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Efficacy of Various Desensitizing Agents in Treatment of Dentinal Hypersenstivity following Scaling and Root Planing: A Systematic Review

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Abstract

Background: The most common side effect of scaling and root planing is dentinal hypersensitivity and it is one of the factors that demotivates the patient for seeking periodontal therapy. Many modalities have been used to overcome this and literature points to merits and demerits of various agents. The present review is an attempt to assess the potential benefits of employing various desensitizing agents for managing it and in turn, guiding one to manage post scaling and root planing dentinal hypersensitivity in an effective way.

Materials and methods: A total of 252 articles were searched on electronic database, out of which 15 articles fulfilled the inclusion criteria for the review. Data was extracted and systematically reviewed to draw inferences.

Results: The results showed that most of the active treatment options had significant benefits over placebo and degree of the beneficial results varied between different studies.

Conclusion: Additional clinical trials are required to better compare the different types of treatments modalities and their effectiveness for a longer study period.

Keywords:, Dentinal hypersensitivity, Desensitizing agents, Lasers, Periodontal therapy, Toothpastes

Introduction

Pulp is confined within the dentin and any physiologic or pathologic change in one or both tissues will exhibit an exaggerated sudden and sharp painful response succeeding application of a stimulus as dentinal hypersensitivity, regardless of its location.[1] The exact mechanism by which the stimulus is transmitted from the dentinal surface to the pulp is not clear, but several theories have been proposed.[2] According to the "Brannstrom Hydrodynamic Theory" thermal and osmotic stimuli provoke movement of fluid within dentinal tubules that stimulate nociceptive nerves on the pulp side of dentinal tubules.[3]

The European Federation of Periodontology has recently reported that the root sensitivity (RS) is associated with periodontal disease and its treatment.[4] Though the cementum is only 20 to 50 µ thick and is sometimes removed by overzealous tooth-brushing or scaling and root planing.[5,6] As the literature reported a higher prevalence of dentinal hypersensitivity following SRP[7-10] but one of the study could not find sufficient data to accept the term root sensitivity (RS) for hypersensitivity following periodontal therapy.[11] Literature states that constantly present DH for long time provokes chronic discomfort and emotional distress making dental plaque control difficult for patient.[12,13] Although, several researchers have reported that there is limited data on its epidemiology and prevalence.[14] The prevalence ranges from 3% to 73% with highest peak in age range of 20–40 years, reporting more female predominance than male and commonly affecting premolar and incisor teeth.[5]

The dentinal hypersensitivity following SRP sometimes doesn't get reported due to its self remission overtime. The "natural desensitization process" may be related to a patient's salivary ion exchange and/or oral hygiene practices.[4] There may be a decrease in hypersensitivity due to the generation of secondary dentin.[15] Ultimate goal in treatment of dentinal hypersensitivity is immediate and permanent relief of pain. Numerous approaches have been suggested including at-home and in-office methods. To date no treatment modality has been considered as "gold standard" for dentinal hypersensitivity.[16] Current treatment modalities are based on chemically induced mechanical obstruction of dentinal fluid movement by various solutions, adhesives, lasers, medications etc. Sodium fluoride, potassium nitrate, strontium chloride, stannous fluoride, cavity varnishes, lasers, sodium fluoride, stannous fluoride, adhesive resins, potassium nitrate, calcium phosphate etc are some formulations available for reducing or even eliminating, the symptoms of dentine hypersensitivity. A few of the investigations have compared one professional treatment with one or another home use product with another, but mostly comparisons are with a control, minus active or placebo treatment. Thus, there is a dearth of information as to the changes produced at the dentine surface either by so called desensitizing agents or by products containing these agents.

This review evaluates the efficacy of various available desensitizing treatment modalities used for treatment of dentinal hypersensitivity after scaling and root planing.

Materials and Methods

Methods of this systematic review followed recommendations from the Cochrane Collaboration (Cochrane Handbook for Systematic Reviews of Interventions 5.1.0.,http://www.cochrane-handbook.org) **(Von Troil B et al 2002)**[8] and reporting followed the guidelines for Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA).

