

Dentin hypersensitive: Ethiology and treatment

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ABSTRACT

Dentin hypersensitivity is a response in exposed dentine with a symptom of clinically sharp and short pain. This condition may occur to exposed dentine due to gingival recession or enamel loss. Dentin hypersensitivity treatment aimed to either occlude the open dentinal tubules or block the neural response of the pulp. Invasive treatment are pulpectomy, restoration or surgery, while non invasive treatment are usually done by using tooth paste or mouthwash which is added by desensitizing agent.

Keywords: Dentin hypersensitivity, gingival recession, enamel loss, desensitizing.

ABSTRAK

Hipersensitif dentin merupakan respon berlebih pada dentin yang terbuka dengan gejala klinis nyeri yang tajam dan singkat. Kondisi ini disebabkan oleh terpaparnya tubules dentin akibat resesi gingiva atau kehilangan enamel. Perawatan hipersensitif dentin bertujuan untuk menutup tubules dentin yang terbuka dan memblokir respon saraf pada pulpa. Perawatan dapat dilakukan secara invasif dengan pulpektomi, restorasi, atau tindakan bedah, sedangkan perawatan non invasif umumnya menggunakan pasta gigi atau obat kumur yang ditambahkan dengan material desensitisasi.

Kata kunci : *hipersensitif dentin, resesi gingiva, kehilangan enamel, desensitisasi.*

INTRODUCTION

A high prevalence of dentin hypersensitivity in the world was 30% and in Indonesia it was 27% of population, makes it difficult for dentist and patient to control plaque properly due to sharp and short pain resulted.^{1,2} Moreover, hypersensitivity can cause problems in daily activity, especially when eating, drinking, or having a diet.³ Dentin hypersensitivity was hyper response in open dentine due to stimulus including changes in temperature, chemical, tactile, or evaporation.^{4,5}

The term "dentin hypersensitivity" was firstly described as dentin sensitivity that explains normal response of open dentin. This sensitivity occurs naturally due to extension of odontoblast and a complex formation of dentin - pulp. In histology, this extension of odontoblast processes occurs by thickness of dentin from pulp to dentinoenamel junction (DEJ) and surrounding by dentinal fluid on tubules.⁶ Dentinal fluid volume on tubules is 22% of total dentin volume and form connector from pulp to outer layer of dentin.⁷

In periodontology, sensitivity is related with periodontal disease and the treatment, and also root sensitivity. Clinically, dentin hypersensitivity has been described as an acute pain, localized, expand fastly, and short in duration which occurs in all teeth where the most sensitive areas are cervical and root surface.⁸

Dentin hypersensitivity treatment aimed to occlude the dentinal tubules that connecting dentin surface with the nerves on top of the dentin and blocks nerve response of the pulp. The addition of a particular material on toothpaste or mouthwash are also considered as the treatment for dentin hypersensitivity.^{9,10}

LITERATURE REVIEW

Incidence rate of dentin hypersensitivity in the world according to Bartold² was 4-74% of population and 30% in prevalence, and 27% in Indonesia.^{1,2} Albashaireh and Aljamal⁶ explained that the number of dentin hypersensitivity cases on female was higher than on male. Most cases

of dentin hypersensitivity occur on age between 21 - 30 years old, which are caninus and first premolar followed by incisivus, second premolar, and molar.⁵

Dentin hypersensitivity can be affected by the number of reasons, including nausea, frequency of vomits, cold and acid drink consumptions, bleaching, gingivitis, scaling, and orthodontic treatment.⁸ Bushari et al explained dentin hypersensitivity mechanism that is divided into two phases: localization of lesion which cause dentin exposure due to enamel loss or gingival recession and initial lesion phase which cause the opening of dentinal tubules. In vitro study explains that most of toothpastes containing adhesive material or detergent can cause opening of tubules.

Another theory by Miglani et al⁶ explained that dentin hypersensitivity occurs in two phases, localized lesion due to loss of protection that covers the dentin (enamel loss or cementum) and or due to periodontal disease causing gingival recession. Main cause of dentin hypersensitivity is enamel loss on crown or gingival recession causing root exposure.¹²

Dentin hypersensitivity due to enamel loss can occur by non caries cervical lesion including abrasion, erosion, abfraction, or attrition. The most frequent cause is erosion by intrinsic or extrinsic factor, disease related acid gastric dysfunction or systemic disease, bulimia, and diet causing oral environment become more acidic.⁵ In the other hand, another study by Ozcan and Canacki¹⁴, argue that the main factor causing enamel loss was attrition with 41,7% prevalence. Attrition was described as the condition causing flattening in cups of teeth.¹⁴

Abrasion can be generated due to several factors related tooth brushing activity, for example the rigid structures of tooth brush bristles, tooth brushing method and frequency, abrasive tooth brush, and the duration of the whole factors interactions.⁵ Abfraction is lesion caused by hyperbiomechanical force causing fracture of enamel prisma or dentin.¹⁵ Study by Bamise et al¹⁴ argues that posterior region is the most affected area.



