

PREVENTION OF DENTAL HYPERSENSITIVITY

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ABSTRACT

Dental hypersensitivity is a pathological condition in which the exposed dentin is attached to a vital tooth sensitive to mechanical, osmotic, chemical or thermal smears.

The study included 30 subjects from both genders. The respondents were dental students and residents at the Faculty of Dentistry, Ss. Cyril and Methodius" University in Skopje. During the study all respondents used the Colgate® Sensitive Pro-Relif™ paste and Slim Soft toothbrush. The investigated period lasted for 4 weeks. These surveys are based on a pre-made questionnaire, in which the following data were noted: what kind of pain the respondents feel; have they experienced an improvement after using the Colgate® Sensitive Pro-Relif™ toothpaste and after how long it occurred?

A large percentage of the respondents (86 %) experienced improvement after using the Colgate Sensitive Pro-Relif™ toothpaste, after two weeks at most (53.3 %) and after three weeks at least (3.3%). The sensitivity of the teeth among the subjects was mostly caused by cold (56.7%), and in only 3.3% of the subjects, it was provoked by sweets.

High percentage of the respondents experienced improvement after using Colgate® Sensitive Pro-Relif™ toothpaste, after a maximum of two weeks, and at least after the third week.

Pro-arginine treatment product reduces hypersensitivity of the dentine, and in some cases it could be completely cured.

Key words: hypersensitivity, toothpaste, pro-arginine

Introduction

Teeth hypersensitivity is one of the most common clinical problem. It manifests itself in response to stimulation of the exposed dentin, regardless of its localization.[1] It is characterized by a short, acute pain caused by the exposed dentin in response to stimulations, usually thermal, volatile, tactile, osmotic or chemical, and which can not be rewritten to any other dental defect or pathology.[2]

There are three basic theories – hypotheses about the spreading/transmission of the dental pain. One of them is odontoblast theory according to which odontoblasts have a sensitive role and transmit irritations through a cholinergic sympathetic relationship. Then, a direct innervation theory that relies on findings obtained by an electron microscope (SEM). This theory demonstrated the presence of non-myelinated nerve fibers extending along the entire length of the dentinal tubules.

However, as a disadvantage of this theory, the same condition is found in a normally sensitive dentine. Today's most widely accepted is the hydrodynamic theory of the 1960s referring to the rapid loss of fluid inside the dental tubules as a result of an external stimulus. The distortion of the odontoblast extensions, by about 240 Å, is transmitted to the A-nerve fibers (in the periphery of the pulp and dentine) that act as mechanoreceptors. In accordance to this theory, the importance of the number and the circulation of dental tubules in the appearance of painful sensations in relation to the normal susceptible dentin has been proven.[3]

Teeth hypersensitivity usually occurs between 20 and 40 years of age, and more often in females. In terms of localization, it is more common in the vestibular than on the oral surfaces of the teeth. It most commonly occurs in upper canines, followed by premolar, incisors, lower premolars and lower incisors. Some studies have shown that the entire area of the hypersensitive dentin is most sensitive to the mesial and distal edges, and the central part and the incisal edge are the least sensitive, with a ratio of 3:2:1:15. The appearance of teeth hypersensitivity is in reverse proportion to the

plaque index, and this condition is more common related to the teeth on the left side.[4]

Saliva plays an important role in the natural reduction of dental hypersensitivity through the supply of calcium and phosphate ions in open dentinal tubules, gradually blocking the tubules, and the formation of a surface protective layer consisting of precipitated salivary glycoprotein calcium phosphate aggregates.[5] Decreased salivary flow, hyposalivation, xerostomia are risk factors for demineralization and dental caries, but they can worsen dental hypersensitivity. The saliva with its buffering systems maintains the concentration of hydrogen ions (pH) in the oral environment at physiological limits, thus preventing the demineralization process.

