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Systematic review

Photobiomodulation Therapy as an Adjuvant in Reducing Postoperative Pain in Third Molar Surgery. A Systematic Review

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Abstract

Introduction: Third molar surgery is normally associated with different complications, the main one being postoperative pain. Commonly, therapy focuses on the prescription of nonsteroidal anti-inflammatory drugs (NSAIDS) as adjuvants to minimize pain. However, the NSAIDS have numerous gastrointestinal, renal and haematological side effects. Currently, the implementation of photobiomodulation (PBM) therapy has been suggested, in an effort to offer the best adjuvant

treatment in the control of postoperative pain that does not generate side effects. **Objective:** To make a research about the effectiveness of implementing PBM therapy to reduce postoperative pain in third molar surgery. **Materials and methods:** An electronic search was performed in three databases: PubMed®, ScienceDirect® and Wiley Online Library. These included randomized controlled trials (RCT) published from 2015 to 2021. **Results:** A short number of articles were found, none of them had a standardised PBM therapy protocol (wavelength, measured power density, J/cm^2 energy per point). Besides, these articles did not present agreement between the characteristics of the PBM therapy application. However, from the included studies, all showed statistical significance in the reduction of pain when applying PBM therapy. **Conclusion:** According to the results of this review, the application of PBM therapy is effective in reducing postoperative pain in third molar surgery.

Keywords: Photobiomodulation therapy, low level laser therapy, third molars, pain.

INTRODUCTION

The surgical extraction of third molars is one of the most performed procedures in oral and maxillofacial surgery worldwide[1]. Among the most frequent complications associated with this procedure are postoperative pain, inflammation, trismus, sensory nerve injury, alveolar osteitis, mandibular fractures and infections[2]. Lago-Méndez *et al.* report that the maximum intensity of pain occurs between 3 and 5 hours after surgery, lasting for 2 or 3 days and gradually decreasing until the seventh day[3]. A common method to minimize this complication is the use of nonsteroidal anti-inflammatory drugs (NSAIDS), analgesics and relaxants, but most of them can have side effects, such as a tendency towards systemic bleeding, gastrointestinal irritation and allergic reactions[4, 5]. These observations justify efforts to find a new method of postoperative pain control that does not cause side effects. Recently, photobiomodulation (PBM) therapy has been suggested as an adjuvant in patients undergoing third molar surgery, controlling the inflammatory process, promoting pain relief, and accelerating tissue repair without having adverse effects on patients[6, 7]. PBM therapy, also known as low level laser therapy, is defined as a non-ionizing light therapy that, through the stimulated emission of laser beams, light-emitting diodes (LED), and/or broadband irradiation in the visible and infrared spectrum is capable of producing physiological changes in cells and tissues. The above gives rise to therapeutic benefits, which is why it is used in various disciplines of medicine and dentistry, due to its analgesic, biostimulant and anti-inflammatory properties[8].

PBM therapy promotes rapid effects in reducing the level of pain and inflammatory mediators such as prostaglandin E2, interleukin-1 (IL-1), tumor necrosis factor, and cyclooxygenase-2 (COX-2)[9, 10]. In addition, it will generate a biological impact on tissues and cellular structures, by promoting the state of hyperpolarization directly on the primary nerve endings, inhibiting the transmission of painful stimuli to the central nervous system[11], and inducing analgesia, by stimulating the synthesis of endogenous endorphin (β-endorphin), decreasing the activity of C nerve fibers, bradykinin, and modifying the pain threshold[12].

Fabre *et al.*[13] evaluated the analgesic effects of intraoral application of PBM therapy to control pain after extraction of third molars. All patients received four consecutive daily sessions

of PBM therapy using the LED (660 nm, 35 mW, 5 J/cm^2). The conclusion was that the intensity of pain decreased from the third postoperative day onwards. Similar results were reported in double-blind randomized controlled trials (RCT), carried out by Eshghpour *et al.*[14] where the level of pain was significantly lower with the use of the laser than with the placebo at all times of the experiment ($p < 0.05$). Therefore, it was demonstrated that PBM therapy is effective in reducing the intensity of postoperative pain after third molar extraction and can be recommended to alleviate the symptoms that patients present after surgery. In this sense, the purpose of the present systematic review was to determine the effectiveness of photobiomodulation therapy as an adjuvant in reducing postoperative pain in third molar surgery.