Picture 1. A. Erosion; B. Abrasion; C. Attrition; D. Abfraction (green) due to traumatic lateral force caused by malocclusion (red) and tongue thrusting (blue).^{3,16-18}

Gingival recession commonly occurs as patient aging, related to the duration of gingival exposure with etiological factors. Gingival recession has multiple etiological factors which cause cementum loss and dentinal exposure.^{13,16} Several common causes of gingival recession are including the anatomy of the labial plate of the alveolar bone, the thin alveolar bone, fenestration, or other factors causing gingival recession. Poor oral hygiene and bad tooth brushing technique can also cause gingival recession. Moreover, frenulum attachment that makes the tissue moving towards the cemento-enamel junction and occlusal trauma to patients with active periodontal disease and periodontal attachment loss may cause the sensitivity even more severe. Another factor causing gingival recession is inadequate attached gingiva, periodontal surgery, scaling, and root planing or crown preparation.^{7,8,9}

The presence of gingival recession and root exposure will eventually allow a faster tubules opening because the cementum in root is thin and can be easily removed. Prevalence of dentin hypersensitivity due to gingival recession is about 36,8%.¹³



Picture 2. A. Sensitivity on anterior teeth without gingival recession; B. Sensitivity on anterior teeth with expanded gingival recession.²⁰



Picture 3 .A. Gingival recession in premolar; B and C. Gingival recession due to frenulum attachment.⁵

In periodontia, sensitivity is related to periodontal disease and its treatment, and also sensitivity at the root. The most infected area of dentin hypersensitivity are cervical and root surface. It is enabled by the thickness of enamel in cervical is thinner than other location. In

addition, the speed of enamel loss is influenced by tooth brushing activity.²¹

In histology, on dentin hypersensitivity cases, dentinal tubules is twice wider than normal tubules and its quantity of tubules per area is higher.¹⁹

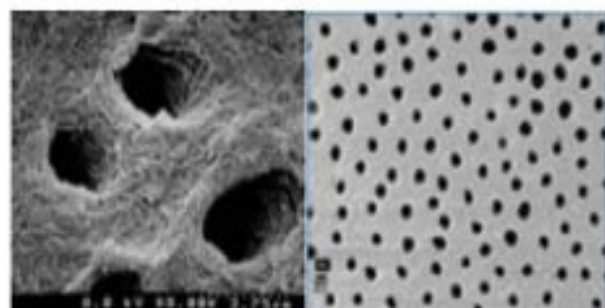


Figure 4. Opened dentinal tubules.^{3,22}

Several theories about mechanism of dentin hypersensitivity existed, in which one of them is neural theory that explained dentinal tubules is innervated by nerves that can extend up to 100 micron along the dentinal tubules. But the current histological research on dentinal tubules has broken the theory. Other theories are odontoblastic transduction theory that explained odontoblast as a receptor, and hydrodynamic theory that explained pain receptor in the pulp

and stimulated by fluid on dentinal tubules.^{4,11,16} According to the hydrodynamic theory by Brännström²⁴, pain is caused by fluid movement in open dentinal tubules due to lesion causing enamel loss or cementum especially in cervical area of tooth.¹⁹ Fluid movement in dentinal tubules is caused by stimulation that changes the pressure on dentine and activates myelinated A delta fibers around odontoblast or nerve in dentinal tubules that subsequently is recognized as a pain.⁵

Stimulus causing fluid movement in tubules can be temperature changes, air pressure, osmotic pressure, chemical (for instance : sugary, acidic, or salty food), or mechanical (for instance : extensive pressure on tooth or friction with bristles of brush). Cold stimulation is the most common cause of dentin hypersensitivity. The pain generated may have different level of effects to each individual according to the pain tolerance, physiological, and emotional factor of the patient, including the environment.^{16,19}