In 2002, Kleinberg et al. published a new anti-sensitive technology based on the saliva role in the natural reduction of dentine hypersensitivity. The basic components of this new technology are arginine, an amino acid that is positively charged at physiological pH, i.e. pH 6.5-7.5, bicarbonate, pH buffer and calcium carbonate. This technology is named as Pro-Argin.[6] Early studies showed a rapid improvement in the sensitivity of dentine after just one application, 71.7% decrease in sensitivity measured by air jet and 84.2% reduction obtained by "tooth" test of the tooth. The decrease in susceptibility to dentine occurred immediately after its administration, and the examination lasted 28 days.[7]

In 2007, Colgate-Palmolive purchased the rights of technology, known as Pro-Argin™ technology, and introduced the Colgate® Sensitive Pro-Relief™ desensitized paste. The recommendation was to apply the paste using a low speed, with a moderate amount of pressure, to place in the exposed tubules, sealing them. In clinical trials, it was found that this product provided immediate and permanent loss of hypersensitivity of teeth if used only four weeks.[8-10]

Investigating the mechanism of action of arginine and calcium carbonate containing paste using an electron microscope (SEM), Petrou et al. found that this technology completely and rapidly closed dentinal tubules as a result of the formation of deposits on the surface and in dentinal tubules containing large amounts of phosphate, calcium

and carbonate. In addition, by testing hydraulic conductivity, it was found that these deposits significantly reduced the flow of dentinal fluid into tubules.[11]

With the technological development and the advent of laser technology and its growing use in dentistry, an additional therapeutic option is available for the treatment of dental hypersensitivity.[12-14]

Restorative sensitivity - clinically it has been established that in 29% of cases there is a susceptibility after cavitation preparation and the setting of definite filling. The appearance of sensitivity occurs as a result of the interspace between the charge and the walls of the cavity as a consequence of the contraction that occurs during polymerization. The contamination of the composite leads to micro-permeability and the appearance of appropriate symptoms, that is, the tooth reacts to a cold that is a classic mechanism for dental hypersensitivity.[15]

Therapeutic procedures for dentin hypersensitivity can be divided into reversible and irreversible. Dentin hypersensitivity can be reduced by the natural closure process of the tubules lasting for long time. In addition to the numerous possibilities of reversible procedures, there are two fundamental approaches: interfering with transmission of the pain of A-nerve fibers or by blocking open tubules (with strontium, oxalate, fluoride). Certain proteins may have a double effect. Professionally fluorides are most commonly used, and they can reduce hypersensitivity with peripheral occlusion of the tubules and by reducing the movement of the fluid to and from the pulp. Fluoride gels or pastes with higher fluoride concentration (5000 ppm) can be applied. Another group of materials with similar effect are oxalate salts, such as tin and iron oxalate.[16] Also, HEMA/ glutaraldehyde preparations seal the tubules or stimulate the deposition of proteins in them.

Once we diagnose dentine hypersensitivity and etiological factors were identified, therapy and prevention should be the primary goal.[14,15] If one or more teeth are predisposed to dental hypersensitivity, they should be subjected to continuous treatment. The patient should be shown a toothbrush technique to prevent further

loss of dentine that would contribute to dental hypersensitivity. Inadequate brushing of teeth is also associated with this phenomenon. [17]

Various treatments in the practice or at home have been proposed by several authors to treat dentin hypersensitivity in order to immediately solve the problem.[18-20] A number of treatments with topical products in the form of tooth creams and varnishes. Various agents - strontium chloride, sodium monofluorophosphate, sodium fluoride, calcium hydroxide, calcium phosphate, potassium nitrate, potassium citrate, formaldehyde, sodium citrate-plural gel, glucocorticoids, adhesives, binding agents and resins, voice- ionomer cements, bioactive and biocompatible glasses, oxalate-containing products,[22] polymers containing Novamin and CPP-ACP (Caesin phospho peptide - amorphous calcium phosphate), [23, 24] ionophoresis and lasers. [25,26]

Fluoride is used as a preventive agent for cavities that can help and demineralize enamel or dentin. [27] Various clinical trials have shown that the administration of a fluoride solution may reduce dental hypersensitivity. [28, 29] Fluoride acts by reducing the permeability of dentine by depositing calcium fluoride crystals inside the dentinal tubules. [30] These crystals are partially insoluble in saliva. Examination by electron microscope (SEM) revealed granular precipitates in the peritubular dentine after the application of fluoride. [31] Different fluorides are used to treat dentin hypersensitivity, such as sodium fluoride, sodium monofluorophosphate, fluorosilicates and fluoride in combination with ionophoresis. [32]

