30 days after the first application.
5. The degree of sensitivity was determined following predefined criteria.

Overview of Results:

It may be concluded that both treatments may be effective in decreasing cervical dentinal hypersensitivity. Sodium Fluoride Treatment Effect in Dentin Hypersensitivity.

Moreover, the low-level GaAlAs laser showed improved results for treating teeth with higher degree of sensitivity

6- Clinical Evaluation of Lasers and Sodium Fluoride Gel in the Treatment of Dentine Hypersensitivity (Sebnem et al, 2009)

The study was conducted toassess the use of low-level galium–aluminium– arsenide laser and sodium fluoride varnish in the treatment of cervical dentine hypersensitivity. The aim was to assess and evaluate the efficacy of lasers

1. Alone and

2. In combination with (topical) sodium fluoride (NaF) in the managing dentine hypersensitivity (DH)

In the trial, 50 patients presenting with a total of 420 sensitive teeth were randomly grouped into five groups.

1) Group 1 was treated with 2% NaF

2) Group 2 and 3 were lased by a CO2 (1 W, continuous wave mode, for 10 sec) or Er: YAG (30 Hz, 60 mJ for 10 sec, without water/air spray) laser

3) Group 4 and 5 received NaF plus the CO2 and the Er: YAG laser, respectively.

4) The scanning speed of the laser was 0.8 mm/sec. The degree of thermal sensitivity was determined with an evaporative stimulus consisting of a 1-sec air blast at a distance of 2 mm from each site tested.

5) Quantification of the degree of discomfort was determined according to a four-point pain scale before treatment and 1 wk, 1 mo, and 6 mo after treatment.

All treatment forms resulted in significant improvement of discomfort. At 1 wk, 1 mo, and 6 mo, cold air blast scores were significantly reduced compared to baseline scores, except for the NaF group. In the NaF group, there was a statistically significant increase in mean degree of discomfort at 6 mo compared with 1 wk (p _ 0.01) and 1 mo (p _ 0.001).

Overview of Results:

It may be concluded that both lasers in grouping with NaF gel become visible to show better efficiency compared to either treatment modality alone.

Sodium Fluoride Treatment Effect in Dentin Hypersensitivity.

NaF gel appears to show better efficiency results in combination with lasers.

7- Long-Term Effect of Diode Laser Irradiation Compared to Sodium Fluoride Varnish in the Treatment of Dentine Hypersensitivity in Periodontal Maintenance Patients. (Hasan et al, 2011)

The aim was to assess and compare the desensitizing effects of a laser and sodium fluoride (Na F) varnish on dentine hypersensitivity (DH) in periodontal maintenance patients. The trial was done with following specifications.

1. 48 patients with 244 sensitive teeth affected by DH were included in the study.
2. The subjects had to have 4 or more hypersensitive teeth.
3. Selected teeth were randomly laser group, placebo laser group, NaF varnish group, or a placebo NaF varnish group. Laser therapy was performed at 8.5 J/cm2 energy density.
4. In the placebo laser group, the same laser without laser emission was used.
5. In the NaF varnish group, the varnish was painted at the cervical region of the teeth.
6. In the placebo NaF varnish group, the same treatment procedures were performed with a saline solution.
7. DH was assessed with a visual analog scale (VAS); immediately, at 1 week, and at 1, 3, and 6 months after treatments.
8. Intragroup time-dependent data were analyzed by Friedman's test, and Wilcoxon's rank sum test was used to appraise the differences within groups.

Overview of Results:

The result of the trial was much obvious to discuss. Laser treatment proved to be effective among all the treatment sides. However, when Sodium Fluoride was used in treatment of DH, it was liked as more effective treatment. So we can conclude from the trial that laser irradiation was effective in the treatment of DH and is more comfortable procedure.Also, this is proved to be a faster procedure than traditional DH treatment.

Sodium Fluoride Treatment Effect in Dentin Hypersensitivity.

Lasers treatment with NaF gel appears to show better efficacy than treatment alone.

Possible Drawbacks:

This is to note that different percentages at different concentration of NaF solution are yet to evaluate yet. May be increased solution of Na F than 2% might show a better result than alone 2%.

8- Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil(Fischer et al, 1992).

The objective of the study was to see the prevalence, distribution and possible causal factors of DH were considered in a population.

A good size of sample was taken in the clinical trial. A total of 635 patients were examined for the presence of cervical dentine hypersensitivity by means of a questionnaire and intraoral tests25 % of the patients (59 males and 98 females) reported having hypersensitive teeth and 10% reported anarration of hypersensitivity. Females presented a higher prevalence of hypersensitive teeth than males, but this difference was not statistically noteworthy.

Overview of results:

This was concluded that that incisors and premolars were the most ordinary teeth sensitive to the air and probe stimuli, whereas molars were the slightest sensitive ones.

Possible drawbacks:

Questionnaire survey should be done in order to take more clear output from the patients apart from clinical studies.

9- Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross-sectional study. (West et al, 2013).

In this trial, the objective to study to measure the prevalence of DH and relative importance of risk factors. In the trial , 3187 adults were observed from general dental practices in France, Spain, Italy, United Kingdom, Finland, Latvia and Estonia. DH was clinically seen by cold air tooth stimulation.

Overview of results

Prevalence of DH was high compared to many available findings, with a well-built, progressive association between DH and erosive tooth wear, which is significant to distinguish for patient preventive therapies and clinical managing of DH pain.

Possible drawbacks

Comprehensive study of literature is required to determine the exact prevalence of DH. Also, differential diagnosis is required to include in the study for its marking.

10- Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross- sectional study (White et al, 2007)

In this trial , commercial dentifrices (including Crest Cavity Protection Regular, Colgate Total, and a new dentifrice comprised of stannous fluoride/sodium hexametaphosphate (SnF2/HMP: Crest Pro-Health)) were cycled throughout a pre-treatment period on smear layer-covered dentin surfaces, including intermittent soaking in dentifrice slurries and whole human saliva engagement.

It was seen that while following pre-treatments, the cycling treatments were modified to comprise dietary acid exposure, including soaks in an acidic soft drink. Vickers surface microhardness, changeable pressure scanning electron microscopy (VP-SEM), and confocal laser scanning microscopy in reflection mode (CLSM) were used to typify dentin reactivity and smear layer guard.

Overview of Results:

A stannous fluoride/sodium hexametaphosphate dentifrice prevents dietary acid softening and tubule exposure of smear layer dentin surfaces.

Possible drawbacks:

No of studies and sample used in trial should be more in quantitative to evaluate the results.

Mechanism of action	Example(s)
Action by nerve desensitization	Potassium nitrate
By protein precipitation	Glutaraldehyde Silver nitrate Zinc chloride Strontium chloride hexahydrate
By method of plugging dentinal tubules	Sodium fluoride Stannous fluoride Strontium chloride Potassium oxalate Calcium phosphate Calcium carbonate Bioactive glasses (SiO2–P2O5–CaO–Na2O)
Dentin adhesive sealers	Fluoride varnishes Oxalic acid and resin Glass ionomer cements Composites Dentin bonding agents
Lasers	Neodymium:yttrium aluminum garnet (Nd:YAG) laser Galium-aluminium-arsenide (GaAlAs) laser Erbium-yttrium aluminium garnet (Er:YAG) laser
Homeopathic	Propolis

Table 1: Treatments commonly used for dentin hypersensitivity. (Canadian Advisory Board on Dentin Hypersensitivity,2003)

Chemical agents	Physical agent
Corticosteroid	Composites
Silver nitrate	Resins
Strontium chloride	Varnishes
Formaldehyde	Sealants'
Calcium hydroxide	Glass Ionomer cements
Potassium nitrate	Lasers
Fluorides	
Sodium citrate	
Iontophoresis with 2% Sodium fluoride	
Potassium oxalate	

Table 2: Classification of desensitizing agents on the basis of physical and chemical properties