The PICO Question was formulated as "Do Desensitizing agents used for treatment of Dentinal Hypersensitivity

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resolve the patients discomfort problem caused by scaling and root planing?"

Types of study: Clinical trials, RCTs, Placebo clinical trials and other evaluating various desensitizing treatment modalities for dentinal hypersensitivity following scaling and root planning.

Inclusion and Exclusion Criteria

Inclusion criteria for relevant studies were dentate, systemically healthy patients reporting dentinal hypersensitivity after non-surgical periodontal treatment and application of different desensitizing therapeutic agents for treatment of the same. The age of the included subjects ranged between 28 and 77 years irrespective of gender. Studies having unreported baseline data, irrelevant method assessing DH, improper study design, published in other language than English and same repeated articles were excluded**.**

Type of intervention

Assessment of the efficacy of various in office materials, Lasers, at home agents along with use of Ayurvedic remedies as desensitizing agents following scaling and root planing procedures.

Type of Outcome Measures

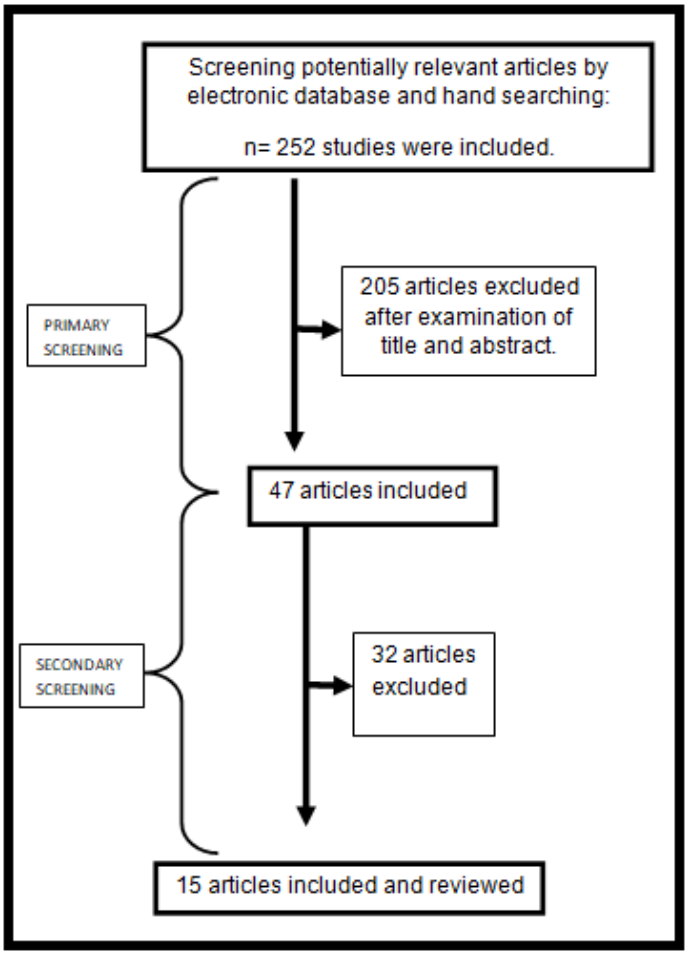
Following outcome measures were assessed:

VAS (visual analog scale) and VRS (verbal rating score) scale were used to determine the efficacy of application of various desensitizing agents on dentinal hypersensitivity following scaling and root planning.

Search Methods

The search methodology aimed to find articles related to above review through electronic database at Medline, PubMed, Wiley Online Library and Cochrane Oral Health Group Trials Register databases until July 2020 which included both short-term and long-term studies as well as manual search of the cross references given in the included articles. The search keywords were: root sensitivity OR dentinal sensitivity OR cervical sensitivity OR desensitizing agents OR desensitizing dentifrice OR desensitizing mouthwashes OR homecare desensitizing agents OR in office use desensitizing Agents OR lasers OR controlled clinical trials OR case controls OR cohort OR follow up. Many journals related to this review were hand searched. Unpublished studies, abstracts and conference proceedings were also searched from relevant journals.