Some of the recommendations for patients to prevent the appearance of teeth hypersensitivity are: avoid using a large amount of toothpaste, do not use brushes with medium and hard fibers, avoid brushing the teeth immediately after ingestion of sour food, do not brush teeth by applying pressure and for a long time, avoid excessive and inappropriate use of inter-proximal brushing agents. [33]

Purpose

The purpose of this study was to investigate the efficacy of a paste containing 8% arginine and

calcium carbonate in the treatment of dental hypersensitivity (Colgate® Sensitive Pro-Relif™).

Material and method

The study included 30 subjects from both genders. The respondents were dental students and residents at the Faculty of Dentistry, Ss. Cyril and Methodius' University in Skopje. During the study all respondents used the Colgate® Sensitive Pro-Relif™ paste and Slim Soft toothbrush. The investigated period lasted for 4 weeks.

The exclusion criteria for the study were as follows: patients who had dental pathology causing pain similar to cervical dentinal hypersensitivity (such as teeth with caries, the presence of orthodontic appliances and restorations and/or the presence of a history of periodontal surgery in the area of the tooth during the previous three months), patients who took any medication, patients who received professional treatment with desensitizing agents in the previous six months, patients who received any treatment in the past 30 days and patients who had the presence of a vital bleaching history.

These surveys are based on a pre-made questionnaire, in which the following issues were noted:

- Maintenance of oral hygiene of the mouth and teeth: the frequency of tooth brushing, duration and means used in maintaining oral hygiene: toothpaste and toothbrush, interdental floss and interdental brush, chemical means for maintaining hygiene;
- What kind of pain the respondents feel;
- Have they experienced any improvement after using the Colgate® Sensitive Pro-Relif™ toothpaste and when it occurred?

Statistical analysis

The statistical analysis of the obtained data was made in the statistical program SSRS IMB 20.

Results

The following tables show the results from the conducted survey and the answers to the questions.

Table 1 presents the percentage of using additional means for maintaining oral hygiene. These included: mouth rinse, interdental floss, interdental brushes used by 30% of the subjects, mouth rinse used by 20%, and only one respondent used an interdental brush and a floss.

Table 1. Did you use additional means for maintaining oral hygiene?

	Frequency	%
mouth rinse	6	20.7
interdental floss	4	13.3
mouth rinse, interdental floss	7	2.0
mouth rinse, interdental floss, interdental brushes	9	30.0
mouth rinse, interdental brushes	2	6.7
interdental floss, interdental brushes	1	3.3
water jet-tooth pick	0	0.0
I do not use additional means	1	3.3

The frequency of tooth brushing is shown in **Table 2**. All 30 subjects brushed their teeth in the morning and evening.

Table 2. You are brushing teeth?

	Frequency	%
in the morning	0	0.0
at night before going to bed	0	0.0
after every meal	0	0.0
in the morning and at night	30	100.0

The largest percentage of respondents used a soft toothbrush (60%), and none used a hard brush (**Table 3**).

Table 3. What type of brush do you use?

	Frequency	%
ultra-soft	8	26.7
soft	18	60.0
medium	4	13.3
hard	0	0.0

Table 4 shows teeth sensitivity (which causes the pain). Most of the subjects (56.7%) were sensitive to cold, and only 3.3% to sweet flavor.

Table 4. The pain (sensitivity) of your teeth appearing on?

	Frequency	%
cold	17	56.7
warm	0	0.0
sour	0	0.0
sweet	1	3.3
cold and sweet	5	16.7
did not respond	7	23.3

Table 5 shows the frequency of the pain experienced by the respondents. In the largest percentage of respondents acute and short-term pain (70%) was observed, and 23.3% of the subjects did not feel pain.

Table 5. You are brushing teeth?

