Clinical Efficiency of Low-Level Diode Laser in Reducing Dentin Hypersensitivity

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Abstract—Dentin hypersensitivity (DH) is a relatively common clinical condition, especially in periodontal patients after treatment. In this study it was evaluated 28 teeth who presented dentin hypersensitivity. The teeth were subjected to clinical and radiographic exams and were divided into groups following the treatment and the time of examination after application proposed: GI: PO 3% (Potassium Oxalate—group control)/Baseline; GII: PO 3%/3 days after first session; GIII: PO 3%/6 days; GIV: PO 3%/30 days; GV: PO 3%/60 days; GVI: PO 3%/90 days; GVII: Laser (Low-level diode laser with 110 mW/cm\textsuperscript{2})/Baseline; GIX: Laser/7 days after first session; GX: Laser/14 days; GXI: Laser/30 days; GXII: Laser/60 days; and GXIII: Laser/90 days. The groups I–VI, the teeth were subjected to 3 applications (GI–GIII) of desensitizing agent at regular intervals of seven days. The Groups VII–XI, each tooth was subjected to three applications (GVII–GIX) in three different points (mesial, meddle and distal surfaces) with an interval of 72 h. The time of application in each point was of 33 s and the patients from both groups were followed up to 90 days. The nonparametric test Friedman (\(\alpha = 0.05\)) was applied and the test of Mann Whitney (\(\alpha = 0.05\)) was used to compare the time of examination between groups. The application of Laser was effective 6 days after first session and to PO was 30 days. It was observed that both treatments were effective for the reduction of dentin hypersensitivity, however the laser presented better effectiveness.

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INTRODUCTION

Dentin hypersensitivity (DH) is a common clinical condition; especially in patients submitted the periodontal therapy and plaque control procedures [1]. The DH is characterized by a short, sharp pain arising from exposed dentin in response to stimuli, typically thermal, evaporative, tactile, osmotic or chemical [2, 3].

There are few studies that have been concerned with the prevalence of tooth hypersensitivity [4] and one of them [5] was verified a prevalence of 72% to 98% in patients after periodontal therapy.

The mechanism of DH is based on the hydrodynamic theory that sensitive dentin is permeable throughout the length of the tubules, and fluid flow within dentinal tubules is altered (increased or changed directionally) [6, 7].

Many treatment methods of tooth hypersensitivity have been reported [8–10]. The active management of DH can be performed separately or in combination using over-the-counter and in-office therapies that shall be evaluated by severity of the clinical condition and the number of teeth involved [11].

The desensitizing agents can be used to treatment of DH such as relief effect, including fluoride, potassium nitrate, oxalate and calcium phosphates [12]. Fluorides such as sodium fluoride and stannous fluoride can reduce dentin sensitivity [13] and can decrease the permeability of dentin in vitro [14], possibly by precipitation of insoluble calcium fluoride within the tubules [12].

Recently, laser has been used as a treatment [14–16] and has a beneficial effect under certain conditions.

The aim of this study was evaluated a laser application as method of DH treatment compared with a potassium oxalate up to 90 days after treatment.

MATERIALS AND METHODS

Ethics committee following resolution 196/96 of the National Counsel of Health of the Ministry of Health approved this study with protocol number 2008/0078.
The patients with a history of dentinal sensitivity were selection to pre-evaluation. Medical and dental history of the patients were collected, and sensitive teeth were differentiated from other clinical conditions which frequently interfere with dentine sensitivity. Accordingly, sensitive teeth with improper restorations, caries, fractures and pulpitis were not included in this study. Additionally, patients receiving active periodontal treatment; having received non-surgical periodontal treatment within the past 3 months; using desensitizing tooth pastes within the past 6 weeks; or receiving regular medication including anti-histamines, anti-inflammatory, anti-depressants or analgesics were excluded as were women who were pregnant or lactating.

The patients provided signed written informed consent prior to study enrolment and then they were submitted to evaluation of DH for analyzing the degree of this sensitivity following mechanical stimulus with a sharp explorer and a thermal stimulus by a blast of cold air from a dental syringe.

After the stimulus, the patient was asked to mark the intensity of pain on a Visual Scale, which was marked “no pain (number 0),” low pain (number 1), “moderate pain (number 2)” and “extreme pain (number 3).”

The twenty-eight teeth were randomly divided into groups: GI: PO 3% (Potassium Oxalate—group control)/Baseline; GII: PO 3%/3 days after first session; GIII: PO 3%/6 days; GIV: PO 3%/30 days; GV: PO 3%/60 days; GVI: PO 3%/90 days; GVII: Laser (low-level laser diode)/Baseline; GVIII: Laser/7 days after first session; GIX: Laser/14 days; GX: Laser/30 days; GXI: Laser/60 days; and GXII: Laser/90 days.