Figure 1: Selection process flow diagram



Data Collection

All studies were assessed by the authors independently and screened for inclusion criteria so as to reduce the risk of viewer bias. Data from selected studies were extracted and recorded. Any differences to inclusion or exclusion of article or study were resolved following discussion between authors.

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Risk of Bias Assessment

Six out of fifteen studies were having low risk of bias for random sequence generation, three studies had low risk of bias for allocation concealment, two studies were low risk of bias for blinding of participants and personnel, only two studies had high risk of bias in terms of detection, attrition or incomplete data. four studies were found to have moderate overall bias [Table 1].

Results

Descriptive result: Home care desensitizing agents like Toothpastes, mouthwashes and varnishes containing fluorides, potassium nitrates and calcium hydroxide significantly reduced the dentinal hypersensitivity. Ease of its use by patients and fast desensitizing action, pleasant taste and ease availability are some factors that contributed toward better clinical outcomes. Short term desensitizing effects are major drawbacks for home use desensitizing agents. On the other hand, in office used desensitizing agents like lasers have shown long term desensitizing effect but are technique sensitive and time consuming procedure with multiple applications and slow action which leads to negative effect on treatment outcomes. Oil pulling, Milk, ayurvedic products and other treatment modalities have also shown significant results but are not statistically significant.[16,22,25,28,35,42,45,49,50]

Analytical Results: [Table 2].

Table 1: Summary of Cochrane risk of bias assessment

Author & Year	Selection Bias Random Sequence Generation	Selection Bias Allocation Concealment	Reporting Bias Selective Reporting	Other Bias Other Sources Of Bias	Performance Bias Blinding	Detection Bias Blinding	Attrition Bias Incomplete Data	Reviewer Assessment
Pillon FL et al 2004[33]	Low	Low	High	Low	Low	Unclear	Low	Low
Singal P et al 2005[25]	Low	Low	Unclear	Low	Low	Low	Low	Low
Uchida A et al 1980[27]	Low	Low	Low	Low	Low	Low	Low	Low
Gugnani S et al in 2008[42]	Low	Unclear	Low	Low	Low	Unclear	Low	Low
Sabir M et al 2016[28]	Low	Low	Low	Unclear	Low	Low	Low	Low
Madhurkar JG et al. 2017[29]	Low	High	Low	Low	High	Low	High	Low
Qahtani WAA et al 2020[47]	Low	Low	High	Low	Low	Low	Low	Moderate

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Umberto R et al 2012[32]	Low	Low	Low	Unclear	Low	Low	Low	Low
Kumari M et al 2013[45]	Low	Unclear	Low	High	Low	Unclear	Low	Low
John h et al 1962[44]	Low	Low	Low	Unclear	High	Low	Low	Moderate
Kanaparthy R et al 2011[41]	Low	Low	Unclear	Low	Low	Low	Low	Low
Carlo GT 1982[49]	Low	Unclear	Low	Low	Low	Low	Low	Low
Pesevska S et al 2010[50]	Unclear	Low	Low	Low	High	Low	Unclear	Low
Tarbet WJ et al 1980[40]	Low	Low	Low	Low	Unclear	Unclear	Low	Low
Bal M V et al 2015[48]	Low	Low	Unclear	Unclear	High	Unclear	Low	Moderate

Table 2: Outcome of various desensitizing agents

Desensitizing Agents	Outcomes
Silver nitrate containing toothpaste	Less Significant
Calcium hydroxide containing toothpaste:	Significant
Potassium nitrate containing toothpaste:	Significant
Arginine-containing toothpaste	Significant
Fuoride-containing toothpaste	Significant
Qxalate -containing Toothpaste	Less significant
Calcium sodium phosphor-silicate agent	Less significant
Varnisher	Less significant
Resin based dentinal adhesive system	Significant
Bioglass	Significant
Glucocorticoids	Less significant
Portland cement	Significant
Lasers	Significant
Oil pulling	Less significant