No	Description	Research	Year
1	**Lasers treatment is superior than conventional methods of treatment** Lasers treatments are superior to topical desensitising agents (while comparing laser therapy and other topical desensitising agents, such as fluoride varnish, dentine bonding agents) but to note that this superiority was minor.	Laser therapy for dentine hypersensitivity.	2011
2	**Laser therapy has clinical advantage** While in treatment of DH ,Laser therapy has a minor clinical gain over topical medicaments	1-Laser therapy for dentine hypersensitivity 2-Effectiveness of laser therapy and topical desensitising agents in treating dentine hypersensitivity, a systematic review. Journal of Oral Rehabilitation	2011
3	**Quick pain and inflammation reduction** In DH, Laser therapy is able to reduce DH-related pain	Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. Journal of Endodontics	2011

4	**Advantage of Low power Laser Vs High Power Laser** Low-power laser therapy is an suitable treatment scheme to promote biomodulatory effects, diminish pain and decrease inflammatory processes. Its employ has been broadly accepted and approved due to satisfactory results reported. In contrast, the effects of high-power lasers, such as the carbon dioxide, Nd:YAG, Er:YAG and Er,Cr:YSGG lasers, are connected to an augment in surface temperature which can effect in the absolute closure of dentinal tubules after recrystallization of the dentinal surface	Effects of Er: YAG and Er, Cr: YSGG lasers on dentine hypersensitivity. Short-term clinical evaluation. (Lasers Med Sci)	2012
5	**Advantages of use of laser with chemical agents** The combination use of laser irradiation with many chemical agents such as sodium fluoride and stannous fluoride may augment treatment efficiency by more than twenty (20) % over that of laser treatment alone	1-The combined effectiveness of the semiconductor lasers with Duraphat in the treatment of dentin hypersensitivity. Journal of Clinical Laser Medicine & Surgery 2- Long term effects of CO2 laser irradiation on treatment of hypersensitive dental necks: Results of an in vivo study. Journal of Clinical Laser Medicine and Surgery. 3- The combined occluding effect of sodium fluoride varnish and Nd: YAG laser irradiation on human dentinal tubules. Journal of Endodontics	1994,1998,1999
6	**Combination of (Nd: YAG laser) and chemical agents (5% NaF varnish)** Combination of Nd: YAG laser and 5% NaF varnish showed better results when compared to each treatment alone.	(Short-term assessment of the Nd:YAG laser with and without sodium fluoride varnish in the treatment of dentin hypersensitivity—a clinical and scanning electron microscopy study) Journal of Periodontology.	2005
7	**Advantage of Diode laser with Fluoride** The combination of the GaAlAs laser (830 nm wavelength) with fluoridation enhances action efficiency by more than 20% over that of laser Treatment only. Most dentinal tubule orifices were occluded after treatment by Nd:YAG laser irradiation followed by topical sodium fluoride	The combined effectiveness of the semiconductor lasers with Duraphat in the treatment of dentin hypersensitivity. Journal of Clinical Laser Medicine & Surgery	1994

8	**Laser therapy in reducing DH pain** Laser therapy can decrease DH-related pain, but the proof for its effectiveness is weak.	(J Endod)	2011
9	**Synergetic effect of Stannous fluoride and Diode laser** Diode laser is a helpful device for DH management and adding of stannous fluoride has synergistic effect on laser efficiency.	Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study Journal of Dental Lasers	2013
10	**Advancement of laser technology is more rapid than conventional** Advancement and rapid development of laser skill and technology and its rising utilization in dentistry has given a supplementary therapeutic option for the treatment of DH. Diverse types of low (He-Ne, diode) and middle output power (CO2, Nd: YAG) lasers have been experienced for the diminution of DH but available studies are not sufficient to give any ultimate decisive remarks.	1- Nd:YAG laser treatment of dentinal hypersensitivity. Br Dent J 2-Effects of CO2 laser in treatment of cervical dentinal hypersensitivity. J Endo 1998;24:595-97. 3- Treatment of dentine hypersensitivity by lasers: A review. J Clinical Periodontol	1992,1998,2000
11	**Combination therapy Vs single agent therapy** Combination of diverse types of laser with chemical agents (such as sodium fluoride and stannous fluoride) have been analyzed with promising results and it was noted that effectiveness has been found more than 20% over the laser treatment only .Adding of fluoride has synergistic effect on laser desensitization	1. Short-term assessment of the Nd: YAG laser with and without sodium fluoride varnish in the treatment of dentin hypersensitivity: A clinical and scanning electron microscopy study. J Periodontol. 2. Laser treatment of hypersensitive dentin: Comparative ESEM investigations. J Oral Laser Appl Journal of Dental Lasers	2005,2007,2013
12	**Laser treatment is rapid with long lasting effect** Many treatments and mode of treatment are available amongst which laser seems to be more valuable, and has rapid and lasting effect • When satisfactory oral hygiene is maintained laser treatment plays vital role in reduction of sensitivity which is common problem to patient and dentist and causes painful distress .	Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study	2013
12	**Laser treatment is rapid with long lasting effect** Many treatments and mode of treatment are available amongst which laser seems to be more valuable, and has rapid and lasting effect • When satisfactory oral hygiene is maintained laser treatment plays vital role in reduction of sensitivity which is common problem to patient and dentist and causes painful distress.	Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study	2013

Table 3: Advantages of Laser Treatment, a reference study table.

No	Description	Research	Year
1	Controversial Effectiveness of laser treatment The studies on effectiveness of laser treatment in reducing dentinal hypersensitivity (DH) is still controversial. Researches on laser therapy may reduce DH-related pain, but the proof for its effectiveness is quite weak still.	Journal of Endodontics Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review.	2011
2	High Cost of laser therapy DH laser treatment has disadvantages of having high cost	1- Managing dentin hypersensitivity. J Am Dent Assoc 2006; 137:990–8. 2- Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. J Endod.	2006,2011
3	Complexity of use Different lasers have different specifications to use, different wavelength and different temperature. So this is complex to use in most of cases	Managing dentin hypersensitivity. J Am Dent Assoc.	2006
4	Decreasing effectiveness over time With passage of time efficiency of laser therapy will decrease.	Managing dentin hypersensitivity. J Am Dent Assoc	2006
5	Limited its clinical utility Clinical utility of lasers is diminished with passage of time.	Managing dentin hypersensitivity. J Am Dent Assoc 2006	2006
6	Weak efficacy of laser treatment Efficacy of laser treatment for DH therapy is controversial.	Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. J Endod.	2011
7	Controversial theories of working with lasers Mechanism of action of laser treatment for DH therapy is very controversial	Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. J Endod	2011
8	Lasers have weak effectiveness Laser therapy can reduce DH-related pain, but the evidence for its effectiveness is weak	(J Endod)	2011
9	Thermal Threshold of Laser is a limitation Studies and researches have addressed the safety of using laser for treating DH. One such study found the impact of thermal threshold, if temperature increase within the pulp remains below 5_C, then no pulp damage is evident .This thermal threshold is commonly not exceeded when	Treatment of dentine hypersensitivity by lasers: a review. J Clin Periodontol.	2000

	the energy and power settings of the laser remain in described ranges.		
10	No ideal treatment protocol for Dh is available so far This contributes to laser treatment as well. Many researches and studies revealed that ideal treatment for DH does not exist, even in case of laser combination of different protocols and standard.	Treatment of Dentine Hypersensitivity by Diode Laser: A Clinical Study. International Journal of Dentistry	2012
11	Laser treatment is transitory in some cases According to some studies and references, laser treatment looks to be transient, though, and the sensitivity returns in time. The mechanism of reappearance is unknown. As laser effects are considered to be due to the effects of sealing of dentinal tubules, nerve analgesia or placebo effect. The sealing effect is considered to be hard-wearing, while nerve analgesia or a placebo effect is not so much durable.	Text book of endodontics. 2007 Dentine hypersensitivity—into the 21st century. Arch Oral Biol.	1994, 2007

Table 4: Disadvantages of Laser Treatment, a reference study table

Keywords	Results (2000-2013)	After Elimination
Hypersensitivity dentine and diode laser 980nm	88	7
Hypersensitivity dentine and sodium fluoride varnish	751	10
Hypersensitivity dentine	8220	20
Diode laser 980nm and HD	1	1
Diode laser 980nm or HD	1232	5
Fluoride varnish and HD	27	4
Fluoride varnish or HD	843	4
Use of diode laser 980nm in HD	1	1
Use of fluoride varnish in HD	27	5