The potassium oxalate 3% (OxaGel®, Kota) was used following manufacture’s instructions. A total of three sessions were made with interval of 7 days.

Low-level diode laser (UltraBlue, DMC, São Carlos, Brazil) was used to laser groups with power density of 110 mW/cm². Three sessions were made with interval of 72 h, which each session was applied three times on three different points during 33 s (figure).

The patients were submitted at five different times to evaluate the degree of DH. The data were submitted to non-parametric test (Friedman Test) and the comparisons between groups were made with Mann–Whitney Test. The significance level was set at \( \alpha = 0.05 \).

**RESULTS**

The medians of the values obtained are presented in table.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Median</th>
<th>Minimal</th>
<th>Maximal</th>
<th>Mann–Whitney (( \alpha = 0.05 ))***</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI: PO 3%/Baseline*</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>Aa</td>
</tr>
<tr>
<td>GII: PO 3%/3 days after first session*</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>Aba</td>
</tr>
<tr>
<td>GIII: PO 3%/6 days*</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>ABCba</td>
</tr>
<tr>
<td>GIV: PO 3%/30 days</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>Ca</td>
</tr>
<tr>
<td>GV: PO 3%/60 days</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>BCa</td>
</tr>
<tr>
<td>GVI: PO 3%/90 days</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>BCa</td>
</tr>
<tr>
<td>GVII: Laser/Baseline**</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>Aa</td>
</tr>
<tr>
<td>GVIII: Laser/7 days after first session**</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>ABb</td>
</tr>
<tr>
<td>GIX: Laser/14 days**</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>Bb</td>
</tr>
<tr>
<td>GIX: Laser/30 days</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>ABb</td>
</tr>
<tr>
<td>GX: Laser/60 days</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>ABb</td>
</tr>
<tr>
<td>GXI: Laser/90 days</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>ABb</td>
</tr>
</tbody>
</table>

* Application period of the PO 3%.
**Application period of the Laser therapy.
***The same letters (superscript to same method and subscript to different method) indicate no difference significance between them.
The Laser therapy showed decrease significant 6 days (GIII) after first session. The GII, GIV–GVI showed no difference between baseline (G1). The PO 3% showed decrease 14 days (GIX) after first session and after this examination, the hypersensitivity showed lower than baseline (GVII).

The comparison between the treatments showed that hypersensitivity after laser application (GII, GIV, GV, and GVI) were lower than PO 3% application (GVIII).

DISCUSSION

Despite the wide variety of treatments available to reduce the DH, it is still considered a chronic problem of uncertain post-treatment [17]. The most treatments are directly related to the interruption of transmission of a stimulus to reduce the movement of fluid within the dentinal tubules [3, 18, 19]. The occlusion of dentinal tubules can be performed using fluorides, potassium nitrate, oxalates, calcium phosphates oxalates and adhesive restorative materials and laser therapy [5, 11, 20–22].

This study evaluated the clinical efficiency of two different treatments to DH, which the both treatments were observed a decrease on the DH. The oxalate 3% (OxaGel®) is a drug of occlusive effects on the dentin, but also can possible an effect of overlapping neural [23, 24].

The laser has been widely used in many specialties of dentistry [25–28]. The low-level laser therapy stimuli promote the inflammatory process modulation that modify the transmembrane electric potential, activating Na⁺ and K⁺ ATPase pump, and increasing the synthesis of adenosine triphosphate (ATP) [29]; acceleration of leukocytes activity; interleukin; level reduction and angiogenesis capillary and lymphatic increase contributing to modulation of inflammatory process [30–32].

In this study the low-level laser had a faster response to DH reduction with a statistically significant difference 6 days after first session. On the other hand, the oxalate 3% showed only 30 days after first session, which should be necessary three or more application to verify the HD decrease.

Other clinical study does not support this finding [33] that the laser therapy reducing the pain sensation no more than placebo. There have been some studies of the effect of low-level laser on DH [14–16, 34]. Most studies have used GaAlAs laser treatment, and have demonstrated decrease on DH, with efficiency rate of approximately 90% [15, 34]. There is also evidence that the HeNe lasers can reduce DH. In a randomized, double-blind clinical study involving 19 subjects, the hypersensitivity was efficient on 63% when the stimulus was by air and 61% with a sharp explorer. All teeth remained vital after laser treatment, with no adverse reactions or complications.

There are no protocols established to treatment of DH with low-level laser therapy. This can be difficulty the comparison with others studies.

CONCLUSIONS

The both treatments were efficient to decrease the DH and showed longevity up to 90 days. However, the low-level laser therapy showed more effective than oxalate 3%.

REFERENCES