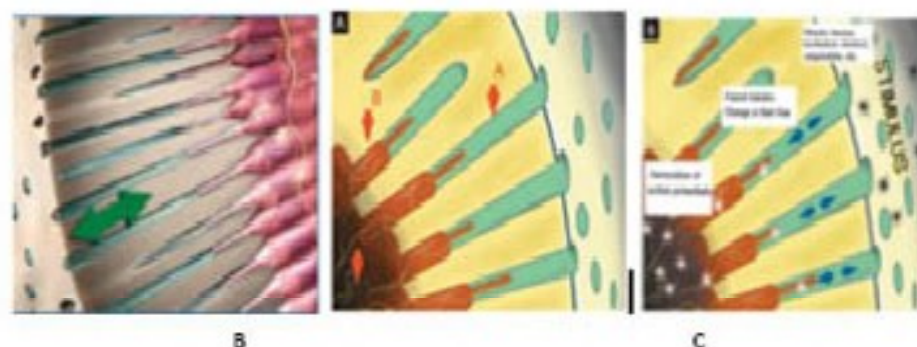


Figure 5. (A) Hydrodynamic theory on dentinal tubules causing pain²²; (B) A. Dentinal tubules; B. Odontoblast cell and the extension of processus related to the nerve; C. Pulp nerve; (C) The presence of stimulus (thermal, evaporation and chemical) can cause opening in dentinal tubules and fluid movement on dentinal tubules that generates pain.²³

Differential diagnose of dentin hypersensitivity is including cracked tooth syndrome, fracture of restoration, sensitivity due to tooth bleaching, caries or pulpitis. To get this diagnose, is important to know the predisposition factor of dentin hypersensitivity, medical record, dietary pattern, and oral hygiene of the patient.

Clinical examination, radiograph, and a diagnostic test usage including percussion, palpation, and vitality test may help the diagnose of dentin hypersensitivity.²³ Measuring the scale of pain can be using two methods, Verbal Rating Scale (VAS) which is recording patient response after the test using cold air and Visual Analog Scale method.⁴

A number of previous researches provided evidence that dentin hypersensitivity can be healed by itself. This is enabled by the formation of reparative dentin, sclerotic dentin, or calculus.²⁴ However, it is needed to manage the treatments of dentin hypersensitivity in two steps, both preventive and direct treatment. Preventive step is related to the etiology of dentin hypersensitivity aiming to localize the causal lesion that includes improving the oral hygiene, dietary pattern modification, and medical consultation for dentin hypersensitivity due to systemic disease. Direct therapy is aimed to block the neural response on the pulp and occlude the dentinal tubules which became the connector between dentinal surfaces

to the nerves at the top of dentin. Direct therapy can be done by dentist, patient, or combination of both depends on the pain severity and its influence in quality of life improvement of the patient.²³

Blocking neural pulp on dentin hypersensitivity case is commonly done by using potassium salt or potassium nitrate. This material will penetrate the dentinal tubules and decrease neural response of the pulp to the given stimulus by using its ability on increasing the extracellular potassium ion. In addition, potassium ion will diffuse along dentinal tubules and decrease the stimulation of intradental nerve by changing the neural potential membrane. This material can be used daily on toothpaste with the affectivity range of use for 4 weeks.^{4,10,23}

Another treatment method by occluding the dentinal tubules is aimed to decrease the stimulus due to fluid movement on dentinal tubules.²³ Occluding the dentinal tubules can be done by plugging tubules, dentine sealer, laser, or by periodontal surgery. The materials that can be used to occlude the open dentinal tubules are strontium (chloride, acetate), strontium fluoride, calcium sodium phosphosilicate, oxalate, fluoride, arginine calcium carbonate, and other nanoparticle material with functional agent. Those material are commonly added to the toothpaste or mouthwash and will work by its ability in precipitate the material in tooth surface.²³

Adhesive material can also be used for dentin hypersensitivity therapy as a tubules sealer. Adhesive material in form of bonding agent and varnish can be indicated for cases without tooth structure loss. Therapy using this method is easy and fast to do, but also can be easily removed.¹⁹

According to the type of treatment, dentin hypersensitivity comprise of non invasive and invasive treatment.^{5,10} Non-invasive treatment can be done by adding material commonly in form of tooth paste, mouthwash, desensitizing agent contained gel; while invasive treatment includes pulpectomy, restoration, and periodontal surgery.⁴ Laser usage in periodontal surgery for treatment of dentin hypersensitivity is also included in invasive treatment.¹⁶

Restoration is commonly done by using composite resin or glass ionomer cement as additional filler to occlude the open dentinal tubules and block the sensitivity by forming a

sealing covering. This material restoration usage is only for cases with tooth structure loss.¹⁹

Periodontal surgery is aimed to cover the exposed dentin, especially to its exposed root. Another treatment by using laser is aimed to occlude the open dentinal tubules or shallow the depth of dentinal tubules so that fluid movement on the dentinal tubules becoming limited.²³ Pashley²⁴ explained that the mechanism of treatment for dentin hypersensitivity by using laser is to coagulate and precipitate plasma protein on the fluid of dentinal tubules or by influencing the activity of neural fiber.