Table 5: Summary of key words used in review

1.	**International Journal of Dentistry**
2.	Text book of endodontics
3.	Journal of Clinical Periodontol.
4.	Journal of Oral Laser Applications
5.	Journal of Oral Rehabilitation
6.	Journal of Clinical Laser Medicine & Surgery
7.	Journal of Dental Lasers
8.	Journal of Dental Lasers
9.	Journal Oral Rehabilitation
10.	Australian Dental Journal
11.	Journal of Conservative Dentistry
12.	Journal of Conservative Dentistry
13.	Journal Applied Oral Science
14.	Journal of West Scottish Periodontol
15.	Journal of Dental Research
16.	British Dental Journal
17.	Scottish Medical Journal
18.	Journal of Oral Science
19.	Clinical Oral Investigations

Table 6: Name of Some Quality International Journals used in Dentistry

Title	Study Type	Type	Year	Sampling	Conclusions:	Results
In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser	Clinical study	980-nm Diode Laser	2013	20 human 3 molar.	Irradiation with 980-nm diode laser is effective clinical treatment of DH, and 2.0W/CW (166 J/cm²) is a appropriate energy parameter due to rapid sealing of the exposed dentin tubules	Diode laser with settings of 2.0 W and 980-nm sealed dentin tubules effectively, and no important morphological alterations of the pulp and odontoblasts seen following an irradiation
An Evaluation of the 980nm GaAlAs High-Level Diode Laser in the Treatment of Dentine Hypersensitiv	Clinical study	980-nm Diode Laser	2007	20 subjects Each with two single rooted teeth	High-level 980 nm GaAlAs diode laser therapy produces a clinical reduction of pain sensitivity. In this initial study we observed that the treatment was proficient; yet we need a randomized study in order to show its effectiveness in actual life conditions.	The results confirmed that, after each process, the time beyond until occurrence of pain sensation was delayed, in direct relation to the surface temperature reduction of the tooth. The standard difference between the initial temperature of the tooth and the one when the pain sensation come into view, were considerable after each laser treatment ($p<0.005$).
Treatment of Dentine Hypersensitivity by Diode Laser:	Clinical study	980nm Diode laser	2012	10 patients +115 teeth	Diode laser is a helpful device for DH treatment if used only and mostly if used with NaF gel.	Considerable pain reduction was showed. The NRS reduction percentages were intended, and there was a real decrease of DH above all in G3 than G2 and G1

Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study	Clinical study	980-nm Diode Laser	Dec 2013	30 Patients + 534 teeth	Diode laser is a practical device for DH management and addition of stannous fluoride has synergistic outcome on laser desensitization result.	Both the Groups have shown important reduction in DH after the laser irradiation but reduction in DH was more obvious in G1 than G2
Long-Term Effect of Diode Laser Irradiation Compared to Sodium Fluoride Varnish in the Treatment of Dentine Hypersensitivity in Periodontal Maintenance Patients: A Randomized Controlled Clinical Study	Clinical Hasan *et al.*	Sodium Fluoride varnish And Diode laser	2011	48 patients + 244 teeth	Within the limits of the learning, GaAlAs laser irradiation was efficient in the treatment of DH, and it is a more relaxing and faster procedure than conventional DH treatment	GaAlAs laser irradiation was effectual in the treatment of DH.
Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity S.	clinical study Corona *et al.*	Low level Diode laser and Sodium Fluoride	2003			It may be concluded that both treatments may be effective in decreasing cervical dentinal hypersensitivity. Moreover, the low-level GaAlAs laser showed improved results for treating teeth with higher degree of sensitivity.
Clinical Evaluation of Lasers and Sodium Fluoride Gel in the Treatment of Dentine Hypersensitivity	Clinical study Sebnem et al,	Evaluation of lasers vs Sodium Fluoride gel.	2009	50 patients + 420 hypersensitive teeth	Comparison of the other treatment regimens shown that cold air blast scores were considerably	We finished that both the CO2 and Er:YAG lasers have talented possible for the treatment of dentine hypersensitivity.

					lower for the other four treatments than for NaF gel alone (p _ 0.001). No advantage was found for desensitization among the CO2, Er:YAG, CO2 _ NaF, and Er:YAG _ NaF groups.	Lasers in grouping with NaF gel appear to show better effectiveness compared to either treatment
Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil	Clinical study	The prevalence, distribution and possible causal factors of cervical dentine hypersensitivity were studied in a population from a Marine Dental Clinic in the city of Rio de Janeiro, Brazil. A total of 635 patients were examined for the presence of cervical dentine hypersensitivity by means of a questionnaire and intraoral tests (air and probe stimuli).	1992	635 patients	Twenty-five per cent of the patients (59 males and 98 females) reported having hypersensitive teeth and 10% reported a history of hypersensitivity Females presented a higher prevalence of hypersensitive teeth than males, but this difference was not statistically significant	The intraoral distribution of hypersensitivity showed that incisors and premolars were the most common teeth sensitive to the air and probe stimuli, while molars were the least sensitive ones.

Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross-sectional study		This study aimed to assess the prevalence of DH and relative importance of risk factors, in 18–35 year old Europeans	2013	3187 adults were enrolled from general dental practices in France, Spain, Italy, United Kingdom, Finland, Latvia and Estonia. DH was clinically evaluated by cold air tooth stimulation	41.9% of patients reported pain on tooth stimulation and 56.8% scored 1 on Schiff scale for at least one tooth. Clinical elicited sensitivity was closely related to Schiff score and to a lesser degree; questionnaire reported sensitivity (26.8%), possibly reflecting the transient nature of the pain, alongside good coping mechanisms. Significant associations were found between clinically elicited DH and erosive tooth wear and gingival recession	

Stannous Fluoride/Sodium Hexametaphosphate Dentifrice Increases Dentin Resistance to Tubule Exposure In Vitro	In Vitro clinical studies	Stannous fluoride/ sodium hexametaphosphate	2007	Human teeth	Immediately after stratification there were no significant differences in surface micro hardness between specimens in each treatment group. Average hardness values were consistent with literature observations on sound root dentin.	A stannous fluoride/sodium hexametaphosphate dentifrice prevents dietary acid softening and tubule exposure of smear layer dentin surfaces.

Table 7: Summary of studies included

Description	**Study trial**
Study Title	In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser
Desired Objective	To evaluate the ultra structural changes of dentin that is undergone irradiated with 980-nm diode laser in diverse parameters The associated objective with this study was to observe the morphological changes in morphology of dentin complex (of odontoblasts and pulp tissue) to conclude the safety parameters of 980-nm diode laser
Methodology used	20 extracted human 3rd molars were particular to prepare dentin discs. Each dentin disc was divided into 4 areas and was treated by 980-nm diode laser under different parameters. The morphological changes of the dentin surfaces and odontoblasts were observed with scanning electron microscopy (SEM), and the morphological changes of the dental pulp tissue irradiated by laser were observed with an erect or upright microscope.

Deliverables	Treatment with 980-nm diode laser may be helpful for routine clinical treatment of DH, and 2.0W/CW (166 J/cm²) was an appropriate energy factor due to its rapid sealing of the exposed dentin tubules and its safety to the odontoblasts and pulp tissue.
Better Result	Results with safety
Extract link	Ying Liu1, Jie Gao1,Yan Gao2, Shuaimei XU, Xueling Zhan, Buling Wu;2013,In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser; J Lasers Med Sci; 4(3):111-9

Table: 8: Selected study review summary 1

Description	**Study trial**
Study Title	An Evaluation of the 980nm GaAlAs High-Level Diode Laser in the Treatment of Dentine Hypersensitiv
Desired Objective	To assess and analyze the efficiency of the 980nm high-level diode laser in minimizing dentinal hypersensitivity to hypersensitive teeth.
Methodology used	Twelve patients were selected for this trial with at least two single-rooted teeth affected by cervical dentinal hypersensitivity. -One tooth was treated with laser diode (980 nm; 0.5 W; 30 s. exposure time; 19 J per exposure) while -The second tooth was considered witness and was irradiated with a guiding beam of the diode
Deliverables	High-level 980 nm GaAlAs diode laser therapy produces a clinical reduction of pain sensitivity. In this initial study it showed that the treatment was efficient and effective for the treatment of DH in patients with sensitive teeth
Better Result	Results with safety
Extract link	Mariana-Ioana Miron, Dorin Dodenciu, Diana Lungeanu, Cosmin Anton Balabuc, Laura Maria Filip, Carmen Todea,2007,An Evaluation of the 980nm gaalas High-Level Diode Laser in the Treatment of Dentine Hypersensitivity, Proceedings of the 2nd international conference on lasers in medicine, timisoara, JULY 5 -7,. PART I I

