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CLINICAL EVALUATION OF THE IMMEDIATE EFFECTIVENESS OF GaAIAs LASER ON THE THERAPY OF DENTIN HYPERSENSITIVITY

AVALIAÇÃO CLÍNICA DA EFICÁCIA IMEDIATA DO LASER DE GaAIAs NA TERAPIA DA SENSIBILIDADE DENTINÁRIA

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** "In memorian"*

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ABSTRACT

The aim of the present study was to determine the effectiveness of GaAlAs laser therapy with λ670nm laser on the treatment of dentin hypersensitivity. Thirty-two intact human teeth were evaluated, the sensitivity of which to thermal (cold water), mechanical (probe) and evaporative (air) stimuli was recorded before and immediately after irradiation. Whenever desensitization was not observed after the first application, the patient was scheduled for a maximum of three further applications at 4-day intervals. The results demonstrated that laser therapy yielded a statistically significant reduction ($p<0.05$) in dentine hypersensitivity to the three stimuli analyzed. According to the results, the utilization of GaAlAs laser therapy (λ670nm) required just one application for the thermal and mechanical stimuli, whereas the evaporative stimulation demanded at least two applications of laser for the achievement of a similar effect.
Uniterms: Dentin sensitivity; Laser; GaAIAs.

RESUMO

O objetivo deste trabalho foi realizar um estudo clinico para avaliar a eficácia da laserterapia com laser de λ670nm no tratamento da sensibilidade dentinária. Foram avaliados 32 dentes íntegros cuja sensibilidade a estímulo térmico, tátil e evaporativo foi registrada antes e após irradiação. Quando não era evidenciada dessensibilização após a primeira sessão de irradiação, o paciente era agendado para novas aplicações, máximo de três sessões, sempre com intervalos de quatro dias. De acordo com os resultados a laserterapia promoveu uma redução estatisticamente significante ($p< 0,05$) da sensibilidade dentinária para os três estímulos analisados. De acordo com os resultados obtidos com a utilização do laser de GaAlAs foi necessária apenas uma sessão terapêutica para os estímulos sonda e térmico, embora tenham sido necessárias duas sessões para conseguir-se redução da sensibilidade ao estímulo evaporativo.
Unitermos: Sensibilidade dentinária; Laser; GaAlAs.

INTRODUCTION

Dentin hypersensitivity is an exaggerated response of the exposed vital dentin to thermal, chemical or tactile stimuli. This condition is highly uncomfortable to the patient and one of the most difficult problems to be solved by the dentist[17,20]. The literature[7,10,12,20,24] mentioned that one out of each seven patients presents dentin hypersensitivity, which yields a very significant number when applied to the Brazilian population, which is currently around 160 millions of inhabitants[24]. Data on the prevalence of dentin hypersensitivity may vary according to the areas because of social and dietary habits and is more frequent on adult patients aged 20 to 40 years old, being the largest prevalence observed at the final of the third decade of life, with no statistically significant differences between males and

females. It is further observed that 68.8% of the non-carious cervical lesions affect premolars, and 98% of these are located at the buccal surface of teeth[8].

As regards the mechanism of action of dentin hypersensitivity, Brännstrõm[4] (1986) stated that phenomenon associated to this clinical condition may be explained by the movement of fluid through the dentin induced by capillary forces, at a displacement rate of 2mm/sec, which might possibly cause pain because of deformation of the mechanoreceptors located at the nerve endings of the dentinal tubuli. This theory is called "hydrodynamic" and is the most widely accepted by several investigators [1,3,9,12,26].

Several therapeutic agents and protocols have been suggested and described in the literature for the therapy of dentin hypersensitivity, such as Strontium chloride[26], glass ionomer cement[7], iontophoresis[11] , fluoride varnish and laser[2,9,11,12,28]. The laser employed for the therapy of dentin hypersensitivity may be ablative or non-ablative, the mechanisms of action of which are completely different. Whereas the ablative laser vitrifies the dentin surface exposed, therefore obliterating the dentinal tubuli and preventing the "hydrodynamic mechanism"[14,15], the non-ablative laser produces photochemical or photophysical effects related to the selective action of the tissues according to the light intensity applied on them, which is then transformed in vital energy and produces effects as: release of substances such as histamine, serotonin and bradykinin; stimulation of mitochondria and consequent increase of ATP; increase in cell breathing; rebalance of the cell membrane potential and healing rate[5].

