Short Communication

Laser acupuncture and intravascular laser irradiation of blood for management of pediatric dental anxiety

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Abstract: The aim of this study was to assess the effectiveness of laser acupuncture and intravascular laser irradiation of blood (ILIB) for managing anxiety in pediatric dentistry. Eighty-four children recruited at a university dental clinic were randomly assigned to three groups: the Sham group (n = 27) underwent sham laser irradiation of three acupuncture points, the ILIB group (n = 25) underwent 10 min of ILIB, and the laser acupuncture group (LAC, n = 32) underwent 40 s of laser acupuncture over points VG20 (Baihui), PC6 (Neiguan), and the Oppression Point. The results suggest that ILIB and laser acupuncture are feasible alternatives for managing dental anxiety in children.

Keywords: acupuncture, cortisol, dental treatment anxiety, ear acupuncture, low-level laser therapy

Introduction

Several core procedures of pediatric dentistry are associated with discomfort, including anesthesia, use of high- and low-speed handpieces, radiographs, impression molding, endodontic treatment, and oral surgery [1,2]. Prolonged treatment can also cause discomfort resulting in symptoms such as diaphoresis, tachycardia, psychomotor agitation, restlessness, and crying [3]. Both physical and chemical restraints, including sedation and general anesthesia, are widely used in pediatric dentistry [4].

The resources most commonly used to control pediatric dental anxiety are physical restraints, chemical restraints, sedation, and general anesthesia [1,4]. Acupuncture, hypnosis, music therapy, and laser therapy are promising alternatives in this context [1,4,5]. Little is known about the effectiveness of laser acupuncture for anxiety management [2,3], and past studies have provided no data on the effects of intravascular laser irradiation of blood (ILIB) and laser acupuncture on the management of dental anxiety in children. Therefore, the aim of this study was to evaluate laser acupuncture and ILIB as alternatives for controlling pediatric dental anxiety. The null hypothesis was that laser acupuncture and ILIB would have no effect on anxiety in children undergoing dental treatment.

Materials and Methods

This study was approved by the Ethics Committee of Pontificia Universidade Católica de Campinas (PUC-Campinas; protocol no. 2.951.142). All experiments on humans were conducted in accordance with the principles of the Declaration of Helsinki (http://www.wma.net, 2019-12-16), and all procedures were performed with the adequate understanding and written consent of the patients and their guardians. The investigators explained the study to the child and their parents and received their consent.

Sample

Eighty-four boys and girls aged 5 to 10 years participated in the study. All were selected at the pediatric clinic.

Inclusion criteria

Patients were included in the study if they were not currently using anxiolytics, if they were receiving treatment at the pediatric clinic of the authors’ institution, if written informed consent or assent was provided by their parents or guardians, and if they were receiving treatment involving anxiety-generating procedures, such as anesthesia, restorative dentistry, oral surgery (deciduous tooth extraction), or endodontics.

Exclusion criteria

Patients were excluded from the study if they were using drugs that affect the central nervous system, such as anxiolytics, antidepressants, and muscle relaxants; if they had a diagnosis of psychiatric or mental disorders or cerebral palsy; if they were older than 18 years; if parents or guardians refused to sign the Informed Consent Form or patients refused to sign the Assent Form; or if they were using corticosteroids.

Recruitment

Children were recruited from the waiting room of the pediatric clinic at the PUC-Campinas School of Dentistry. Overall, 106 children were screened, and eight who did not meet the inclusion criteria were deemed ineligible. Of the 98 children included, 14 were excluded (12 during the second cortisol collection and two for not answering all questions on the scales). Losses during the second cortisol collection were due to contamination of the samples by blood from surgical sites (Fig. 1). The 84 children were selected and randomly assigned (www.random.org, 2020-02-25) to three groups (Fig. 1). Researchers who were not authors of this work generated the random allocation sequence, enrolled participants, and assigned participants to interventions. The sample size calculation was performed by ANOVA. The minimum difference between treatment means was 0.0115 (salivary cortisol before and after treatment: arithmetic means 0.1697 and 0.1582, respectively), the standard error was 0.01, the number of treatments was three, the statistical power was 0.80, and alpha was 0.05. The minimum number of patients per group was calculated as 25.

Sham

Twenty-seven children underwent sham (simulated) laser acupuncture on the systemic points VG20 (Baihui; located at the vertex, specifically where the midline intersects an imaginary line starting from the vertical axis of each ear) and PC6 (Neiguan; located between the palmaris longus and flexor carpi radialis tendons, above the transverse skin crease of the wrist) and on the auricular Oppression Point (located at the origin of the crus of the helix, end point of the solar plexus zone). The laser device was applied to each of these points for 40 s and then switched off. The points were selected for their anxiolytic, soothing, and antiemetic properties, as well as for their exposure and ease of access.

ILIB

Twenty-five children underwent ILIB with a laser bracelet (Therapy EC, DMC, São Carlos, São Paulo, Brazil; parameters: energy 60 J, continuous application, wavelength 660 nm, power 100 mW). The bracelet was placed under the radial artery, in a region not corresponding to any acupuncture point.