Table 9: Selected study review summary 2

Description	Study trial
Study Title	Treatment of Dentine Hypersensitivity by Diode Laser
Study Objective	This study makes an important note on comparison of the efficiency of GaAlAs diode laser alone and with the use of (Naf) sodium fluoride gel in treatment of Dentin Hypersensitivity patien
Methodology used	The trial was done on 10 patients (8 F/2 M, age 25 to 60) and 115 teeth. Teeth were arbitrarily divided into three groups G1 (34 teeth) treated by 1.25% NaF; G2 (33 teeth) lased at 0.5 W PW (T on 100 m and T off 100 ms), fluence 62.2 J/cm2 in defocused mode with a 320 μ fiber. Each tooth received three 1′ applications G3 (48 teeth) received NaF gel plus laser at same G2 parameters
Deliverables	Diode laser is a useful device for DH treatment if used alone and mainly if used with NaF gel.
Better result	Diode laser is excellent in DH treatment if used with NaF gel.
Extract link	Romeo Umberto, Russo Claudia, Palaia Gaspare, Tenore Gianluca, and Del Vecchio Alessandro,2012; Treatment of Dentine Hypersensitivity by Diode Laser International Journal of Dentistry , Article ID 858950, 8 pages

Table 10: Selected study review summary 3

Source: (Romeo et al, 2012)

Description	Study trial
Study Title	Efficacy of 980 nm diode laser as an adjunct to fluoride in the management of dentinal hypersensitivity: A controlled, prospective clinical study (Rajeev *et al*, 2013)
Desired Objective	To assess and contrast the clinical efficiency of diode laser alone and with topical 2% fluoride gel in the management of dentinal hypersensitivity
Methodology used	30 Subjects (14 males and 16 females, age 19-70 years), contributing 534 teeth with dentin hypersensitivity (DH) were trialed by air stimuli and measured by verbal rating scale (VRS). For each patient, the sensitive sites were randomly divided into

	-Group 1(G1) (267 teeth), treated by application of 2% fluoride gel followed by application of GaAlAs diode laser (Sunny Germany, 980 nm, 2W, 25 Hz) in continuous mode and -Group 2 (G2) (267 teeth), was subjected to only diode laser at the same parameters as in G1. VRS recordings were assessed. Both the groups have shown significant reduction in DH after the laser irradiation but reduction in DH was more evident in G1 than G2.
Deliverables	Diode laser is a useful device for DH management.
Better result	Good Results in synergism
Extract link	Rajeev Ranjan, Kausar Jaha Yadwad1, Sudhir R Patil1, S Mahantesha3, Aslam A Rahman2, Varun B Bhatia1,2013, Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study; Journal of Dental Lasers, Issue 2 • Vol 7

Table 11: Selected study review summary 4

Description	**Study trial**
Study Title	Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity (Coronoa *et al*,2003)
Desired Objective	The aim of this study was to assess the use of low-level galium–aluminium–arsenide laser and sodium fluoride varnish in the treatment of cervical dentine hypersensitivity
Methodology used	Twelve patients, with at least two sensitive teeth were selected. 1-A total of 60 teeth were included in the trial. 2-Prior to desensitizing treatment, dentine hypersensitivity was assessed by a thermal stimulus and patients' response to the examination was considered to be a control. 3-The laser (15 mW, 4 J/cm2) was irradiated on contact mode and fluoride varnish was applied at cervical region. 4-The efficiency of the treatments was assessed at three examination periods, immediately after first application, 15 and 30 days after the first application. 5-The degree of sensitivity was determined following predefined criteria.
Deliverables	It may be concluded that both treatments may be effective in decreasing cervical dentinal hypersensitivity.
Better result	Moreover, the low-level GaAlAs laser showed improved results for treating teeth with higher degree of sensitivity
Extract link	S. A. M. Corona, t. N. Do Nascimento, a. B. E. Catirse,R. F. Z. Lizarelli, w. Dinelli§ & r. G. Palma-dibb, Clinical evaluation of low-level laser therapy and fluoride Varnish for treating cervical dentinal hypersensitivity Journal of oral rehabilitation 2003 30; 1183–1189

Table 12: Selected study review summary 5

Description	Study trial
Study Title	Clinical Evaluation of Lasers and Sodium Fluoride Gel in the Treatment of Dentine Hypersensitivit.
Desired Objective	The aim was to assess and evaluate the efficacy of lasers 1-Alone and in combination with (topical) sodium fluoride (NaF) in the managing dentine hypersensitivity (DH)
Methodology used	50 patients presenting with a total of 420 sensitive teeth were randomly allocated into five groups. 1-Group 1 was treated with 2% NaF, 2-Group 2 and 3 were lased by a CO2 (1 W, continuous wave mode, for 10 sec) or Er: YAG (30 Hz, 60 mJ for 10 sec, without water/air spray) laser, and3-Group 4 and 5 received NaF plus the CO2 and the Er: YAG laser, respectively. 4-The scanning speed of the laser was 0.8 mm/sec. The degree of thermal sensitivity was determined with an evaporative stimulus consisting of a 1-sec air blast at a distance of 2 mm from each site tested. 5-Quantification of the degree of discomfort was determined according to a four-point pain scale before treatment and 1 wk, 1 mo, and 6 mo after treatment.
Deliverables	All treatment forms resulted in significant improvement of discomfort. At 1 wk, 1 mo, and 6 mo, cold air blast scores were significantly reduced compared to baseline scores, except for the NaF group. In the NaF group, there was a statistically significant increase in mean degree of discomfort at 6 mo compared with 1 wk (p _ 0.01) and 1 mo (p _ 0.001).
Better result	NaF gel appear to show better efficiency results in combination with lasers
Extract link	Sebnem Dirikan Ipci, D.D.S., Ph.D.,1 Gokser Cakar, D.D.S., Ph.D.,1 Bahar Kuru, D.D.S., Ph.D.and Selcuk Yilmaz, D.D.S., M.Sc., Ph.D,2009; Clinical Evaluation of Lasers and Sodium Fluoride Gel in the Treatment of Dentine hypersensitivityphotomedicine and Laser Surgery Volume 27, Number 1

Table 13: Selected study review summary 6

Description	**Study trial**
Study Title	Long-Term Effect of Diode Laser Irradiation Compared to Sodium Fluoride Varnish in the Treatment of Dentine Hypersensitivity in Periodontal Maintenance Patients: A Randomized Controlled Clinical Study (Hasan *et al*, 2011)
Desired Objective	The aim was to assess and compare the desensitizing effects of a laser and sodium fluoride (NaF) varnish on dentine hypersensitivity (DH) in periodontal maintenance patients
Methodology used	1-Forty-eight patients with 244 teeth affected by DH were included in the study. 2-The subjects had to have 4 or more hypersensitive teeth at different quadrants. 3-Selected teeth were randomly laser group, placebo laser group, NaF varnish group, or a placebo NaF varnish group. Laser therapy was performed at 8.5 J/cm2 energy density. 4-In the placebo laser group, the same laser without laser emission was used. 5-In the NaF varnish group, the varnish was painted at the cervical region of the teeth. 6-In the placebo NaF varnish group, the same treatment procedures were performed with a saline solution. 7-DH was assessed with a visual analog scale (VAS); immediately, at 1 week, and at 1, 3, and 6 months after treatments. 8-Intragroup time-dependent data were analyzed by Friedman's test, and Wilcoxon's rank sum test was used to appraise the differences within groups
Deliverables	Laser irradiation was effective in the treatment of DH, Laser treatment is a more comfortable procedure This is a faster procedure than traditional DH treatment.
Better result	Lasers in combination with NaF gel appear to show better efficacy than treatment alone.
Extract link	Hasan Guney Yilmaz, D.D.S., Ph.D. Sevcan Kurtulmus-Yilmaz, D.D.S., Ph.D. and Esra Cengiz, D.D.S;2011, Long-Term Effect of Diode Laser Irradiation Compared to Sodium Fluoride Varnish in the Treatmentof Dentine Hypersensitivity in Periodontal MaintenancePatients: A Randomized Controlled Clinical Study, Photomedicine and Laser Surgery,Volume 29, Number