The non-ablative lasers have not been thoroughly investigated, especially as regards their application for the therapy of dentin hypersensitivity. For that reason, the present study aimed at conducting a clinical investigation for evaluation of the effectiveness of 670nm laser irradiation on the therapy of dentin hypersensitivity.

MATERIAL AND METHODS

This study involved twenty patients (thirty-two teeth with dentin hypersensitivity) attending the dental clinics of the State University of Feira de Santana (UEFS) for treatment. The teeth selected did not have any extensive occlusal or cervical restorations. The patients aged 19 to 54 years old and accepted to participate in the study according to Brazilian regulations. Each patient had two homologous teeth selected for examination for the study, with and without dentin hypersensitivity. The tooth not presenting dentin hypersensitivity was stimulated by probing and air-water spray, in an attempt to trigger sensitivity, so that the patient might experience the stimuli and become able to compare the degree of sensitivity to each of these stimuli, therefore not being submitted to evaluation of the effects of laser therapy. The homologous tooth, which displayed dentin hypersensitivity reported by the patient, was submitted to the stimuli, the responses were recorded and then the tooth received application of laser following the protocol established for the present study. Thus, each patient was assessed twice, before and after irradiation, and acted as his or her own "control". This has the advantage to reduce the variability that might exist between different groups.

The teeth with no dentin hypersensitivity had their buccal surface stimulated by each of the following stimuli: a) mechanical stimulation with a dental probe (Golgran Instrumentos Odontologicos), b) icy water (<10°C) by means of a Luer Lock syringe (5ml), and c) application of air with the air syringe of the dental equipment (Dabi Atlante S.A.). The sensitivity response to each of these stimuli was recorded on the scale suggested by Uchida, et al.[26] (1984): 0 – no significant discomfort; 1 – discomfort with no considerable pain; 2 – acute pain during stimulation; 3 – acute pain during and after stimulation.

Thereafter the teeth presenting with hypersensitivity were stimulated as previously described and the responses were similarly recorded. After this initial measurement, the sensitive tooth was submitted to application of λ670nm laser at 5J/cm^2 DP=15mW with a KC 611 device (Kroman, Ind. e Com. LTDA). Each sensitive tooth was submitted to two applications in two distinct points at the buccal surface, being one at the mesial and other at the distal end. These two exposures constituted one application of laser. After irradiation, sensitivity was measures again and whenever this measurement yielded a score different than 0 or 1 (demonstrating lack of desensitization), the patient was schedules for further applications, up to a maximum of three applications, at 4-day intervals.

RESULTS

The results presented in Table 1 were submitted to statistical analysis by the χ^2 test on the EPI Info 6.04 DOS software.

DISCUSSION

Analysis of the results revealed that the reduction in hypersensitivity after laser therapy was statistically significant ($p<0.05$) for the three stimuli assessed, in agreement with Wakabayashi and Matsumoto[28] (1988) and Gerschman, et al.[10] (1994).

Strang, et al.[25] (1988) and Marsílio, et al.[17] (2003) stated that 70 to 88.88% of patients treated with non-ablative lasers experienced pain relief soon after irradiation. Similarly, Aun, et al.[2] (1989) investigated the HeNe laser and observed a statistically significant reduction in the mean duration of stimulated pain. According to the authors, the mean duration was six seconds before therapy, having been decreased to two seconds after the first application and one second after the third application.

Paired analyses of the results achieved (analysis between sessions) revealed no significant reduction in hypersensitivity after the first session of laser therapy as

regards the stimulation by air. This reduction was effective just after the second application.

These data allow the conclusion that isolated sessions of laser therapy are ineffective to promote desensitization to stimulation by air. However, two or three sessions at 4-day intervals demonstrated to be a successful procedure. This may probably be explained by the presence of a cumulative therapeutic effect expressed just after the second session of laser therapy. However, Marsílio, et al.[17] (2003) indicated irradiation of teeth at 3 and 5J/cm^2 for up to six sessions, with a 72-h interval between each application.

As regards the stimulation by probe, a statistically significant reduction was found soon after the first session, demonstrating that the first application was responsible for the therapeutic outcome achieved. According to Sampaio, et al.[22] (1994), this brings about great advantages to the patient as it promotes a fast improvement in the quality of oral hygiene.

