

# Research Review

## EDUCATIONAL SERIES

### Management of Dentine Hypersensitivity

#### About Research Review

Research Review is an independent medical publishing organisation producing electronic publications including Dental Review, GP Research Review, Diabetes & Obesity Review and Natural Health Review. These publications are quick and easy to read, and provide summaries of studies from the most respected medical journals in the world together with a local specialist commentary indicating why they matter in New Zealand.

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**Disclaimer:** This publication is an independent review of significant research in the management of dentine hypersensitivity. It provides summaries and opinions of published data that are the opinion of the writer rather than that of the scientific journal or research group. It is suggested the reader reviews the full trial data before forming a final conclusion on any recommendations.

#### Introduction

This publication is intended as an educational resource for health professionals. It presents a short background on dentine hypersensitivity in New Zealand and offers general practice considerations for successful management of this condition, with reference to the most recent literature. The review is intended to update readers about the latest developments and advancing clinical practice in dentine hypersensitivity.

#### Defining Dentine Hypersensitivity

Dentine hypersensitivity, or cervical dentine sensitivity, is a very common clinical presentation and often results in considerable discomfort for patients. It is defined as short sharp pain arising from exposed dentine frequently in response to thermal, tactile, chemical or osmotic stimuli; this pain is not attributable to any other form of dental defect or pathology.<sup>1-4</sup> The condition generally involves the facial surfaces of teeth near the cervical aspect and is very common in premolars and canines.<sup>5</sup> Typically, this condition develops in patients with gingival recession, periodontal diseases, and after periodontal surgery or loss of cementum following non-surgical periodontal therapy.<sup>6,7</sup> In addition, tooth defects, dentine exposure as a result of a developmental anomaly, and improper brushing habits can predispose patients to cervical exposure and pain.<sup>8,9</sup>

Cited prevalence rates of dentine hypersensitivity vary, from more than 40 million people in the US annually<sup>10</sup>, 14.3% of all dental patients<sup>1</sup>, between 8% and 57% of the adult dentate population<sup>11</sup>, and reportedly between 72.5% and 98% of periodontal patients.<sup>12</sup> The majority of individuals are aged between 20 and 40 years; dental hypersensitivity has been shown to peak in prevalence in 30-year-olds.<sup>13</sup>

#### Prevention of Dentine Hypersensitivity

Suggestions for preventing dentine hypersensitivity include dietary counselling and oral hygiene instructions, when advising patients about self-care practices (see Table 1).<sup>14</sup>

The increased emphasis on aesthetics and 'white teeth' has meant a dramatic increase in the number of tooth whitening procedures performed worldwide; New Zealand is no exception. Whether applied professionally or at home, tooth bleaching is associated with mild to moderate transient tooth sensitivity (e.g. 55% to 75% of treatment groups in double-blind clinical studies have reported sensitivity during use of nightguard bleaching products), which may be worsened in cases of existing gingival recession or a prior history of root sensitivity. It is recommended that patients undergo thorough evaluation of their mouths before they commence practice- or home-based bleaching, so that they can avoid, or at least be informed about, the potential for hypersensitivity following such procedures.<sup>14</sup>

The patient may have to decrease the frequency (typically, to every other day) and duration of treatments.<sup>15</sup> If these measures fail to resolve the problem, it may be worthwhile using topical fluorides in conjunction with the bleaching treatments.<sup>15</sup> Evidence suggests that sensitivity to tooth-whitening procedures may be reduced or prevented in patients who use a desensitising toothpaste containing potassium nitrate for several weeks prior to initiating as well as during bleaching.<sup>14,15</sup>

**Table 1.** Prevention of dentine hypersensitivity

Suggested tips for patients
Avoid gingival recession due to poor plaque removal by practicing good oral hygiene techniques
Avoid using large amounts of dentifrice, or reapplying additional dentifrice during brushing
Avoid hard bristled toothbrushes without end rounded bristles
Avoid brushing teeth immediately after ingestion of acidic food or beverages
Avoid over brushing with excessive pressure for prolonged periods of time
Avoid excessive flossing or incorrect use of other interproximal cleaning devices
Avoid 'picking' at the gums or using toothpicks inappropriately
Suggested tips for professionals
Avoid over instrumenting the root surfaces during calculus removal and scaling and root planing
Avoid over polishing the exposed roots during stain removal
Avoid violating the biologic width when placing crown margins causing subsequent recession
Avoid 'burning' the gingival tissue during in-office tooth whitening or bleaching procedures