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Discussion

Dentinal root hypersensitivity is neither a recent problem nor a rare one. Several clinical studies have attempted to analyse the contribution of various clinical variables to the development of dentinal hypersenstivity after both non-surgical **(Wallace & Bissada 1990, Fischer et al. 1991)** and surgical **(Nishida et al. 1976, Uchida et al. 1980)** periodontal therapy.[1,4,9,11] Scanning electron microscopic examination reveals wide open dentinal tubules in hypersensitive dentin which was eight times higher in sensitive dentin as compared to non-sensitive dentin.[17] The hypersensitivity resulting from periodontal scaling and root planing therapy affects oral hygiene measures and thus may affect the success of periodontal therapy.[7]

The therapeutic management of dentinal hypersensitivity is based on the early detection, elimination or reduction of the etiologic factors and use of desensitizing agents.[18] A number of treatment modalities exist to reduce or potentially eliminate hypersensitivity, and these approaches fall into two classes: those that physically occlude the tubules, which comprise the majority of treatment modalities; and those that block synaptic neural transmission at the pulpal tissues.

Substances that occlude dentinal tubules or decrease their size lead to reduction in tooth sensitivity. Natural tubule occlusion can occur through the formation of calculus or intratubular crystals from salivary minerals.[19] **Karlsson UL et al (1975)**[16] described a film of microcrystalline debris “smear layer” remaining on mineralized tissue after it had been cut with rotary or hand instruments. **Krell and his colleagues**[19] have reported smear layers created on radicular dentine using curettes shows different solubility properties than smear layers created with burs making it more resistant to acid attack. The rate of dissolution of these structures probably depends upon the amount of calcium and phosphate in the saliva, the frequency and vigor of the patient's tooth brushing, as well as the acidity of the diet and the rate of plaque development on the dentin surface.

Variety of methods and materials are applicable to both home and office use desensitizing modalities. For periodontitis patients there is a tendency for more frequent use of in-office hypersensitivity agents due to the intensity of the symptoms during the initial post-periodontal treatment phase. Some of the homecare and in office used modalities are discussed below.

Home use desensitizing agents: Various tooth pastes, mouth washes, chewing gums and local application ointments containing various desensitizing agents like silver nitrate, flouride, potassium nitrate etc are frequently used. Silver nitrate is a powerful protein precipitant. **Greenhill** and **pashley**[20] found that the silver nitrate both alone or in combination with formalin precipitated silver chloride or elemental silver, respectively and greatly reduced dentinal fluid flow. However, silver salts can diffuse through the dentin into pulp, and creates a minor pulpal inflammation in shallow cavities. **Naylor**[21] and **Anderson and Matthews**[22] in their study found silver nitrate to be less effective in the management of dentine sensitivity.

The potassium content of potassium nitrate may play a role directly or indirectly on the dentin neuro–sensory unit. **Greenhill** and **pashley**[20] found potassium nitrate to be ineffective in decreasing any dentinal fluid flow in in vitro coated dentin, even at a 30% concentration. But many investigators have found 5% potassium nitrate to be an excellent dentinal desensitizing agent. **Green (1977)**[23] compared potassium nitrate with calcium hydroxide and concluded that calcium hydroxide was more consistently effective in decreasing sensitivity than potassium nitrate. **Hodash m. (1974)**[24], on the other hand, reported potassium nitrate as a "superior desensitizer" and found it

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highly effective in 300 patients in an uncontrolled study at concentrations of 1 to 15%. The ease of patient brushing with agents, pleasant taste, easily availability, multiple application etc are some factors contributing toward success of these agents.