The results indicated that, from twenty-four teeth with score 2 or 3 presenting with sensitivity to probing before therapy, just four remained sensitive after the third application. No significant differences were found between the first and second sessions, nor between the second and third sessions, demonstrating that a single session of laser therapy is enough to provide desensitization to this type of stimulation in most instances, in the present experimental conditions and in agreement with the findings of Aun, et al.[2] (1989), yet differently from the air stimulation, which demanded a cumulative effect of at least two sessions.

The thermal stimulation displayed the largest number of sensitive teeth, adding up to 29 teeth. Just ten teeth were still sensitive at treatment completion. Similarly, the first application was the main factor contributing to the therapeutic effect of laser, since no significant differences were observed between the first and second sessions or between the second and third sessions.

A successful desensitization to the thermal stimulation should be regarded as one of the most important because it constitutes one of the patients' main complaints. According to Chabansk and Gillan[6] (1997), 80 to 90% of the patients with dentin hypersensitivity experience pain after a thermal stimulation. The stronger therapeutic effect for this type of stimulation after the first application was also a positive factor, since it improves the compliance with the treatment and the establishment of a trusting relationship between patient and professional, taking into account the remarkable psychological aspect present in this clinical entity.

The most widely accepted theory for explanation of the dentin hypersensitivity is the hydrodynamic theory[23], according to which an ideal desensitizing agent should obliterate the dentinal tubuli exposed and therefore prevent the occurrence of pain. Nevertheless, according to Oda, et al.[19] (1999), the main problem about therapies based on obliteration of the dentinal tubuli are the maintenance of the therapeutic agent on the sensitive surface for a longer period of time, which would allow a more delayed pain relapse. These authors investigated the possible formation of an impermeable layer after acid etching, which could be provided by products containing glutaraldehyde (Gluma "desensitizer"™); potassium oxalate (Oxa-gel™) and 2.26% sodium fluoride (Duraphat™). The conclusion was that acid etching before treatment did not allow the formation of a uniform desensitizing layer over the dentin. Despite the formation of a thin layer after application of fluoride, such layer was easily removed and therefore could not provide a long-term effect.

According to Marsílio, et al.[17] (2003) and MacCarthy[16] (2004), the etiology of dentin hypersensitivity is still poorly understood, yet it is certainly multifactorial. Regardless of such multiple factors, the fact is that exposed dentinal tubuli promote the hydrodynamic mechanism of stimulation of the pulp nerves. For that reason, the main therapies for dentin hypersensitivity aim at obliteration of these tubuli, especially by chemical means, either at home or at the dental clinic. However, these traditional therapies have been presenting relative failures, especially in the long-term. The employment of high-power lasers is promising. Lan, et al.[14] (2004) indicated that Nd:YAG laser irradiation on dentin could melt normal dentin surface and close the exposed dentinal tubule orifices without creating surface cracks. Yet, their outcomes are not 100% effective and many still require chemical associations such as with fluoride and oxalates, and their cost is quite high.

Therefore, the favorable results observed in the present study and the more affordable cost of the equipment render the GaAIAs laser a new and effective therapeutic option, either in isolation or associated to other procedures.

TABLE 1- Amount of sensitive teeth before and after each application of laser in patients with dentin hypersensitivity treated at the clinics of UEFS

Type of stimulus	Amount of sensitive teeth				χ^2 value	p value
	Before therapy	After the 1st session	After the 2nd session	After the 3rd session		
AIR	16	10	04	02	10.39	<0.05
PROBE	24	14	08	04	15.02	<0.05
THERMAL	29	21	15	10	7.98	<0.05

df = 3)

CONCLUSIONS

According to the present methodology and experimental conditions submitted to statistical analyses, the following could be concluded:

1. Just one application of laser was enough to provide a significant reduction in the sensitivity to the mechanical and thermal stimuli, yet not to the evaporative stimulation;

2. The accomplishment of second or third applications of laser was not advantageous as regards the mechanical and thermal stimuli;

3. Two applications of laser were enough to reduce the sensitivity to air;

4. The accomplishment of a third application of laser did not bring any additional benefit as to the evaporative stimulation;

5. Further studies are required to reinforce the findings of the present study.

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