## Theories for dentine hypersensitivity

Several theories have been proposed over the years to explain the mechanism involved in dentine sensitivity. Whereas evidence has failed to support the theory of 'odontoblastic transduction' and 'innervation of dentine' mechanisms, significant evidence supports the 'hydrodynamic theory' and this is the most widely accepted theory to date.<sup>8,16</sup> According to the hydrodynamic theory, when the fluids within

the dentinal tubules are subjected to temperature changes or physical osmotic changes, the movement stimulates a nerve receptor sensitive to pressure, which leads to the transmission of the stimuli.<sup>8</sup> These dentinal tubules are believed to be open to the oral cavity at the dentine surface as well as within the pulp.<sup>8</sup>

## Management strategies

Teeth that are associated with hypersensitivity are not generally viewed as being as seriously affected as those that have developed caries, endodontic problems or periodontal disease, but the condition does warrant appropriate and proper management.<sup>8</sup> The first step in management is to take a complete history of the condition; a number of other conditions are known to present with similar symptoms of 'dental pain', other possible causes of pain must be excluded before undertaking any management strategy for dentine hypersensitivity. Other conditions that result in the typically short, sharp, dentinal pain include caries, chipped teeth, fractured restorations, marginal leakage around restorations, some restorative materials, cracked tooth syndrome and palato-gingival grooves.<sup>17</sup> Treatment options for these conditions are generally quite different from those administered in dentine hypersensitivity. Failure to consider causation in the management of dentine hypersensitivity may

result in recurrence or even failure of treatment.<sup>16</sup> Potential treatment options for dentine hypersensitivity can be reversible, non-reversible, or a combination of both; the severity and extent of the sensitivity will dictate choice of treatment (see boxed text).

### Treatment options for the management of dentine hypersensitivity

Reversible	Non-reversible
Desensitising toothpastes	Glass ionomer cements
Fluoride gels, rinses, and varnishes	Resins, filled or unfilled
Oxalates of ferric, aluminium and potassium	Periodontal flaps or grafts
Protein precipitants	Pulp extirpation and root canal filling

## Self-care at home

Management strategies that account for aetiological and predisposing factors are usually more successful than treatment alone.<sup>16</sup> The practitioner is advised to consider detailed written dietary histories and oral hygiene habits (frequency, duration and timing of brushing, brushing technique, estimation of brushing force, frequency of brush change, and appearance of brush at change).<sup>16</sup> Diet choices may aggravate sensitivity from erosion; foodstuffs that have a low pH material (e.g. fresh tomatoes, orange juice, carbonated drinks, and popular sports drinks) etch areas with exposed dentine, causing sudden sensitivity.<sup>15</sup> Any identified aetiological or predisposing factors may be removed or modified. The patient can be given dietary advice to minimise erosion, while oral hygiene instruction will minimise abrasion and dissociate abrasion from erosion.<sup>16</sup> Treatments should be individually tailored and influenced by the number of teeth involved and the severity of the pain.<sup>16</sup> For patients with exposed dentine and root sensitivity, use of a dentifrice with potassium nitrate or strontium chloride has been shown to reduce dentine hypersensitivity.<sup>14</sup> Based on the hydrodynamic theory, the majority of cases of dentine hypersensitivity are reversible and can be treated with the home-based application of a therapeutic dentifrice

(as shown in Table 2). It is assumed that potassium nitrate works by penetrating the length of the dentinal tube and depolarising the nerve, preventing it from repolarising.<sup>14</sup> Desensitising toothpastes are the simplest and cheapest method for self-care at home and have been endorsed by the Canadian Advisory Board on Dentin Hypersensitivity as the first line of treatment.<sup>13</sup> Patients should be advised to seek a desensitising formula that is most similar to their current regular preference, to encourage regular use of the toothpaste, as this is essential for symptom relief and a successful outcome.

5% Potassium Nitrate
Sensodyne Gentle Whitening
Sensodyne Fresh Impact
Sensodyne Total Care
Sensodyne Total Care Gel
Sensodyne Total Care Plus Whitening

**Table 2.** Dentifrices containing anti-sensitivity agents, available in New Zealand

## Professional applications

Cases of prolonged or severe hypersensitivity are not easily reversed and require professional attention. Professional applications include a range of materials that work by blocking the dentinal tubules and thereby diminish the movement of fluid in the tubules (as per the hydrodynamic theory); these products include professionally applied restorative materials, surgical root coverage, or endodontic therapy.<sup>14</sup> The clinician may apply surface barriers such as varnishes, dentine bonding agents, composite resins, glass ionomer cements and compomers.