MATERIALS AND METHODS

The first step in the systematic review was to use the PICO strategy to define a clinical or research question: PICO. **P**= patients undergoing third molar surgery, **I**= application of postoperative PBM therapy, **C**= other forms of surgical management, **O**= effectiveness in reducing pain. As a result, *is photobiomodulation therapy effective as an adjuvant in reducing postoperative pain in third molar surgery?*

A systematic search was carried out in three different electronic databases, which were: PubMed®, ScienceDirect® and Wiley Online Library. We searched for articles published from 1st January, 2016 to 30th October, 2021 in English and Spanish, and were limited to those articles that were carried out only in humans. The keywords used were: photobiomodulation, low level laser therapy, third molars, pain, in both Spanish & English, MeSH terms and Boolean operators. All RCTS were included in which PBM therapy was applied intraorally and/or extraorally after surgery, using LEDS with a wavelength between 800-940 nm and an average power density of 50-500 mW, RCTS in the split-mouth format, RCTS in the experimental group and control group format as well as the use of the visual analogue scale (VAS). Letters to the editor, pilot studies, short reviews, studies conducted in non-human animals, and *in vitro* studies were excluded. Articles that compared the effectiveness of PBM therapy against drugs, studies with patients whose medical condition increased the pain threshold, and articles that used a measurement scale other than the VAS were eliminated.

Relevant studies were analysed and reviewed separately with the help of two reviewers. A form was used to collect data from each of the studies that included: title, author, year, type of design, application of PBM therapy, wavelength (nm), mean power density (mW), density energy/point (J/cm^2), tracking and VAS. For each selected article, the VAS was considered so as to determine the effectiveness of PBM therapy as an adjuvant in reducing postoperative pain within a maximum follow-up period of 7 days after third molar surgery.

RESULTS

Initially, we identified 134 potential studies, (PubMed®= 36, Wiley Online Library= 50, ScienceDirect®= 48). When applying the selection criteria, 130 articles were excluded, which corresponded to literature reviews, clinical trial protocols, conference abstracts, book chapters and RCTS in non-human subjects. Thus, 4 articles were obtained at the end of the screening (Figure 1).

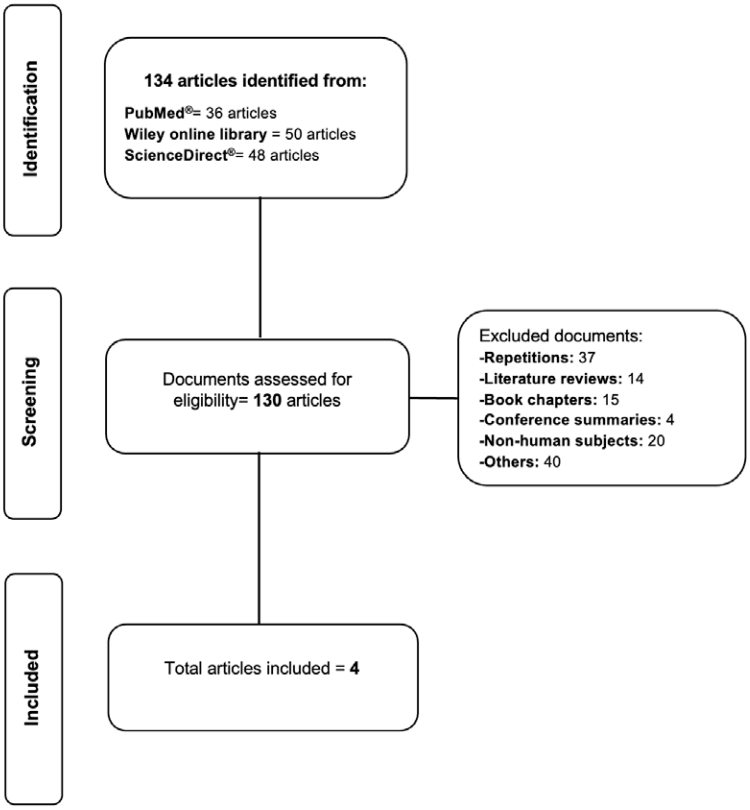

Figure 1. Article selection flowchart.