Laser acupuncture

Thirty-two children received 40 s of laser acupuncture (LAC) per point (Flash Laser II, DMC, São Carlos, São Paulo, Brazil) at points VG20, PC6,
to evaluate normality. The sample exhibited nonparametric behavior. The results were analyzed in Biostat 5.3. The Shapiro-Wilk test was used for pre-and-post comparisons of CDAS, salivary cortisol, HR, oxygen saturation, and the Wong-Baker FACES scale.

### Results

Salivary cortisol

Saliva samples for cortisol measurement were obtained with a Salivette kit (Sarstedt AG & Co. KG, Nümbrecht, Germany) between 7:20 a.m. and 12:40 p.m., when the circadian rhythm of hormone secretion is highest. Swabs containing saliva were refrigerated at 6°C and delivered to the laboratory on the day of collection or the morning of the following day. Swabs were placed in 1 mL of distilled water and analyzed with a Fluorimeter (Perkin Elmer, South Windsor, CT, USA). Cortisol was measured with a competitive enzyme-linked immunosorbent assay (ELISA) kit (Sarstedt AG & Co. KG, Nümbrecht, Germany) between 7:20 a.m. and 12:40 p.m., energy density 142 J/cm², spot area 0.028 cm²) [2,3].

### Discussion

The present comparison of values before and after treatment revealed a reduction in HR in the ILIB and LAC groups but not in the sham group. The variance in cortisol (CS) was measured to assess the physiological response to anxiety, as that would not be representative of clinical practice. Comparing cortisol across groups, ILIB and LAC were associated with a significant decrease in HR after treatment (P = 0.0012 and P = 0.0042, respectively).

For the other variables of interest, neither ILIB nor LAC was associated with a significant difference in comparisons of values before and after treatment (P > 0.05, Table 3).

### Statistical analysis

The results were analyzed in Biostat 5.3. The Shapiro-Wilk test was used to evaluate normality. The sample exhibited nonparametric behavior (P < 0.05), and the Wilcoxon test with a significance 5% was thus used for pre-and-post comparisons of CDAS, salivary cortisol, HR, oxygen saturation, and the Wong-Baker FACES scale.
sons were made between anxiety levels before and after the procedure, thus simulating the routine practice of a pediatric dentist who, on any given day, will treat children with varying levels of anxiety and perform procedures that are differentially anxiogenic.

Khalighi et al. [7] reported that low-level laser therapy alters impulses in the dorsal horn and inhibits pain in the cerebral cortex, balances levels of the neurotransmitters epinephrine and norepinephrine, increases serotonin and glucocorticoid excretion, and increases levels of β-endorphin, all hormones directly associated with anxiety. Isabella et al. [8], Mikhaylov [9], and Huang et al. [10] noted that photoreception of low-level ILIB energy, when applied systemically, is carried by hemoglobin and activates substances such as superoxide dismutase, nitric oxide synthase, catalase, and cytochrome c. These substances interfere with ATP production and alter the plasma membrane by sending information to the neurohumoral regulation system. This response cascade affects the autonomic nervous system, inhibits synthesis of prostaglandins that cause inflammation, and modulates hormones that interfere with anxiety.

The present results suggest that laser therapy and ILIB can be used to help manage children’s anxiety during dental treatment. Additional research should be conducted to further evaluate the use of laser therapy in the behavioral management of children during dental treatment.

Conflict of interest
None.

References
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Table 3  Median (MD), interquartile range (IQR), and Wilcoxon test of measurements obtained before and after treatment in the sample groups

| Groups  | HR Pre | HR Post | SpO2 Pre | SpO2 Post | CS Pre | CS Post | CDAS Pre | CDAS Post | VAS Pre | VAS Post | P-value |
|---------|--------|---------|----------|----------|--------|---------|----------|----------|--------|---------|---------|
| Sham MD | 93.00  | 88.00   | 98.00    | 1.00     | 0.13   | 0.14    | 7.00     | 9.00     | 0.00   | 0.00    | 0.2250  |
|        | (24.00)| (16.50) | (1.00)   | (1.00)   | (0.07) | (0.16)  | (5.00)   | (5.50)   | (2.00) | (2.00)  |         |
| P       |        |         | 0.1318   | 0.5737   | 0.0285*| 0.6155  |         |         |         |         |         |
| ILIB MD | 92.00  | 78.00   | 98.00    | 1.00     | 0.11   | 0.14    | 8.00     | 8.00     | 0.00   | 0.00    | 0.0012* |
|        | (16.00)| (20.00) | (1.00)   | (1.00)   | (0.11) | (0.22)  | (5.00)   | (5.00)   | (2.00) | (2.00)  |         |
| P       | 0.0012*|         | 0.1396   | 0.1213   | 0.5829 |         |         |         |         |         |         |
| LAC MD  | 90.50  | 85.00   | 98.00    | 1.00     | 0.12   | 0.16    | 8.50     | 9.00     | 0.00   | 2.00    | 0.0042* |
|        | (18.75)| (22.00) | (1.00)   | (1.00)   | (0.12) | (0.16)  | (6.25)   | (7.25)   | (2.00) | (4.00)  |         |
| P       | 0.0042*|         | 0.1754   | 0.6115   | 0.0613 |         |         |         |         |         |         |

CDAS, Corah’s dental anxiety scale; CS, salivary cortisol; HR, heart rate; ILIB, intravascular irradiation of blood; LAC, laser acupuncture; Sham, control; SpO2, oxygen saturation; VAS, Wong-Baker FACES scale.

*Statistically significant difference.