



***In vivo* comparative evaluation of low-level laser therapy and strontium chloride desensitizing agent on cervical dentin hypersensitivity**

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Abstract

Dentin hypersensitivity (DH) is a common patient complaint in the dental surgery. This pain is associated to dentin exposure and non-cariou cervical lesions. The knowledge of the lesions types, etiology, and characteristics has been a challenge for dental professionals.

Objective: This study aimed to compare the effectiveness of low-level laser therapy and a desensitizer containing strontium chloride on cervical DH.

Materials and Methods: Patients presenting non-cariou cervical lesion caused by abrasion, erosion, abfraction or enamel, and cementum loss by the gingival recession were selected and divided into two groups: Group 1 (Desensibilize[®] - desensitizing agent) and Group 2 (Whitening Lase II[®] - laser therapy). The teeth were selected in pairs presenting no hypersensitivity and were compared to their homologous. The teeth were submitted to stimuli and the patient assessed using a pain subjective scale. The data were analyzed using the SAS statistical program and submitted to Kruskal–Wallis and Friedman tests at 1% significance level.

Results: Significant differences were found between the groups, Group 1 (Desensibilize[®]) presented 90% efficiency and Group 2 (Whitening Lase II[®]) 95% efficiency. After three sessions, both desensitizing methods effectively reduced the DH.

Introduction

The dentin hypersensitivity (DH) is still a challenge due to its different etiologies, different diagnosis, and treatments that may hamper the clinical procedures resolution. The diagnosis of the DH can be difficult, and a large number of therapeutic alternatives available in the literature shows its clinical relevance for the dental professionals.^[1]

The cervical DH is a common problem and is related to several predisposing factors such as tooth bleaching, radicular dentin exposure in non-cariou lesions, and other factors. It is an exaggerated response from the exposed dentin to thermal, tactile and/or chemical stimuli, and cannot be considered as pathology in the dentin-pulp complex.^[2] It is a sharp pain, short duration, arising during the stimuli and it is associated to the dentinal

tubules exposure to the oral environment.^[3,4] It can be a result from abrasion, erosion, abfraction, cracked teeth, cementum loss from periodontal procedures, restorative procedures as old restorations with marginal infiltration or new restorations presenting cracks due to a technical failure or material contraction, or association of all these risk factors.^[1]

The DH may result in psychosocial life changes, so a proper diagnosis and effective treatment are imperative for the pain relief. However, a correct diagnosis is not easy due to it can be confounded with other pathologies, the anamnesis associated to clinical and radiographic examination are to require to differ the DH from other pathologies including pulp degeneration. The discomfort elimination caused by DH is the major challenge for the dental professionals.^[5]

Grossman, in 2005,^[3] described the ideal desensitizing agent features such as biocompatibility, easy application, rapid in action, be effective, non-irritant to the pulp, and not change the teeth color. Many reports in the literature have described and evaluated some substances and desensitizing products;^[6] however, the correct treatment must regard the pain mechanism.

Most DH products present different formulations containing fluoride such as acidic fluoride, sodium fluoride, salinated fluoride, or strontium chloride, zinc, and potassium oxalate in their composition.^[7-9] The application of these products can enhance the dentin remineralization obliterating the dentinal tubules.

Another alternative is the low-level lasers therapy at the cervical DH treatment. It has been widely used in dentistry and proven to be efficient in long-period^[10] with partial or total pain elimination, with or without any desensitizing agent application.^[3,11,12]

Regarding all the desensitizing products available in the market with different formulations, this study aimed to compare the effectiveness of low-level laser therapy and the strontium chloride desensitizing agent application at cervical DH.

Materials and Methods

After the Ethical Committee approval (EC - UNIGRAN: 201/2010), the patients were selected, aged between 18 and 60 years, both genders, presenting non-carious cervical lesions from abrasion, erosion, abfraction or enamel, and cementum loss as a result of gingival recession.