The alternative dentin hypersensitivity treatment is by using hypnotherapy which is divided into several phases : first discussion phase, introduction phase, intensifying phase or consolidation, intervention phase or therapy, final phase, and final discussion as a follow up. Evaluation of this method do not show a significant affectivity compared with medical therapy. However, hypnotherapy shows the longer duration effect compared with medical methods. Hypnotherapy for dentin hypersensitivity cases is limited only to patients with have knowledge or experience with hypnotherapy.²⁷

DISCUSSION

Dentin hypersensitivity case reports are often found in clinical dental practice. This condition leads to a more difficult treatment due to a frequent sharp and short pain. This pain occurs due to fluid movement on dental tubules that stimulates the nerve of the pulp to signal to the brain that is translated as a sharp and short pain.^{1,2}

Dentin hypersensitivity is an excessive response of the given stimulus to open dentinal tubules due to enamel loss and or gingival recession.¹⁹ Enamel loss is caused by non cervical caries lesion including abrasion, erosion and abfraction or attrition. The most common cause is erosion due to intrinsic or extrinsic factors.⁵ Gingival recession commonly occurs as patient aging, related with the duration of gingival exposure to etiological factors. Several common causes of gingival recession are including the anatomy of the labial plate of the alveolar bone, the thin alveolar bone, fenestration, poor oral hygiene, bad tooth brushing technique, frenulum

attachment that makes the tissue moving towards the cemento-enamel junction and occlusal trauma to patients with active periodontal disease with periodontal attachment loss. Another factor causing gingival recession is periodontal surgery, scaling, and root planing or crown preparation, and inadequate attached gingiva.^{7,8,9} Pathogenesis of dentin hypersensitivity is divided into two phases : localization of lesion which cause dentin exposure due to enamel loss or gingival recession and initial lesion phase which cause the opening of dentinal tubules.¹¹

Dentin hypersensitivity treatments are aimed to occlude the open dentinal tubules or block neural response of the pulp to decrease pulp response to the stimulus. Treatment planning of dentin hypersensitivity is divided into 2 phases, preventive and direct therapy. Preventive phase is related to the etiology of dentin hypersensitivity aiming to localize the causal lesion that includes improving the oral hygiene, dietary pattern modification, and medical consultation for dentin hypersensitivity due to systemic disease. Direct therapy is aimed to block the neural response on the pulp and occlude the dentinal tubules which became the connector between dentinal surfaces to the nerves at the top of dentin. According to the type of treatment, dentin hypersensitivity comprise of non invasive and invasive treatment, that can be done by dentist, patient, or combination of both depends on the pain severity. Other alternatives are by using laser or hypnotherapy that generally did not show a significant result compared with medical therapy, but hypnotherapy shows the longer duration effect compared with medical methods.^{26,27} The treatment method selection is important and need to be adjusted to the etiological factors causing dentin hypersensitivity, the duration of exposure, and severity of the disease.

CONCLUSION

Dentin hypersensitivity is an excessive response on open dentinal tubules with clinically sharp and short pain. Etiology of dentin hypersensitivity are enamel loss and gingival recession. Mechanism of dentin hypersensitivity are divided into two phases, localization of lesion phase and initial lesion phase. Selection of

treatment method is adjusted to the etiological factors, the duration of exposure, and severity of the disease, aiming to occlude the dentinal tubules and block neural response of the pulp.