Fluorides decrease the dentinal permeability by precipitation of calcium fluoride crystals inside the dentinal tubules. Various fluoride formulations including sodium fluoride, stannous fluoride, sodium monofluorophosphate, fluorosilicates and fluoride combined with iontophoresis are available.[29] stannous fluoride and fluorosilicates act by formation of precipitates of calcium phosphates from saliva. **Singal P et al (2005)** compared 2% sodium fluoride-iontophoresis to a commercially available desensitizing agent HEMA – G.[25] Both agents were found to be equally effective immediately after application but the 2% NaF showed 72.3% reduction than HEMA – G 65.54% at 3 month. A clinical study has shown that 0.4% stannous fluoride along with 0.71% of fluoride can provide an immediate affect after a 5 minute professional application.[26] **Uchida et al (1980)** reported that after 30 days, 75% of patients who used a strontium chloride dentifrice experienced complete relief of hypersensitivity and 15% exhibited measurable relief, while complete relief was obtained by only 23.5% of control patients.[27]

Milk rinses are cheap and easily available at home. It can be used as a desensitizing agent, and rinsing with milk for few days is effective and stable in quick reduction of hypersensitivity induced by scaling. **Sabir M et al (2015)**[28] conducted a study to assess the problem of dentine hypersensitivity after non-surgical periodontal treatment and use of commercially available milk at room temperature as mouth rinse for the treatment. The study showed an incidence of 42.5% and prevalence of 77.5% for dentine hypersensitivity after periodontal treatment procedures. After rinsing with milk following periodontal treatment procedures, there was a significant reduction of dentinal hypersenstivity. **MaDHurkar JG et al (2017)**[29] evaluated the efficacy of commercially available milk as a desensitizing agent for the treatment of sensitivity following scaling and root planing and found significant benefits of the agent.

In office used desensitizing agents: Laser is an acronym for light amplification by stimulated emission of radiations. It has been shown in various studies that lasers can be used in the effective management of DH.[34] It has also been proposed that lasers coagulate the proteins inside the dentinal tubules and block the movement of fluid. The lasers used for the treatment of dentin hypersensitivity are divided into two groups: low output power low level lasers [Helium-Neon (He-Ne) and Gallium/ Aluminum/ Arsenide (GaAlAs) Diode Lasers], and middle output power lasers [Nd:YaG and Co_2 lasers].[30]

Adinarayana r et al (2017)[31] evaluated the efficacy of 810 nm diode laser in reduction of dentine hypersensitivity after SRP. The laser therapy was effective in reducing moderate pain in cervical DH after srp. **Umberto et al (2012)**[32] compared the effectiveness of gaalas diode laser alone and with topical sodium fluoride gel (NaF). The diode laser significantly showed a very high capability to improve immediately the DH-related pain, both alone and even better in combination with NaF gel.

Oxalates can reduce dentinal permeability and occlude dentinal tubules by forming a calcium oxalate crystals inside the dentinal tubules.[33] thirty percent potassium oxalate has shown a ninty eight percent reduction in dentinal permeability.[34] also, topical application of three percent potassium oxalate reduced DH after periodontal therapy. The condition can be improved by acid etching of

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the dentinal surface, thus increasing the penetration of calcium oxalate crystals deep into the dentinal tubules.[35] Potassium oxalate can lead to gastric irritation. Therefore, it should not be used with a tray for prolonged placement.[35] Calcium hydroxide by itself has little or no direct effect on dentine sensory nerve activity and its long-term effectiveness is thought to occur because of its ability to cause increased peri-tubular dentin mineralization. **Jorkjend** and **Tronstad**[36] applied calcium hydroxide to sensitive teeth following periodontal surgery and obtained significant results after 7 days. **Levin et al (1973)**[37] found calcium hydroxide paste very effective in 98% of the 118 sensitive teeth tested. Copal varnish can be applied to cover the exposed dentinal surface. But its effect is for short term and is not recommended for long term management of DH.[14] The varnishes can act as a vehicle for fluoride. The fluoride varnishes can be acidulated to increase the penetration of ions.[38]

Resin-based dental adhesive systems can seal the dentinal tubules effectively by forming a hybrid layer and provide a more durable and long lasting dentine desensitizing effect. The conventional dentin bonding agents (DBA) removes the smear layer, etches the dentinal surface and forms deep dentinal resin tags inside the dentinal tubules.[39] It effectively seals the dentinal tubules and prevents DH. Newer bonding agents modify the smear layer and incorporate it in into the hybrid layer. [40] Gluma desensitizer (heraeus kulzer, hanau, germany) contains hydroxyethyl methacrylate (hema), benzalkonium chloride, gluteraldehyde and fluoride.[41] Gluteraldehyde causes coagulation of the proteins inside the dentinal tubules and has shown promising results in the clinical trials.[42] The basic component of bioglass is silica, which acts as a nucleation site for precipitation of calcium and phosphate helps in reduction of DH.[40,43]