Informed consent requirements about the clinical procedures, the discomforts, the risks, benefits, and the treatment follow-up were given to the patients. First, a clinical examination (probing using a mirror) and anamnesis were carried out. The differential diagnosis was obtained since the cervical DH symptoms can be confounded with other pathologies such as decay, cracks, irreversible pulpitis, and occlusal interferences. The diagnostic analysis included the pain story, percussion and palpation tests, thermal test, the tooth and the next tissues analysis. Whether the hypersensitivity did not diminish after the stimulus removal (air-spray for 3 s), the tooth was excluded from the study due to the possibility of pulp pathology. Other differential diagnoses were described as follows:

- Intermittent pain, spontaneous and short duration indicate pulp pathology
- Throbbing pain is found in areas with high intrapulpal pressure indicating irreversible pulpitis
- Provoked pain requires an external stimulation indicating pain of dentinal origin; it is the reversible and typical pain of DH.

Other pathologies that could be confounded with DH were analyzed at the clinical examination, such as crown crack, tooth fracture, caries, fractured restorations, post-restoration sensitivity, and teeth in hyperfunction and when the 6 months follow-up could not be carried out.

At the first session, each patient received an extra-soft toothbrush (Colgate Plus), toothpaste without fluoride (Phillips - Smith Kline & Beccham) and hygiene instruction (45° to the long axis of the tooth, with slight pressure using small movements), mouth rinses, and other products containing fluoride or desensitizing agents were avoided. Only these products were used during the study to standardize the procedures. The patients were advised about the diet because the excessive acidic food consumes, such as citrus fruit, yogurt, tomato, and beverages as soft drinks and wine, could provoke the tooth wear.

The teeth were submitted to two different DH treatments and compared to its homologous tooth, which did not present any dentin hypersensitive. The patient assessed each stimulus (probing, air/water-spray) to compare to teeth with DH. Each stimulus was applied twice, before and after low-level laser irradiation. The tooth without sensitivity was stimulated by an explorer probing, cold water (10°C) using a Luer syringe (5 ml) and air-spray. Then, patient assessed the pain using a subjective scale: Score 0 (no pain), 1-3 (mild pain), 4-6 (moderate pain), 7-9 (strong pain), 10 (worst possible pain).

After 1 week standardization, the desensitizing agent was applied according to the manufacturer's instructions. The lesions were divided into two experimental groups ($n = 10$) showed in Table 1.

First, a pumice powder (SS White[®]) was mixed with distilled water, and prophylaxis was carried out previously all protocols. Then a relative isolation with cotton rolls was placed to avoid the saliva contamination and to displace the soft tissues. No anesthesia was carried out. Same procedures were previously performed before the low-level laser irradiation.

Group 1, a little amount of Desensibilize[®] was applied using a microbrush (Microbrush[®] - KG Sorensen) slightly rubbed for 30 s on the exposed dentin. Then, the Desensibilize[®] gel was placed in the rubber cup using a low-speed (Kavo[®]) and applied in the gingival sulcus with intermittent movements for 15 s. A new application of Desensibilize[®] gel was carried out using a microbrush for 10 min. The procedure was performed twice at the same session according to the manufacturer's instructions. A total of three sessions were performed, with 72 h interval among them.

Group 2 was irradiated using infrared 830 nm wave indium-gallium-arsenide-phosphorous diode laser (Whitening Lase II [DMC Equipamentos, São Carlos - SP]) at potency of 15 mW, the energy was delivered by optical fiber to the treatment site, producing a resulting spot size of 3.6 mm², the energy density

Table 1: Experimental groups, desensitizing agent, and manufacturers

Group	Desensitizing agent	Specimens (n)	Manufacturer/trade mark
1	10% strontium chloride gel	n=10	Desensibilize [®] (FGM Odontológica)
2	Infrared low-level laser (830 nm)	n=10	Whitening Lase II [®] (DMC Equipamentos)

was 3.8 J/cm², and the exposure time was 10 s per point. The dosage was calculated according to the irradiated area of the spot size that was 3.6 mm². Four points (one at buccal cervical area, one mesial, one central, and one distal point) were irradiated using the laser active tip in contact with the exposed dentin and the gingival tissue at the sulcus apical point. This procedure was performed in three sessions, with intervals of 72 h among them. The dosimetry (3.8 J/cm²) used in this study is a protocol from the Optics Group of the Institute of Physics of São Carlos - USP. Both dental professional and the patients used specific protective glasses during irradiation.