Table:14: Selected study review summary 7

Description	Study trial
Study Title	Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil (Fischer *et al*, 1992).
Desired Objective	The prevalence, distribution and possible causal factors of DH were considered in a population
Methodology used	A total of 635 patients were examined for the presence of cervical dentine hypersensitivity by means of a questionnaire and intraoral tests 25 % of the patients (59 males and 98 females) reported having hypersensitive teeth and 10% reported a narration of hypersensitivity. Females presented a higher prevalence of hypersensitive teeth than males, but this difference was not statistically noteworthy
Deliverables	Laser irradiation was effective in the treatment of DH, Laser treatment is a more comfortable procedure. This is a faster procedure than traditional DH treatment.
Better result	This was concluded that that incisors and premolars were the most ordinary teeth sensitive to the air and probe stimuli, whereas molars were the slightest sensitive ones.
Extract link	Fischer C, Fischer RG, Wennberg A, 1992; Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil. J Dent. Oct; 20(5):272-6

Table 15: Selected study review summary 8

Description	Study trial
Study Title	Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross-sectional study (West *et al*, 2013)
Desired Objective	This study aimed to measure the prevalence of DH and relative importance of risk factors.
Methodology used	3187 adults were observed from general dental practices in France, Spain, Italy, United Kingdom, Finland, Latvia and Estonia. DH was clinically seen by cold air tooth stimulation
Deliverables	Prevalence of DH was high compared to many available findings, with a well-built, progressive association between DH and erosive tooth wear, which is significant to distinguish for patient preventive therapies and clinical managing of DH pain.
Better result	This was concluded that that incisors and premolars were the most ordinary teeth sensitive to the air and probe stimuli, whereas molars were the slightest sensitive ones.
Extract link	West NX, Sanz M, Lussi A, Bartlett D, Bouchard P, Bourgeois D 2013 .Prevalence of dentine hypersensitivity and study of associated factors: a European population-based cross-sectional study. J Dent. Oct; 41(10):841-51. doi: 10.1016/j.jdent.2013.07.017. Epub 2013

Table 16: Selected study review summary 9

Description	Study trial
Study Title	Stannous Fluoride/Sodium Hexametaphosphate Dentifrice Increases Dentin Resistance to Tubule Exposure *In Vitro*
Desired Objective	To compare the reactivity of three dentifrice formulations on smear layer-covered root dentin surfaces with effects of the formulation treatments on resistance to acid softening and dentinal tubuli disclosure.
Methodology used	New dentifrice comprised of stannous fluoride/sodium hexametaphosphate (SnF2/HMP: Crest Pro-Health), were cycled through a pre-treatment period on smear layer-covered dentin surfaces, including intermittent soaking in dentifrice slurries and whole human saliva immersion. Following pre-treatments, the cycling treatments were modified to include dietary acid exposure, including soaks in an acidic soft drink. Vickers surface microhardness, variable pressure scanning electron microscopy (VP-SEM), and confocal laser scanning microscopy in reflection mode (CLSM) were used to characterize dentin reactivity and smear layer protection
Deliverables	Specimens treated resisted acid solubilization, evidenced by the absence of disclosed dentinal tubuli. The histo-tomographic observations in this study were in agreement with the hardness measurements. The superior surface protection of dentin with SnF2/HMP would suggest potential benefits in ameliorating dentinal hypersensitivity in the clinical situation.
Better result	A stannous fluoride/sodium hexametaphosphate dentifrice prevents dietary acid softening and tubule exposure of smear layer dentin surfaces.
Extract link	White DJ, Lawless MA, Fatade A, Baig A, von Koppenfels R, Duschner H, Götz H. Stannous fluoride/sodium hexametaphosphate dentifrice increases dentin resistance to tubule exposure in vitro J Clin Dent. 2007;18(2):55-9

Table 17: Selected study review summary 10

Discussion

Dentin hypersensitivity is abbreviated as DH (Karim, 2013) or it can also be abbreviated as DHS (Turp,2012) and also known as sensitive dentin or dentin sensitivity (Miglani, 2010) or cervical sensitivity (Advisory board,2003) and cervical hypersensitivity is a kind of dental pain which is very sharp in character and of very short duration. Regardless of the great diversity of accessible therapeutic methods, dentinal hypersensitivity still remains a constant dental difficulty with a complicated treatment conduct and an unsure prognostic. A likely exclusion of sore symptoms due to the dentine hypersensitivity mechanism, it seems to be straight correlated to the disruption of stimuli transmission to the nerve endings of odontoblast processes by dipping the fluid movement in the dentinal canalicules, by the occlusion of tubules openings

The studies and reviews included were evaluated for methodological outcomes with a proper analysis .Many manuscripts were added in the paper starting from basic knowledge including significant causes, anatomical importance for the occurrence of disease, treatment and classification with a focus on laser treatment along with treatment with sodium fluoride varnish for DH. The primary aim of this study was to evaluate literature regarding comparison between diode laser and Sodium Fluoride treatment. Laser and sodium Fluoride are important in treatment of DH. Both at their own level do the best for the treatment of DH.

Vast number of dentistry journals and literature was studied for the purpose of evaluation of objective. Out of all studied or searched reviews, seven articles of high quality journals were included in the study review. The study of the literature followed strict criteria of inclusion and exclusion. Therefore it includes 7 main studies available from 2000-2013 (diode laser and Na F treatment in DH).

Diverse nature of literature and study material revealed many ideas of laser treatment of DH.It can be concluded that Dentin Hypersensitivity is prevalent condition in population with a possibility of good treatment, although no gold standard or absolute treatment is not available (Addy, 1983) yet. Almost all studies which involved various diode lasers (specially 980 nm Diode laser) in treatment of DH showed a considerable result in treatment of DH (Miron et al, 2007). Different parameters of laser were used in different studies. All studies showed effective result of DH (Although no standard and absolute treatment of DH is available yet). It can also be concluded from the study that Na F (mainly

2 %) has good impact on DH treatment tropically. However this treatment with Na F is less effective than laser therapy in DH and evidences (Canadian Advisory Board on Dentin Hypersensitivity, 2003)are available that show that NA F usage did induce discomfort level again in patients after a specific time of treatment, while this is not so in the case of laser therapy when used alone.

This may also be concluded that Na F and Diode laser when jointly used for treatment of DH (any parameter) showed a remarkable result in the treatment of DH (Coronoa et al, 2003). It showed improved and better result even than when laser was used alone for treatment of DH. (Sebnem et al, 2009).It showed lesser discomfort level in the sensitive teeth. The quality research reviews and manuscripts were evaluated for the desired purpose of treatment. It was carefully estimated that continuous study with upgrading technology variation is mandatory in the treatment of cases. It was concluded that al l the studies were consistent "Gold standard" research is needed in the field of oral dentistry and real benchmarks have to be recorded for enhanced prospect in dentin hypersensitivity treatment protocol.

Finally, in a systematic review of the articles, published through the years 2000-2014, on the effects of laser therapy on treating DH,

1. This has usually been claimed that laser therapy for the treatment of DH is favoured to other applicable local therapies (Sgolastra et al, 2011)

2. Further clinical long-term studies in many diverse samples and better qualities need to be done to prove this claim. (He S et al,2011)

3. In addition, this sort of therapy is highly satisfactory to patients because its proper usage has no negative impacts. So far, there has been no report of adverse reactions or pulp damage in the studies. (Sgolastra et al, 2011)

4. The use of laser in treatment of DH is both rational and suitable (He S et al,2011)

5. This may also be concluded that Na F and Diode laser when jointly used for treatment of DH (specific parameter) showed a remarkable result in the treatment of DH (Coronoa et al, 2003).

Limitations:

The evaluation study between laser and Na Fluoride treatment revealed considerable concrete information about dynamics of treatment (alone or joint application in DH).Yet much more to study yet. Although the study was evaluated for literature review of the diode laser (980nm) and Na F, yet there are some limitations of the study.