### Varnishes and precipitants

Use of varnishes and precipitants have been shown to reduce the pain of dentine hypersensitivity for as long as the agent remains on/in the tubule.<sup>13</sup> The clinical efficacy of professionally applied sodium fluoride and oxalates remain unclear.<sup>13</sup>

### Restorative materials

Among restorative materials, resin-reinforced glass ionomer/compomers, adhesive resin primers and adhesive resin bonding systems have proven successful in the treatment of dentine hypersensitivity. However, treatment can be problematic in cases of little tissue loss and over contouring, and inadequate margins can lead to plaque retentive sites and gingival inflammation, and future attachment loss.<sup>14</sup> These materials can be abraded and may have to be routinely reapplied.

Resin-reinforced glass ionomer has reportedly proven successful.<sup>18</sup> Symptoms can be temporarily alleviated by cavity varnish when applied in a thin film on open dentinal tubules, but the smear layer has to be modified or removed before application, to occlude the tubules and be stable to acidic attack.<sup>13</sup> Scant evidence exists in support of adhesive resin primer products; failure of polymerisation can occur and the films can be easily abraded.<sup>13</sup> However, these materials would

seem appropriate for patients after employment of preventive advice and home use treatment, particularly for isolated teeth that have not responded.<sup>13</sup>

### Laser treatment

Nd:YAG laser irradiation is thought to alleviate symptoms by evaporating the superficial layers of the dentinal fluid and by reducing permeability through coagulation of proteins in the dentinal fluid.<sup>13</sup> However, the clinical evidence regarding laser treatment has been equivocal, with some studies showing encouraging results and others finding that its reduction in pain sensation is not significantly different from placebo treatment.<sup>13</sup>

### Periodontal surgery

Surgical procedures for dentine hypersensitivity can include root coverage with connective tissue grafts, while localised gingival recessions have in some cases been treated with guided tissue regeneration using a bioresorbable membrane or skin allografts with coronally positioned flaps.<sup>14</sup> These procedures are not advocated as the first choice for treatment of dentine hypersensitivity due to their invasiveness and associated cost.<sup>13</sup>

### Future therapies

Proposed future therapies for dentine hypersensitivity include gene therapy treatment of the sensory nerves to dental restorative procedures as well as to surgical and non-surgical debridement that elicits dentine hypersensitivity.<sup>14</sup> One such method that has been explored is the blockade of the increased production of nerve growth factor by pulpal fibroblasts near the lesion; these are thought to contribute to tooth hypersensitivity after restorative procedures.<sup>14</sup>

# Evaluations of strategies used in the clinical treatment of dentine hypersensitivity

## The dentine hypersensitivity patient – a total management package<sup>13</sup>

**Authors:** West N

**Summary:** This article discusses the nature and mechanisms of pain in dentine hypersensitivity, assesses clinical confirmation of diagnosis, the aetiology of this condition and patient behaviour, as well as management strategies. It notes that as most dentine hypersensitivity is associated with either gingival recession or erosive tooth wear, these predisposing conditions must be addressed in conjunction with the hypersensitivity.

**Comment: Dr Jonathan Leichter:** A comprehensive list of possible diagnoses for pain symptoms similar to those of dentine hypersensitivity was the first thing that impressed me about this article. From there a logical and clear progression which proposed three lines of treatment was discussed. Once the diagnosis is confirmed, aetiology and behaviour need to be considered, and, finally, management strategies implemented. This article was full of tips and information that will be useful in the general practice setting. Did you know that if you consumed 1 litre of soft drink per day – an amount not unrealistic for some of our teenage patients – you could theoretically lose one

millimetre of enamel in as little as two years? The discussion of treatment options is well set out and the important fact that we need to address the predisposing conditions and not only the hypersensitivity, was certainly brought home.

**Judith Windle:** West provides a thorough discussion on the pertinent points of managing the patient with dentine hypersensitivity. It is important to arrive at an accurate diagnosis of the cause of the pain being experienced by your patients. There are numerous conditions which may exhibit pain similar to dentine hypersensitivity. The treatment required for these conditions will be vastly different from those used to treat hypersensitivity. Clinicians need to investigate the aetiology and predisposing factors of dentine hypersensitivity for each individual patient.