The data were submitted to SAS statistical software and the Kruskal–Wallis test and Friedman test were used at a significance level of 1%.

Results and Discussion

Many patients have searched this type of study to obtain a pain relief. The products and/or drugs application in the sensitive teeth, the dental professional care, and the personal service may hypothetically increased the placebo effect. In order to reduce this side effect, all volunteers were notified that the procedures could present a positive or negative response. There is a great discussion about the evaluation of hypersensitivity pain in the non-cariou cervical lesions in clinical trials. According to Gillam (1997)^[13] and Camps *et al.* (1998),^[5] the evaluation may be compromised due to the emotional factors may modify the patient response.

After the Friedman test, the null hypothesis was that the treatment would not influence the patient’s response; it means no difference of variance was found, or the treatment did not influence the response. The null hypothesis was false at 95% confidence. Tables 2 and 3 show the scores at the beginning and end of the desensitizing application in Group 1 – (Desensibilize[®]) and Group 2 (Whitening Lase II[®]). Regardless of the desensitizing method, both reduced the DH after three sessions of follow-up, presenting statistically significant difference between them at scale.

However, the chosen treatment must regard the pain transmission mechanism.^[14] The hydrodynamic theory proposes that under certain stimuli on the exposed dentin cause a movement of the dentinal fluid inside the tubules stimulating the extremities of the pulp nerves causing the pain sensation.^[13] The concept of tubular occlusion therapy is a logical conclusion from the hydrodynamic theory. Moreover, the application of chemical solutions containing K⁺ increases its intratubular concentration then the intradental nerves become less excitable to a stimulus causing a depolarization of the nerves fibers.^[4]

The Desensibilize[®] desensitizing gel contains 10% strontium chloride and 5% potassium nitrate. Strontium chloride reacts with the soluble calcium from apatite, from the exposed dentin, resulting in strontium apatite that is less soluble occluding the dentinal tubules entrance. Jacobsen and Bruce^[15] concluded the desensitizing effect of the potassium nitrate is related to the inactivation of nerve fibers and may provoke a transient pain during its application on the exposed dentin, similar to the patients report in this study. According to Rees and Addy^[2] and Vieira *et al.*,^[16] this pain may appear due to the direct action of potassium on the interdental nerve fibers and also as a result of an osmotic effect due to the high concentration of the solution.

Another approach is the low-level laser^[4] that is a source of biostimulation using its thermal energy and light sources. It works on the regulation of the cell physiological functions, analgesia effect, bioregulation of the cells responses and presents anti-inflammatory effects.^[11,12] This study showed the low-level laser was effective because the pain level decreased over time. Authors^[17] regard the analgesic effect of therapeutic lasers affect the release of alpha and beta-endorphins that bind to receptors from the nociceptive system causing analgesia due to the block transmission of the input substances. Reports have evaluated that the low-level laser works as an initial trigger for the activation of the cell natural phenomena.

The effectiveness of laser therapy suggests other mechanisms are involved in the dentinal desensitization. Although it is still unclear, the low-level laser effects require new experiments and evaluations. In theory, the dentinal pain is rapid and specific

Table 2: Score at the beginning and at end of the Desensibilize[®] desensitizing agent applied at cervical buccal face

Type of stimulus	22 (V)		23 (V)		24 (V)		31 (V)		32 (V)		33 (V)		34 (V)		35 (V)		36 (V)		37 (V)	
	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E
Water (10°C)	8	2	6	2	6	2	6	2	5	2	6	2	6	1	6	2	6	2	6	2
Probing	3	1	3	1	3	1	3	1	3	1	3	1	3	1	4	1	3	1	3	1
Air-spray	4	1	4	1	4	1	3	1	3	1	3	2	3	1	3	2	3	1	3	1

Legend - B: Beginning, E: End

Table 3: Score at the beginning and at end of the Whitening Lase II[®] laser applied at buccal cervical face

Type of stimulus	12 (V)		13 (V)		14 (V)		41 (V)		42 (V)		43 (V)		44 (V)		45 (V)		46 (V)		47 (V)	
	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E	B	E
Water (10°C)	6	1	8	1	8	2	6	1	6	1	6	1	8	2	8	2	6	1	8	1
Probing	4	1	3	1	4	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1
Air-spray	5	1	5	1	6	1	5	1	5	1	6	1	6	1	7	1	7	1	7	1