1. All oral procedures involving laser or chemical treatment must also ensure safety aspect of the treatment. Diode laser (980nm) safety treatment must also ensure safety .Similarly NaF treatment must also be included with safety aspect.

2. More studies with different % of Na F must be evaluated in trials.

3. Most of the study trials are uncontrolled clinical trials, more number of randomized control trials are required to evaluate more comparison.

4. Good quality control trials are required to proceed further in the field.

Implications for Patients:

The condition is more associated with morbidity of the disease. So there are multiple implications for the practitioners, patients and the practice finally.

Implications for patients include morbidity, treatment and cost while implications for practitioners include skill, cost and knowledge. Similarly, for practice it is awareness, cost mainly.

Implications for research:

It is clear that further research needs to be conducted to assess the comparative evaluation of treatment of DH with consistency. The current literature study in this project has revealed that there is no ‘god standard’ research is conducted in the field so far. Many studies of these types are required

1. Survey (Open and closed interviews)

2. Mixed approach (qualitative and quantitative study)
3. Retrospective and prospective study and trial
4. Prevalence of DH or signs and symptoms (studies) after using various treatment protocols.
5. Longitudinal prospective studies involving the latest technological advances
6. Evaluation and comparative studies
7. Focus group studies and research.
8. Large sample size of DH patients in order to evaluate the outcomes of treatment.

General Management of DH cases

1. Although gold standard treatment is not available but in evaluation of all types of treatment we may bring quality results by simple management of DH but it varies from case to case. (Davari et al , 2013)
2. The patient should be well informed about all phases of the therapy which he is going to observe. (Davari et al , 2013).
3. Practitioner should take a complete clinical and dietary history of the patient.
4. Accurate diagnosis of the condition gets a more weight in DH treatment.
5. One should start at-home treatment in cases of moderate sensitivity. (Davari et al , 2013) .
6. Start in-office treatment in cases of severe sensitivity or when one or two teeth were involved. (Davari et al , 2013).
7. Managing a regular follow-up visits with importance of the prevention of DH

Conclusion and Recommendation

Dentin Hypersensitivity is a very vast topic to discuss .Hundred of articles and journals can be written on the topic .But in the current topic we tried to cover some aspects of it for future direction and study. This literature which we complied at least can give you a direction where the research should lead to bring some prospects in the oral procedures of dentistry.

There is some solid conclusion form the review study that can be extended in future to bring revolution in the medical field.

Diode laser (980nm) is a practical instrument to bring effective treatment alone. However, its efficacy is increased with treatment of NaF use in the protocol. Although, Na F is effective (Less than laser treatment) but it efficiency is to be discuss more in some other study. We cannot rely on single treatment of Na F treatment.

However, this treatment is very good in those cases where laser cannot be operated due to any reason. In short, recommended and improved results can be obtained by using diode laser and NaF. There are certain recommendations that should bring in serious notes as well.

Safety aspect of all procedures (oral dental procedures including chemical or laser) should be considered as important element of the procedures. Mechanism of action of laser should be evident so that future implications may be in line.

There should be surveys or questionnaire study among the patients and doctors to further elaborate the dynamics of evaluation studies of laser and chemical treatment along with cost impact of the treatment. This will be a useful thing to do.

There is a need for a more systematic and technical approach to the clinical management of cervical dentine hypersensitivity, mainly in determining the long-term and short term effect of the presently available desensitizing agents. For more efficient treatment, additional investigations are required to enhance the understanding of the mechanisms and aetiology of dentinal pain. The findings and observation exposed by both laboratory and clinical research are really important to support the growth or improvement in the respective field.

References

1. Absi EG, Addy M, Adams D. Dentine hypersensitivity. A study of the patency of dentinal tubules in sensitive and non sensitive cervical dentine. J Clin Periodontol.1987;14:280–4

2. Addy M, Dowell P. Dentine hypersensitivity, a review: clinical and in vitro evaluation of treatment agents. Journal of Clinical Periodontology.1983;10:351–63.

3. Addy M, Embery G, Edgar WM, Orchardson R eds, Dentine hypersensitivity: definition, prevalence, distribution and aetiology. In: Tooth wear and sensitivity: clinical advances in restorative dentistryMartin Dunitz, London, 2000; 239-248.

4. Addy M, Mostafa P, Newcombe RG. Dentine hypersensitivity: The distribution of recession, sensitivity and plaque. J Dent.1987; 15:242–8.

5. Addy M, Dentine hypersensitivity: new perspectives on an old problem. Int Dent J 2002;52, 367

6. Addy M, Tooth brushing, tooth wear and dentine hypersensitivity – are they associated? Int Dent J.2005;55, 261-267.

7. Ana Cecilia Corrêa Aranha, Clinical evaluation of desensitizing treatments for cervical dentin hypersensitivity. Braz Oral R, 2009;338; 23(3):333-9

8. Arrais CA, Micheloni CD, Giannini M, Chan DC, occluding effect of dentifrices on dentinal tubules. J Dent. 2003;31, 577-584.

9. Asnaashari M, Moeini M. Effectiveness of Lasers in the Treatment of Dentin Hypersensitivity. J Lasers Med Sci. 2013; 4(1):1-7

10. Bartold PM, Dentinal hypersensitivity: a review. Aust Dent J 2006;51, 212-218.

11. Bekes K, John MT, Schaller H-G, Hirsch C; Oral health-related quality of life in patients seeking care for dentin hypersensitivity. Journal of Oral Rehabilitation,2009;36:45–51.

12. Boiko OV, Baker SR, Gibson BJ, Locker D, Sufi F, Barlow APS, Construction and validation of the quality of life measure for dentine hypersensitivity (DHEQ). Journal of Clinical Periodontology. 2010; 37:973–80.

13. Canadian Advisory Board on Dentin Hypersensitivity.Consensus-based recommendations for the diagnosis and management of dentin hypersensitivity. Journal of the Canadian Dental Association.2003; 69:221-226. caries clinical trial. Community Dent Oral Epidemiol

14. Chabanski MB, Gillam DG.Aetiology, prevalence and clinical features of cervical dentine sensitivity. J Oral Rehabil.1997; 24, 15-19.

15. Chestnutt IG, Schäfer F, Jacobson AP, Stephen KW.The influence of tooth brushing frequency and post-brushing rinsing on caries experience.1998; 52, 154-160

16. Chidchuangchai W, Vongsavan N, Matthews B. Sensory transduction mechanisms responsible for pain caused by cold stimulation of dentine in man. Arch Oral Biol. 2007; 52, 154-160.

17. Clayton DR, McCarthy D, Gillam DG.A study of the prevalence and distribution of dentine sensitivity in a population of 17-58-year-old serving personnel on an RAF base in the Midlands. J Oral Rehabil. 2002; 29, 14-23.

18. Coleman TA, Grippo JO, Kinderknecht KE.Cervical dentin hypersensitivity. Part II: associations with abfractive lesions. Quintessence Int.200;31, 466-473.

19. Dababneh R, Khouri A, Addy M. Dentine hypersensitivity: An enigma? A review of terminology, epidemiology, mechanisms, aetiology and management. Br Dent J. 1999; 187:606–11.

20. Davari AR., Ataei E., Assarzadeh H. Dentin Hypersensitivity: Etiology, Diagnosis and Treatment; A Literature Review Dent Shiraz Univ Med Sci, 2013; Sept. 14(3): 136-145.

21. Dondi dall'Orologio G, Lone A, Finger WJ.Clinical evaluation of the role of glutardialdheyde in a one-bottle adhesive. Am J Dent.2002; 15, 330-334.

22. Dowell P, Addy M Dentine hypersensitivity – a review. Aetiology, symptoms and theories of pain.1983;Am J Dent 12, 243-249.

23. Duran I, Sengun A.The long-term effectiveness of five current desensitizing products on cervical dentine sensitivity. J Oral Rehabil.2004; 31, 351-356.

24. Eisenburger M, Addy M. Erosion and attrition of human enamel in vitro. Part I: interaction effects. J Dent.2002;30, 341-347.

25. Ferrari M, Cagidiaco MC, Kugel G, Davidson CL .Clinical evaluation of a one-bottle bonding system for desensitizing exposed roots. Am J Dent.1999;12, 243-249.