Mosteller[44] used prednisolone in an uncontrolled study of gold restorations and showed that steroid application to dentin increased peritubular dentin mineralization. Thus, the tubule lumen would be decreased, resulting in less dentin tubule fluid movement, reducing the dentinal sensitivity. The efficacy and long-term effectiveness of steroids in the management of dentinal sensitivity still need further investigation. The casein phosphopeptide (CPP) contains phosphoseryl sequences which get attached and stabilized with amorphous calcium phosphate (ACP). The stabilized CPP–ACP prevents the dissolution of calcium and phosphate ions and maintains a supersaturated solution of bioavailable calcium and phosphates. DH. **Gugnani S et al (2008)**[42] compared and evaluated two commercially available desensitising agents casein phosphopeptide amorphous calcium phosphate (CPP-ACP) and HEMA-G (aqueous solution of hydroxyethyl methacrylate and glutaraldehyde) in managing dentine hypersensitivity following scaling and root planing. The study concluded that subgingival scaling and root planing followed by single application of CPP-ACP or HEMA-G provided higher short-term reductions in dentine hypersensitivity compared with controls.

At home ayurvedic medicine: Is one of the most ancient and holistic medical systems of the world. Its roots are in atharvaveda, the oldest recorded compendium of wisdom on the earth (6000 b.c.). It is well practiced in other parts of world as complementary and alternative medicine. **Kumari m et al in 2018**[45] studied the efficacy of a commercially available novel herbal dentifrice in reduction of dentinal hypersensitivity and found the dentifrice to be very effective for treatment of dentinal hypersensitivity. Oil pulling has been used extensively as a traditional indian folk remedy for many years. It provides strength in jaws and voice, prevents mouth drness, development of the face and to maximum the taste

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of food. **Cheema r et al (2014)**[46] conducted a pilot investigation to evaluate the efficacy of oil therapy in reduction of dentin hypersensitivity, as compared to desensitizing dentifrices. Oil pulling was significantly more effective in reducing dentinal hypersensitivity as compared to a desensitizing dentrifrice. **Qahtani wa et al in 2020**[47] conducted a single blinded randomized controlled trial to study the efficacy of sesame oil therapy in reduction of dentin hypersensitivity, as compared to desensitizing dentifrice. Desensitizing tooth paste showed 30.5% reduction in sensitivity, whereas sesame oil application showed 36.2% reduction.

Conclusion

Periodontal instrumentations can cause dentinal hypersensitivity in periodontitis patients and can even worsen the previous existing dentinal hypersensitive condition. Saliva has an ionic sealing action on exposed dentinal tubules that heals up dentinal hypersensitive within few days after periodontal instrumentation without any specific treatment. But in some periodontitis patients a specific home care or in office treatment modality to reduce hypersensitivity is generally required. Various home application desensitizing tooth pastes, chewing gums, mouthwashes etc have shown fast but short lasting desensitizing effect. They are easy to use, do not discolor the teeth are non-irritating to gingiva or other mucous membranes, have pleasant taste and are readily available over the counter. On other hand, In office uses Varnishers, Sealents, and other modalities have drawback of multiple time application and slow action, but the results obtained are very effective and long lasting as compared to home application products. Lasers showed 72% effective reduction in DH. Milk, Oil Pulling and other home based ayurvedic desensitizing agents also showed significant reduction in dentinal hypersensitivity along with the benefit of their ease of availability at home.

Limited access to articles, limited database, lesser number of studies with less risk of bias, variables in recording hypersensitivity parameters, heterogeneity of data recorded etc are some limitations of the study.

So, in future a proper long term studies with homogeneous data are required to evaluate the efficacy of various desensitizing agents in treatment of dentinal hypersensitivity caused by non-surgical periodontal therapy.

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