Self-care at home products such as desensitising toothpastes and fluorides may be the only interventions required. In-surgery interventions may be used instead of or concurrently with the home care regimes.

Assessing the patient as a unique individual will equip the clinician to address the presenting problems more effectively.

## Evaluation of the product based on Recaldent™ technology in the treatment of dentin hypersensitivity<sup>9</sup>

**Authors:** Kowalczyk A et al

**Summary:** This study assessed the effectiveness of GC Tooth Mousse in the treatment of 101 teeth with dentine hypersensitivity due to various factors in 13 subjects aged 23–48 years. An initial examination evaluated the intensity of pain induced by a one-second stream of the air syringe and mechanically, by moving the probe on the tooth surface. Subjects' sensations were recorded on a 10-point visual analogue scale (VAS; 1 = mild pain and 10 = unbearable pain) before and at 15 minutes after the preparation application, then after 1 and 4 weeks.

At baseline, almost 80% of subjects described their pain response to the stream of cold air as strong or very strong, hard to resist. After the preparation application, fewer teeth reacted with extremely strong pain; the percentage of teeth reacting with mild pain increased by 15% and the number of teeth which did not react to the cold air stream increased by 27.72%. The values after 15 minutes were similar. After 1 week, the percentage of teeth with very strong pain had increased (from 5.94% to 11.8%) and the percentage of medium pain had also increased (from 30.69% to 48.51%). Conversely, the number of teeth without pain and with mild pain decreased twice. At 30 days, the percentage distribution was close to the results obtained after 7 days (see Table 3).

**Comment: Dr Jonathan Leichter:** The efficacy of GC Tooth Mousse for dentine hypersensitivity was evaluated in this study. Probing and a stream of cold air were used to assess sensitivity. Subjects were assessed at baseline, directly after application, after 15 minutes, after 1 week and finally after 4 weeks. The conclusions drawn from this study were that the effectiveness and short-term therapeutic effect of Tooth Mousse is insufficient, and that soothing the pain should be regarded as an additional remineralising effect of the product. I was not surprised that this study found Tooth Mousse to be ineffective after only one application. Studies done by the manufacturer of Tooth Mousse involve topical application each night for a period of 6 weeks. It would appear that long-term use is needed to bring about a reduction in dentine hypersensitivity. I am sure that this is the recommendation that most practitioners would give to their patients.

**Judith Windle:** GC Tooth Mousse was evaluated in this study as an effective agent for the treatment of dentine hypersensitivity. The conclusion reached was that Tooth Mousse provides more of a remineralising effect, rather than short-term relief from hypersensitivity. Clinicians report anecdotal comment suggesting benefits in excess of those reported in this study. For the patient experiencing xerostomia alongside hypersensitivity, there is relief from both problems being achieved.

**Table 3.** Evaluation of GC Tooth Mousse effectiveness – the number and percentage of teeth reacting to cold air and mechanical stimuli

Examination	Cold Air				Probe	
	0	1–3	4–6	7–10	0	+
Before the application	–	21 (20.79%)	43 (42.57%)	37 (36.63%)	89 (88.11%)	12 (11.89%)
After the application	28 (27.72%)	35 (34.65%)	29 (28.71%)	9 (8.91%)	94 (93.06%)	7 (6.94%)
After 15 minutes	23 (22.77%)	41 (40.59%)	31 (30.69%)	6 (5.94%)	96 (95.04%)	5 (4.96%)
After 7 days	12 (11.88%)	28 (27.72%)	49 (48.51%)	12 (11.88%)	94 (93.06%)	7 (6.94%)
After 30 days	7 (6.66%)	8 (19.04%)	23 (54.76%)	4 (9.54%)	40 (95.23%)	2 (4.77%)

0 = no pain; 1–3, 4–6, 7–10 = sensations as classified by a 10-point Visual Analogue Scale; + = positive pain reaction.

## Dentine hypersensitivity: a review<sup>8</sup>

**Authors:** Bartold PM

**Summary:** According to this review, the management of dentine hypersensitivity requires a good understanding of the complexity of the problem, as well as the variety of treatments available. These are discussed in the context of current best practice for management of this condition.