Legend - B: Beginning, E: End

(A-delta fibers), while the pulp pain is slow and non-specific (C fibers). The low-level laser application at the tooth apex stimulates the C-fibers while its application at the cervical area stimulates the A-delta fibers. The well-known explanation for the laser therapy successful is that the Na⁺/K⁻ pump in the cell membranes. The pump stimulation will hyperpolarize the membrane increasing the pain threshold, so it means the nerves will be less excited, and the pain threshold will decrease.

The Figures 1 and 2 showed the initial and final scores means of the Group 1 (Desensibilize[®]) and Group 2 (Whitening Lase II[®]). At 95% confidence, the laser was the most effective desensitizing method (10°C water, probing and air-spray stimuli).

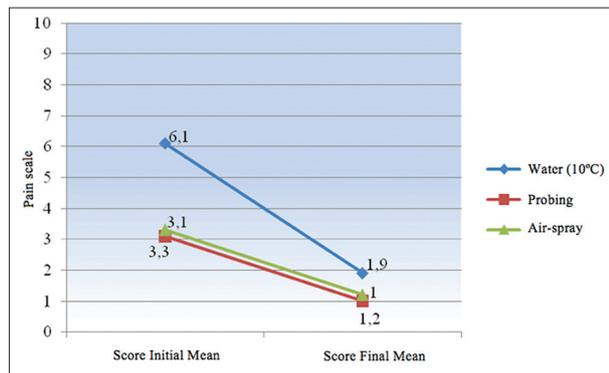


Figure 1: Treatment of dentin hypersensitivity using Desensibilize[®]. Initial and final means from pain scale

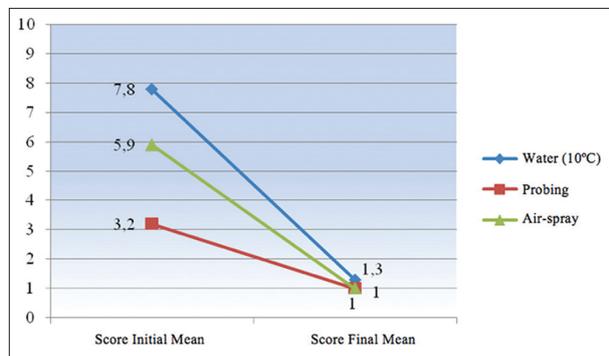


Figure 2: Treatment of dentin hypersensitivity using Whitening Lase II[®]. Initial and final means from pain scale

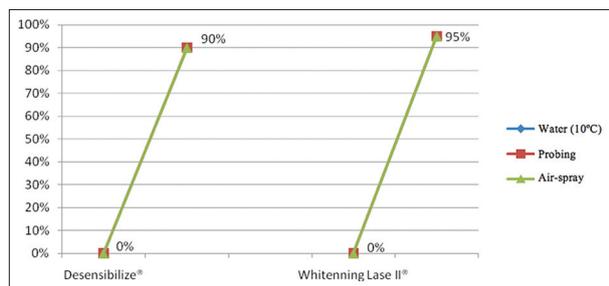


Figure 3: Comparisons between the efficiency of Desensibilize[®] and Whitening Lase II[®] treatments in percentage

Figure 3 displayed the Group 1 (Desensibilize[®]) presented 90% efficiency and Group 2 (Whitening Lase II[®]) 95% efficiency at 95% of confidence level. Both desensitizing methods reduced the pain level in all patients and present advantages and disadvantages. The Desensibilize[®] presented benefits as immediate effects, easier handling and it is cheaper than the laser equipment. The Whitening Lase II[®] low-level laser is effective and a conservative alternative for the DH treatment. However, the high cost of the laser equipment is still a disadvantage, since other materials present effective results in the pain relief.

Conclusion

- Both desensitizing methods reduced the DH after three sessions
- Statistical significant differences were found between the groups. Group 1 (Desensibilize[®]) presented 90% efficiency and Group 2 (Whitening Lase II[®]) 95% efficiency.

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