	Frequency	%
sharp and short	21	70.0
faucet and long-lasting	2	6.7
I do not feel	7	23.3

Most of the respondents (60%) did not avoid using certain foods and drinks in order not to feel the pain (**Table 6**).

Table 6. Do you avoid consuming certain foods and drinks so that you do not feel pain (e.g. cold drinks)?

	Frequency	%
yes	12	40.0
no	18	60.0

Table 7 illustrates the change in the diet of the respondents. Most of them (73.3%) did not change anything in the diet to prevent the onset of pain.

Table 7. Have you changed your diet to prevent pain?

	Frequency	%
yes	8	26.7
no	22	73.3

Table 8 gives a description of the technique for brushing teeth. Even 86.7% of the respondents thought that strong and aggressive brushing is not a good technique.

Table 8. Is "strong and aggressive brushing" a good description for your teeth brushing technique?

	Frequency	%
yes	4	13.3
no	26	86.7

Table 9. Did you notice a gingival withdrawal?

	Frequency	%
yes	15	50.0
no	15	50.0

To a large extent, the respondents (86%) experienced improvement after using the Colgate Sensitive Pro-Relif™ tooth, after two weeks at most (53.3%) and at least after three weeks (3.3%), (**Tables 10 and 11**).

Table 10. Did you experience improvement after using a toothpaste? Colgate® Sensitive Pro-Relif™?

	Frequency	%
yes	26	86.7
no	4	13.3

Table 11. How long have you experienced improvement?

	Frequency	%
after one week	13	43.3
after two weeks	16	53.3
after three weeks	1	3.3

Only one respondent was not satisfied with the paste and toothbrushes Slim Soft, and 96.7% gave a positive answer (**Table 12**).

Table 12. Are you satisfied with the effect of the toothpaste and toothbrushes? Slim Soft?

	Frequency	%
yes	29	96.7
no	1	3.3

Discussion

Dentin hypersensitivity is one of the most common and uncomfortable conditions affecting oral comfort and function. In this examination, a large percentage of the respondents (86%) experienced improvement after using the Colgate Sensitive Pro-Relif™ toothpaste, after two weeks at most (53.3%) and after three weeks at least (3.3%). The sensitivity of the teeth among the subjects was mostly by cold (56.7%), and in only 3.3% of the subjects it was provoked by sweets. It should be emphasized that some of the respondents in addition to the basic means of

maintaining oral hygiene (in our examination Colgate® Sensitive Pro-Relief™ and Brush Slim Soft), the largest percentage (30% of the subjects) used additional means of maintaining oral hygiene, such as: mouth rinse, interdental floss, interdental brushes.

When asked about the intensity of the pain the respondents answered that it was sharp and short (70%), and 23.3% of them did not feel pain.

Our study showed that the Colgate® Sensitive Pro-Relief™ toothpaste reduces the sensitivity of the teeth. However, the limitation of this study is the 4-week follow-up, a time that can be considered short. In parallel with the Colgate® Sensitive Pro-Relief™ toothpaste, other types of desensitize toothpastes as control groups should be included in the future to determine the benefits of this method in reducing dentin hypersensitivity.

Some of our results coincide with the results obtained by Hamlin et al.³⁴ In their study, they applied professional tooth brushing products and immediately afterwards measurements of the sensitivity of the teeth were made. The group of subjects treated with arginine-calcium carbonate paste showed statistically significant improvements in the baseline tactile (132.1%) and air hypersensitivity (48.6%). In addition, the subjects in the control group showed statistically significant improvement in hypersensitivity clearance from the baseline in relation to mean hypersensitivity values (13.9%). Improvement in the hypersensitivity reduction in the control group for tactile hypersensitivity (21.7%) was not statistically significant. Statistically significant differences were demonstrated between the arginine-calcium carbonate group and the control group relative to the baseline tactile (110.0%) and airborne tooth sensitivity (41.9%).