REFERENCES

1. Olusile. Short term clinical evaluation of four desensitizing agents. *J Contemp Dent Prac.* Available:www.thejcdp.com. [cited 01 Feb 2015]. 2008.
2. Bartold PM. Dentinal hypersensitivity. *A Review: Austr Dent J* 2006;51(3):212-8.
3. Bashiru BO, Gabriel U, Babatope O. Retrospective analysis of dentine hypersensitivity among patient at university of port harcourt teaching hospital, Rivers State Nigeria. *Scien J Publ Heal* 2014;2(6):516-9.
4. Bathla S. *Periodontics revisited.* Jaypee Brothers Medical Publishers. New Delhi: 2014.
5. Saylor CD, Overman PR. Dentinal hypersensitivity: A Review. *ADACERP.* Available: www.inedce.com. [cited 01 Feb 2015].
6. Miglani S, Aggarwal V, Ahuja B. Dentine hypersensitivity: Recent trends in management. *J Conser Dentis* 2010Oct-Dec;13(4):218-24.
7. Ojha N. Dentin hypersensitivity: A review on effective treatment with potassium nitrate containing dentrifice. *Inter J Pharma and Bio Scienc* 2013April;4(2):201-06.
8. Albashaireh ZS, Aljamal MK. Prevalency and pattern of dentine hypersensitivity in a jordanian population in irbid city. *Oral Hygiene and Health* 2014;2 Issue 3:1000137.
9. Arnold WH. Effectiveness of various toothpastes on dentine tubule occlusion. *J Dentis xxx.* Elsevier. Available:www.sciencedirect.com. [cited 01 Feb 2015].
10. Rizky A, Aminatun, Widiyanti P. Studi infiltrasi tubulus dentin berbasis hidroksiapatit yang berpotensi untuk terapi hipersensitif dentin. *Prosiding Seminar Fisika Terapan III.* 2012.
11. Bushari BM, Banavali KA, Vazirani N, Warkhandkar A. Dentin hypersensitivity: A Common Cold of Dentistry: A Review. *Medical Science, Internat J Scien Study* 2013;2 Issue 11 November 2013.
12. Chu Chun Hung, Lo ECM. Dentine hypersensitivity : A Review. *Hongkong Dent J* 2010;(7):15-22.
13. Ozcan E, Canakci CF. An analysis of aetiological

- factor related to dentin hypersensitivity and severity. *J Dent Fac Atatürk Uni Clit* 2010;20Sayi(3):145-52.
14. Bamisu CT, Olusile AO, Oginni AO. An analysis of the etiological and predisposing factors related to dentin hypersensitivity. *J Contemp Dent Pract* 2008;9(5July).
 15. Antonelli JR, Hottel TL, Godoy FG. Abfraction lesions - where do they come from I a review of the literature. *J Tennessee Dent Assoc.* 2013.
 16. Walters PA. Dentinal hypersensitivity: A Review. *J Contemp Dent Practice* 2005;6(2): May 2005. Available:www.thejcdp.com. [cited 01 Feb 2015].
 17. Gandara BK, Truelove EL. Diagnosis and management of dental erosion. *J Contemp Dent Pract* 1999;1:1-17. Available:www.thejcdp.com. [cited 01 Feb 2015].
 18. Palmer B. Dental abfractions-a literature review and hypothesis. Available:www.brianpalmerdds.com,hypothesis_abfractions.htm. [cited 01 Feb 2015].
 19. Porto ICCM, Andrade AKM, Montes MAJR. Diagnosis and treatment of dentin hypersensitivity. *J Oral Scie* 2009;51(3):323-32.
 20. Yan Boxi, Yi Jianru, Li Yu, Chen Yin, Shi Z. Arginine containing toothpaste for dentine hypersensitivity:systemic review and meta analysis. *Quintessence International General Dentistry.* [cited 01 Feb 2015].
 21. Addy M. Tooth brushing, tooth wear and dentine hypersensitivity-are they associated?. *Internat Dent J* 2005;55:261-7.
 22. Chun-hung C. Management of dentine hypersensitivity. *Dental Bulletin.The Hongkong Medical Diary* 2010;15(3 March):21-3.
 23. Shiau HJ. Dentine hypersensitivity. *J Eviden Based Dent Pract:Special issue-periodontal and implant treatment* 2012;51:220-8.
 24. Brannstorm M. The hydrodynamic theory of dentinal pain : sensation in preparations, caries, and the dentinal crack syndrome. *Journal of Endodontic* 1986;12Oct(10):453-7.
 25. Wang Z. The dentine remineralization activity of a desensitizing bioactive glass containing toothpaste : an in vitro study. *Austr Dent J* 2001;56:372-81.
 26. Pashley DH. Potential treatment modalities for dentine hypersensitivity : in office product dalam tooth wear and sensitivity. *clinical advances in restorative dentistry* 2000. London. p. 351-65.
 27. Eitner S, Bittner C, Wichmann M, Nickenick HJ, Sokol B. Comparison of conventional therapies for dentin hypersensitivity versus medical hypnosis. *Intl J Clin Experim Hypnosis* 2010;58(4):457-75.