26. Fischer C, Fischer RG, Wennberg A.Prevalence and distribution of cervical dentine hypersensitivity in a population in Rio de Janeiro, Brazil. J Dent. 1992; Oct; 20(5):272-6.

27. Flynn J, Galloway R, Orchardson R.The incidence of hypersensitive teeth in the west of Scotland. J Dent. 1985;13:230–6.

28. Gerschman JA, Ruben J, Gebart-Eaglemont J. Low level laser therapy for dentinal tooth hypersensitivity. Aust Dent J. 1994; 39: 353-357.

29. Gillam DG. The assessment and treatment of cervical dentinal sensitivity. DDS Thesis, University of Edinburgh, Scotland. 1992

30. Gillam DG, Aris A, Bulman JS, Newman HN, Lee F. Dentine hypersensitivity in subjects recruited for clinical trials: clinical evaluation, prevalence and intra-oral distribution. Journal of Oral Rehabilitation 2002; 29:226–31.

31. Gillam DG, Orchardson R.; Advances in the treatment of root dentin sensitivity: mechanisms and treatment principles. Endod Topics.2006; 13, 13-33.

32. Gillam DG, Seo HS, Newman HN, Bulman JS Comparison of dentine hypersensitivity in selected occidental and oriental populations. J Oral Rehabil.2001; 28, 20-25.

33. Grossman L A systematic method for the treatment of hypersensitive dentine. J. 1935;Am Dent Assoc 22, 592-598.

34. Guo C, McMartin KE.The cytotoxicity of oxalate, metabolite of ethylene glycol, is due to calcium oxalate monohydrate formation. Toxicology.2005; 30, 347-355.

35. Hack GD, Thompson VP Occlusion of dentinal tubules with cavity varnishes. Archs Oral Biol.1994;39, S149.

36. Hargreaves KM, Cohen S (editors), Berman LH (web editor),2010;Cohen's pathways of the pulp (10th ed.). St. Louis, Mo.: Mosby Elsevier. pp. 510, 521.ISBN 978-0-323-06489-7.

37. Hargreaves KM, Cohen S , Berman LHCohen’s pathways of the pulp (10th ed.). St. Louis, Mo.: Mosby Elsevier. pp. , 2010; 510, 521.ISBN 978-0-323-06489-7.

38. Haywood VB (2002) Dentine hypersensitivity: bleaching and restorative considerations for successful management. Int Dent J 52, 376-384.

39. He S, Wang Y, Li X, Hu D. Effectiveness of laser ther- apy and topical desensitising agents in treating dentine hypersensitivity: a systematic review. J Oral Rehabil 2011; 38: 348-358.

40. Irvine JH, Root surface sensitivity: a review of aetiology and management. J N Z Soc Periodontol. 1988; 66, 15-18.

41. Karim, BF; Gillam, DG.The efficacy of strontium and potassium toothpastes in treating dentine hypersensitivity: a systematic review."International journal of dentistry 2013:573258. doi:10.1155/2013/573258.PMC 3638644. PMID 236536

42. Kawasaki A, Ishikawa K, Suge T, Shimizu H, Suzuki K, Matsuo T, Ebisu S Effects of plaque control on the patency and occlusion of dentine tubules in situ. J Oral Rehabil.2001;28, 439-449.

43. Kawasaki A, Suge T, Ishikawa K, Ozaki K, Matsuo T, Ebisu S,;Ammonium hexafluorosilicate increased acid resistance of bovine enamel and dentin. J Mater Sci Mater Med. 2005;16, 461-466.

44. Kazemi RB, S¸en BH, Spångberg LSW.Permeability changes of dentine treated with titanium tetrafluoride. J Dent 27.1999;531-538.

45. Kern DA, McQuade MJ, Scheidt MJ, Hanson B, van Dyke TE.Effectiveness of sodium fluoride on tooth hypersensitivity with and without iontophoresis. J Periodontol. 1989;60, 386-389.

46. Kim S Hypersensitive teeth: desensitization of pulpal sensory nerves. J Endod. 1986; 12, 482-485.

47. Kimura Y, Wilder-Smith P, Yonaga K, Matsumoto K, Treatment of dentine hypersensitivity by lasers: a review. J Clin Periodontol. 2000; 27, 715-721.

48. Lee WC, Eakle WS.Stress-induced cervical lesions: review of advances in the past 10 years. J Prosthet Dent. 1996; 75, 487-494.

49. Ling TY, Gillam DG.The effectiveness of desensitizing agents for the treatment of cervical dentine sensitivity (CDS) – a review. J West Soc Periodontol Periodontal Abstr.1996; 44, 5-12.

50. MacDonald E, North A, Maggio B, Sufi F, Mason S, Moore C, et al, Clinical study investigating abrasive effects of three toothpastes and water in an in situ model. Journal of Dentistry. 2010; 38:509–16.

51. Marini MG, Greghi SLA, Passanezi E, Sant'Ana ACP Gingival recession: prevalence, extension and severity in adults. J Appl Oral Sci. 2004; 12, 250-255.

52. Markowitz K, Pashley DH.Personal reflections on a sensitive subject. J Dent Res. 2007;86, 292-295.

53. Matthews B, Andrew D, Wanachantararak S Biology of the dental pulp with special reference to its vasculature and innervation. In: Tooth wear and sensitivity: clinical advances in restorative dentistry. 2000

54. Mayhew RB, Jessee SA, Martin RE, Association of occlusal, periodontal, and dietary factors with the presence of non-carious cervical dental lesions. Am J Dent.1998; 11, 29-32.

55. McCarthy D, Gillam DG, Parson DJ In vitro effects of laser radiation on dentine surfaces. J Dent Res 76, Special issue, 233.Med.1997; 7: 104-133.

56. Miglani S, Aggarwal V, Ahuja B, Dentin hypersensitivi- ty: Recent trends in management. J Conserve Dent. 2010; 13: 218-224.

57. Minkoff S, Axelrod S. Efficacy of strontium chloride in dental hypersensitivity. J Periondontol. 1987;58, 470-474.

58. Minoux M, Serfaty R, vital tooth bleaching: biologic adverse effects – a review. Quintessence Int. 2008; 39, 645-659.

59. Morris MF, Davis RD, Richardson BW, Clinical efficacy of two dentin desensitizing agents. Am J Dent. 1999; 12, 72-76.

60. Nicola Xania West, Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross-sectional stud. j o u r n a l o f d e n t i s t r y. 2013; 4 1; 8 4 1 – 8 5 1

61. Orbak R, Canakci V, Tezel A, Clinical evaluation of an electro-ionizing toothbrush with a tooth paste containing stannous fluoride in treatment of dentine hypersensitivity following periodontal surgery. Dent Mater J.2001; 20, 164-171.

62. Orchardson R, Cadden SW, an update on the physiology of the dentine-pulp complex. Dent Update. 2001; 28, 200-206, 208-209.

63. Orchardson R, Gillam DG Managing dentin hypersensitivity. J Am Dent Assoc. 2006; 137, 990-998.

64. Orchardson R, Gillam DG. The efficacy of potassium salts as agents for treating dentin hypersensitivity, Division of Neuroscience and Biomedical Systems, Institute of Biomedical and Life Sciences, University of Glasgow, J Orofac Pain. 2000 Winter; 14(1):9-19

65. Osborne-Smith KL, Burke FJ, Wilson NHThe aetiology of the non-carious cervical lesion. Int Dent J.1999; 49, 139-143.

66. Paine ML, Slots J, Rich SK, Fluoride use in periodontal therapy: a review of the literature. J Am Dent Assoc. 1998; 129, 69-77.

67. Pashley DH Dentin permeability, dentin sensitivity and treatment through tubule occlusion. J Endod. 1986; 12, 465-474.