In another study, immediately after the application of the product and 4 weeks later, subjects treated with arginine-calcium carbonate containing paste showed statistically significant improvements to the baseline in relation to the average value for the air stream (44.1% and 45.9%) and tactile results for hypersensitivity (156.2% and 170.3%). A group of subjects treated

with arginine-calcium carbonate paste showed statistically significant reductions in dentine hypersensitivity compared to the control untreated group.³⁵

Conclusion

The following conclusions can be derived based on the results obtained in our study:

Pro-arginine treatment product reduces hypersensitivity of the dentine, and in some cases it could be completely cured.

References

1. Addy M. Etiology and clinical implications of dentine hypersensitivity. *Dent Clin North Amer* 1990; 34:503-14.
2. Addy M, Urquart E. dentinal hypersensitivity; its prevalence a etiology and clinical management. *Dental update* 1992; 19:407-412.
3. Brännström M. A hydrodynamic mechanism in the transmission of pain-produced stimuli through the dentine. In: Anderson DJ, editor. *Sensory mechanisms in dentine*. Oxford: Pergamon; 1963. pp. 73-79.
4. Porto IC, Andrade AK, Montes MA. Diagnosis and treatment of dentinal hypersensitivity. *J Oral Sci* 2009; 51:323-332.
5. Miglani S, Aggarwal V, Ahuja B. Dentin hypersensitivity: Recent trends in management. *J Conserv Dent* 2010; 13:218-224.
6. Kleinberg I, Sensistat. A new saliva-based composition for simple and effective treatment of dentinal sensitivity pain. *Dent Today* 2002; 21:42-7.
7. Lata S, Varghese NO, Varughese JM. Remineralization potential of fluoride and amorphous calcium phosphate-casein

- phospho peptide on enamel lesions: An In vitro comparative evaluation. *J Conserv Dent* 2010; 13:42-6.
8. Merh A, Singhbal K, Parikh V, Mehta S, Kulkarni G. Comparative evaluation of immediate efficacy of diodont laser versus desensitizing paste containing 8% arginine and calcium carbonate in treatment of dentine hypersensitivity: an in vivo study. *J of Evolution of Med and Dent Sci* 2015; 4(25):4346-4355.
 9. Panagakos F, Schiff T, Guignon A. Dentin hypersensitivity: Effective treatment with an in-office desensitizing paste containing 8% arginine and calcium carbonate. *Am J Dent* 2009; 22(Special Issue A):3-7.
 10. Panagakos F, Schiff T, Guignon A. Dentin hypersensitivity: Effective treatment with an in-office desensitizing paste containing 8% arginine and calcium carbonate. *Am J Dent* 2009; 22(Special Issue):3-7.
 11. Petrou I, Heu R, Stranick M, Lavender S, Zaidel L, Cummins D, Sullivan RJ, Hsueh C, Gimzewski JK. A breakthrough therapy for dentin hypersensitivity: How dental products containing 8% arginine and calcium carbonate work to deliver effective relief of sensitive teeth. *J Clin Dent* 2009; 20(Special Issue):23-31.
 12. Sicilia A, Cuesta-Frechoso S, Sua´Rez A, Angulo J, Pordomingo A, De Juan P. Immediate efficacy of diode laser application in the treatment of dentine hypersensitivity in periodontal maintenance patients: a randomized clinical trial. *J Clin Periodontol* 2009; 36:650-660.
 13. Ahmet Eralp, Suat et al. A Clinical Investigation of Low-Level Laser Irradiation on Hypersensitive Dentine. *Research Journal* 2006; 30(2):94-99.
 14. Rosane De Fatima et al. Clinical effects of low intensity laser vs light-emitting diode therapy on dentin hypersensitivity. *L Oral Laser Applications* 2007; 7: 129-136.
 15. Cummins D. Dentin hypersensitivity: from diagnosis to a breakthrough therapy for everyday sensitivity relief. *J Clin Dent* 2009; 20:1-9.
 16. Gillam DG, Bulman JS, Eijkman MA, Newman HN. Dentists' perceptions of dentine hypersensitivity and knowledge of its treatment. *J Oral Rehabil* 2002; 29:219-225.
 17. Ricarte JM, Matoses VF, Llacer VJ, Fernandez AJ, Monero BM. Dentine Sensitivity: Concept and Methodology for Its Objective Evaluation. *Med Oral Patol Oral Cirbucal* 2008; 13(3):201-6.
 18. Shen S-Y, Tsai C-H, Chang Y-C. Clinical efficacy of toothpaste containing potassium citrate in treating dentin hypersensitivity. *Journal of Dental Sciences* 2002; 4(4):173-177.
 19. Pradeep AR, Sharma A. Comparison of clinical efficacy of a dentifrice containing calcium sodium phosphosilicate to a dentifrice containing potassium nitrate and to a placebo on dentinal hypersensitivity: A Randomized Clinical Trial. *Journal of Periodontology* 2010; 81(8):1167-1173.
 20. Prasad KW et al. Efficacy of two commercially available dentifrice in reducing dentinal hypersensitivity. *Indian J Dent Res* 2010; 21:224-230.
 21. Addy M. Dentine hypersensitivity: New perspectives on an old problem. *Int Dent J* 2002; 52(Suppl.):367-75.
 22. Ye W, Feng XP, Li R. The prevalence of dentine hypersensitivity in Chinese adults. *J Oral Rehabil* 2012; 39:182-7.
 23. Rees JS, Addy M. A cross-sectional study of buccal cervical sensitivity in UK general dental practice and a summary review of prevalence studies. *Int J Dent Hyg* 2004; 2:64-9.
 24. Vijaya V, Sanjay V, Varghese RK, Ravuri R, Agarwal A. Association of dentine hypersensitivity with different risk factors-A cross sectional study. *J Int Oral Health* 2013; 5:88-92.