**Comment:** *Dr Jonathan Leichter:* This article discusses the aetiology, incidence and management of dentine hypersensitivity – a relatively common problem with a reported incidence of between 4% to 74% of the population. As the author is attached to the Dental School at the University of Adelaide I had hoped that it might put more of a local perspective on this condition. A wide variety of treatment options are discussed. These include not only the more commonly used strategies such as nerve desensitisation with potassium nitrate, covering/plugging of dentinal tubules with a range of substances such as calcium hydroxide, sodium fluoride or stannous fluoride, but also a variety of other treatments. These include

anti-inflammatory agents (not particularly useful), fluoride iontophoresis, and more recent advances such as the use of casein phosphopeptides and lasers. Restorative materials and periodontal surgery get a mention too. This article makes easy reading, is informative and provides a good overview of dentine hypersensitivity.

**Judith Windle:** Whatever the theory used to describe the problem of dentine hypersensitivity, or whatever the aetiology, Bartold explains that there will always be open dentinal tubules which provide a direct link between the external environment and the internal pulp of the tooth.

There are many treatment options available to alleviate the problem, either by occluding the tubules, reduction of the dentinal sensory nerve activity, or restorative and surgical procedures.

If the patient is taught to self manage this problem with improved plaque control and at-home application of suggested product(s), relief from sensitivity can be achieved.

## Oral hygiene and periodontal considerations in preventing and managing dentine hypersensitivity<sup>19</sup>

**Authors:** Drisko C

**Summary:** This article presents the evidence for factors associated with dentine hypersensitivity, those associated with the prevalence and severity of gingival recession and dentine hypersensitivity, and discusses treatment options for these conditions.

**Comment:** *Dr Jonathan Leichter:* The onset of dentine hypersensitivity is almost exclusively associated with exposed dentine due to tooth wear or to gingival recession, or both. This article discusses the latter problem with reference to anatomic factors, overzealous, incorrect brushing and periodontal disease. The table which listed toothpastes according to their abrasivity was very interesting and I will certainly refer to it again. The toothbrushes ranked according to their number of tufts and percentage of acceptably end-rounded filaments was not as relevant in New Zealand! Although informative, this article would certainly appeal more to those general dentists who have a keen interest in periodontology. Treatment options focused mainly on root coverage techniques, although desensitising toothpastes and the use of a Nd:YAG laser were mentioned.

**Judith Windle:** The aetiology of dentine hypersensitivity appears to be as complex as the methods available to provide relief from this commonly oc-

curing problem. Drisko elucidates on the multifactorial nature of dentine hypersensitivity, from the simple explanation of overzealous tooth brushing causing tooth wear and hence recession exposing dentine, to the patient with poor oral hygiene and periodontal disease. The clinician should investigate each patient's current home care regime; dietary factors and risk potential i.e. tooth position, thickness of marginal gingival and smoking history. An important consideration is identifying causative behaviour and modifying this when possible. This may be as simple as altering tooth brushing technique and changing from abrasive toothpaste. Toothpastes containing potassium or strontium salts have produced encouraging results, according to Drisko.

Clinical treatment modalities addressing sensitivity may range from desensitising agents, dentine bonding, cervical restorations, and use of Nd:YAG laser, to autograft and allograft procedures. All patients should be cautioned against overzealous tooth brushing and all clinicians should be cognisant of the impact of repetitious instrumentation (scaling and root planing) of healthy shallow periodontal pockets. This commonly occurring problem appears to require a collaborative approach between patient and clinician to achieve a successful outcome.

## CONCLUSION – Dr Jonathan Leichter

While a wide variety of treatment strategies are available for the management of dentine hypersensitivity, there certainly appears to be no "quick fix". The first essential element in treatment is a definitive diagnosis based on clinical examination and objective assessments with other possible conditions being eliminated. Where possible, aetiological factors need to be modified or avoided. It is difficult to reach definitive conclusions regarding available treatment products based on the reading of journal articles, as not all products have been thoroughly or independently tested. Conclusive evidence of successful treatment regimes is not available.

Desensitising toothpastes are certainly the most commonly used

method, and would appear to provide statistically significant improvements. Professionally applied topical products have their role to play with all currently available treatments appearing to work. More recent strategies such as the use of Tooth Mousse or lasers appear promising, but more published studies are needed. Invasive strategies such as the placement of restorations are only recommended as a last resort if there has been significant loss of tooth structure or no response to other treatment strategies. Periodontal surgery may be required for moderate to severe hypersensitivity with accompanying gingival recession. Dentine hypersensitivity is a common problem, and is often challenging to treat successfully in the long-term.

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