68. Pashley Mechanisms of dentin sensitivity. Dent Clin North Am. DH .1990; 34, 449-473.

69. Pashley DH Smear layer: overview of structure and function. Proc Finn Dent Soc. 1992;88, 215-224.

70. Pashley DH.Potential treatment modalitiesfor dentine hypersensitivity: in-office products. In: Tooth wear and sensitivity: clinical advances in restorative dentistry 2000

71. Pashley DH. Dynamics of the pulpo-dentinal complex. Crit Rev Oral Biol Med. 1996; 7:104

72. Petersson, Lars G, "The role of fluoride in the preventive management of dentin hypersensitivity and root caries". Clinical Oral Investigations.2012; 17 (S1): 63–71. doi: 10.1007/s00784-012-0916-9. PMC 3586140.PMID 23271217.

73. Pillon FL, Romani IG, Schmidt ER Effect of a 3% potassium oxalate topical application on dentinal hypersensitivity after subgingival scaling and root planing. J Periodontol. 2004; 75, 1461-1464.

74. Porto IC, Andrade AK, Montes MA. Diagnosis and treatment of dentinal hypersensitivity. J Oral Sci. 2009 ;51: 323-332.

75. Prati C, Cervellati F, Sanasi V, Montebugnoli L Treatment of cervical dentin hypersensitivity with resin adhesives: 4-week evaluation. Am J Dent. 2001; 14, 378-382.

76. Prati C, Chersoni S, Lucchese A, Pashley DH, Mongiorgi R Dentin permeability after toothbrushing with different toothpastes. Am J Dent.1999; 12, 190-193.

77. Prati C, Montebugnoli L, Suppa P, Valdrè G, Mongiorgi R.Permeability and morphology of dentin after erosion induced by acidic drinks. J Periodontol. 2003; 74, 428-436.

78. Prati C, Venturi L, Valdrè G, Mongiorgi R .Dentin morphology and permeability after brushing with different toothpastes in presence and absence of smear layer. J Periodontol. 2002;73, 183-190.

79. Rajeev Ranjan, Kausar Jaha Yadwad1, Sudhir R Patil1, S Mahantesha3,Aslam A Rahman2, Varun B Bhatia1.Efficacy of 980 nm diode laser as an adjunct to Snf2 in the management of dentinal hypersensitivity: A controlled, prospective clinical study; Journal of Dental Lasers. ,2013; Issue 2 • Vol 7

80. Rapp R, Avery JK, Strachan DS .Possible role of the acetylcholinesterase in neural conduction within the dental pulp. In: Biology of the dental pulp organ, Finn SB ed, University of Alabama Press, Birmingham. ,1968; 309-331.

81. Rees JS, Jin LJ, Lam S, Kudanowska I, Vowles R. The prevalence of dentine hypersensitivity in a hospital clinic population in Hong Kong. J Dent. 2003; 31, 453-461.

82. Rimondini L, Baron C, Carrassi, A. Ultrastructure of hypersensitive and non-sensitive dentine. J Clin Periodonto. 1995; 22:899–902.

83. Romeo Umberto, Russo Claudia, Palaia Gaspare, Tenore Gianluca, and Del Vecchio Alessandro, Treatment of Dentine Hypersensitivity by Diode Laser International Journal of Dentistry. 2012; Article ID 858950, 8 pages

84. S. A. M. Corona T. N. do Nascimento, A. B. E. Catirse, R. F. Z. Lizarelli , W. Dinelli and R. G. Palma-DIBB.Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity Journal of Oral Rehabilitation. 2003; Volume 30, Issue 12, pages 1183–1189, December.

85. Sanjay Miglani, Dentin hypersensitivity: Recent trends in management. Journal of Conservative Dentistry 10/2010; 13(4):218-24. DOI: 10.4103/0972-0707.73385

86. Santaella MR, Braun A, Matson E, Frentzen M.. .Effect of diode laser and fluoride varnish on initial surface demineralization of primary dentition enamel: an in vitro study. Int J Paediatr Dent.2004;. May;14(3):199-203

87. Sauro S, Gandolfi MG, Prati C, Mongiorgi R.Oxalate-containing phytocomplexes as dentine desensitizers: an in vitro study. Arch Oral Biol ,2006; 51, 655-664.

88. Scherman A, Jacobsen P L. Managing dentin hypersensitivity: Whattreatment to recommend to patients. J Am Dent Assoc. 1992;123: 57-61.

89. Schmidlin, Patrick R.; Sahrmann, Phlipp, Current management of dentin hypersensitivity. Clinical Oral Investigations. 2012; 17 (S1): 55–59.doi:10.1007/s00784-012-0912-

90. Sgolastra F, Petrucci A, Gatto R, Monaco.A. Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. J Endod. 2011; 37: 297-303

91. Singal P, Gupta R, Pandit N.2% sodium fluoride-iontophoresis compared to a commercially available desensitizing agent. J Periodontol. 2005; 76, 351-357.

92. Smith B G N. Toothwear: aetiology and diagnosis. Dent Update. 1989; 16:

93. Sowinski J, Ayad F, Petrone M, DeVizio W, Volpe A, Ellwood R, Davies R.Comparative investigations of the desensitizing efficacy of a new dentifrice. J Clin Periodontol. ,2001; 28, 1032-1036.

94. Sowinski JA, Bonta Y, Battista GW, Petrone D, DeVizio W, Petrone M, Proskin HM. Desensitizing efficacy of colgate sensitive maximum strength and fresh mint sensodyne dentifrices. Am J Dent. 2000; 13, 116-120.

95. Suge T, Kawasaki A, Ishikawa K, Matsuo T, Ebisu S.Ammonium hexafluorosilicate elicits calcium phosphate precipitation and shows continuous dentin tubule occlusion. Dent Mater. 2008; 24, 192-198.

96. Suge T, Kawasaki A, Ishikawa K, Matsuo T, Ebisu S ,2006; Effects of plaque control on the patency of dentinal tubules: an in vivo study in beagle dogs. J Periodontol 77, 454-459.

97. Suge T, Kawasaki A, Ishikawa K, Matsuo T, Ebisu S, Effect of ammonium hexafluorosilicate on dentin tubule occlusion for the treatment of dentin hypersensitivity. Am J Dent. 2006; 19, 248-252.

98. Taani DQ, Awartani F, Prevalence and distribution of dentin hypersensitivity and plaque in a dental hospital population. Quintessence Int. 2001; 32, 372-376.

99. Tay FR, Pashley DH, Mak YF, Carvalho RM, Lai SC, Suh BI, Integrating oxalate desensitizers with total-etch two-step adhesive. J Dent Res,2003; 82, 703-707.

100. Thrash WJ, Dodds MW, Jones DL, The effect of stannous fluoride on dentinal hypersensitivity. toothbrushing and dietary compounds on dentine in vitro: an SEM study. J.1994; 48, 31-41.

101. Turp, Jens C, 2012; Discussion: how can we improve diagnosis of dentin hypersensitivity in the the dental office?" Clinical Oral Investigations 17(S1): 53–54. doi: 10.1007/s00784-012-

102. Von Troil B, Needleman I, Sanz M, A systematic review of the prevalence of root sensitivity following periodontal therapy. J Clin Periodontol. 2002; 29, 173-177.

103. West NX, Dentine hypersensitivity: preventive and therapeutic approaches to treatment. Periodontol. 2008; 48, 31-41.

104. West NX, Sanz M, Lussi A, Bartlett D, Bouchard P, Bourgeois D.Prevalence of dentine hypersensitivity and study of associated factors: a European population-based cross-sectional study. J Dent. 2013; Oct;41(10):841-51. doi: 10.1016/j.jdent.2013.07.017. Epub Aug

105. White DJ, Lawless MA, Fatade A, Baig A, von Koppenfels R, Duschner H, Götz H. Stannous fluoride/sodium hexametaphosphate dentifrice increases dentin resistance to tubule exposure in vitro. J Clin Dent.2007;. 18(2):55-9.

106. Wilchgers TG, Emert RL, Dentin hypersensitivity. Oral Health.1997; 87, 51-53, 55-56, 59.

107. Ying Liu1, Jie Gao1,Yan Gao2, Shuaimei XU, Xueling Zhan, Buling Wu; In Vitro Study of Dentin Hypersensitivity Treated by 980-nm Diode Laser; J Lasers Med Sci; .2013;4(3):111-9.

108. Yoshiyama M, Noiri Y, Ozaki K, Uchida A, Ishikawa Y, Ishida H,1990; Transmission electron microscopic characterization of hypersensitive human radicular dentin. J Dent Res 69, 1293-1297.