25. Al-Wahadni A, Linden GJ. Dentine hypersensitivity in Jordanian dental attenders. A case control study. *J Clin Periodontol* 2002;29:688-93.
26. Cai F, Shen P, Morgan MV, Reynolds EC. Remineralization of enamel subsurface lesions in situ by sugar-free lozenges containing casein phosphopeptide-amorphous calcium phosphate. *Aust Dent J* 2003;48:240-243.
27. Bahsi E, Dalli M, Uzgur R, Turkal M, Hamidi MM, Colak H. An analysis of the etiology, prevalence and clinical features of dentine hypersensitivity in a general dental population. *Eur Rev Med Pharmacol Sci* 2012;16:1107-16.
28. West NX, Lussi A, Seong J, Hellwig E. Dentin hypersensitivity: pain mechanisms and etiology of exposed cervical dentin. *Clin Oral Investing* 2013;1:S9-19.
29. He S, Wang Y, Li X, Hu D. Effectiveness of laser therapy and topical desensitising agents in treating dentine hypersensitivity: a systematic review. *J Oral Rehabil* 2011;38:348-358.
30. Amarasena N, Spencer J, Ou Y, Brennan D. Dentine hypersensitivity in a private practice population in Australia. *J Oral Rehabil* 2011;38:52-60.
31. Vijaya V, Sanjay V, Varghese RK, Ravuri R, Agarwal A. Association of dentine hypersensitivity with different risk factors - A cross sectional study. *J Int Oral Health* 2013;5:88-92.
32. S.A.M. Corona, et al. Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dental hypersensitivity. *J Oral Rehabil* 2003;30:1180-1189.
33. Drisko C. Dentine hypersensitivity. Dental hygiene and periodontal considerations. *Int Dent J* 2002;52:385-393.
34. Hamlin D, Williams KP, Delgado E, Zhang YP, DeVizio W, Mateo LR. Clinical evaluation of the efficacy of a desensitizing paste containing 8% arginine and calcium carbonate for the in-office relief of dentin hypersensitivity associated with dental prophylaxis. *Am J Dent* 2009;22(Spec. Iss. A):16-20.
35. Schiff T, Delgado E, Zhang YP, De Vizio W, Mateo LR. Clinical evaluation of the efficacy of a desensitizing paste containing 8% arginine and calcium carbonate in providing instant and lasting in-office relief of dentin hypersensitivity. *Am J Dent* 2009; 22 (Spec. Iss. A):8A-15A.