The characteristics of the included studies were broken down by author, year, study design, intervention, sample size in each group, follow-up, pain measurement, and results expressed as mean (Table 1). The mean ages of the patients included in the articles ranged from: 24.08±3.26 to 28±11.54 years, with the majority being women. In one of the articles, the gender did not show differences in terms of their pain score, while in the remaining articles no information was provided in this regard.

Table 1. Characteristics of the studies included.

AUTHOR	STUDY	DESIGN	INTERVENTION (*nm ,mW, J/cm²*)		SAMPLE		FOLLOW-UP	PAIN MEASUREMENT	RESULTS (VAS)		p
			PBM GROUP	CONTROL GROUP	INTERVENTION	CONTROL			PBM THERAPY	CONTROL	
Isolan *et al* [15]	Double blind RCT	Parallel	808 nm 50 mW 11 J/cm²	No irradiation	51	50	6, 24 and 48 hours after extractions	VAS	**T6** (x̄=0.9;I.C:0,63-1,16)** **T24** (x̄= 0.72;I.C:0,51-0,93)** **T48** (x̄= 0.64;I.C:0,36-0,92)**	T6 (x̄=2.50; I.C:2.10- 2,88)** T24 (x̄=2.86; I.C:2,40 -3,31** T48 (x̄=2.86; I.C:2,37-3,34)**	<0,001 [a]
Mohajerani *et al*[16]	Double blind RCT	Parallel	PBM: 810 nm, 500 mW, 5 J/cm² LED: 632 nm, 500 mW, 2 J/cm²	No irradiation	20	20	Postoperative day 3 and 7	VAS	**Day 3:** 3.35 ± 1.23* **Day 7:**0.9 ± 0.64*	Day 3: 4.6 ± 0.94* Day 7: 1.4 ± 0.5*	0.03 [a] 0.01 [a]
Momeni *et al*[17]	Double blind RCT	Split-mouth	940 nm, 500 mW,30 3J/cm²	Radiation-free fiber tip	Control and intervention group: 25		Every day for one week	VAS	**Day 6:** 1.08 ± 1.10* **Day 7:**0.4 ± 1.5*	Day 6: 2.76 ± 2.82* Day 7: 1.71 ± 2.26*	< 0.05 [b]
Nejat *et al*[18]	Double blind RCT	Split-mouth	660 nm 200 mW, 1.5 J/cm²	Simulated LLLT	Control and intervention group: 80		Every day for one week	VAS	24.52 ± 7.32*	27.89 ± 8.26*	<0,001 [b]

RCT: Randomized controlled trial, PBM: Photobiomodulation therapy therapy, LED: light emitting diode, nm: wavelength in nanometres, mW: Average power density, J/cm²: Energy dose/ point, T: time, VAS: Visual Analogue Scale, * Mean and standard deviation, Mean and confidence interval**. P: *p* value. a: Mann-Whitney *U* test. b: Student's *t*-test

Of the selected articles, the basic treatment that patients received was dipyrone 500 mg/single dose, paracetamol 500 mg/6h/5 days, ibuprofen 400 mg/12h/3 days and paracetamol 500 mg/8h, respectively. Regarding the application of PBM therapy as an adjuvant in reducing postoperative pain in third molar surgery, the results reveal that the mean VAS scores were significantly lower in the groups exposed to PBM therapy compared to the groups that received sham therapy or those who did not receive irradiation.

DISCUSSION

Among the unwanted postoperative effects of third molar surgery, the inflammatory process that follows the tissue injury and consequently the manifestation of postoperative pain arises. So, to control pain and inflammation, drugs have been implemented that inhibit phospholipase A2 and modulate or block the synthesis of inflammatory mediators, such as prostaglandins, prostacyclins, bradykinin and leukotrienes. The disadvantage is the possible side effects they cause, and that is why it has been sought to offer alternatives that do not generate such effects. PBM therapy has been used successfully in the health area for 40 years. It was first described by Mester *et al.*[19] in 1971, who concluded that its use stimulates wound regeneration. Since then, PBM therapy has been used in different branches of health sciences, such as in dentistry to treat different conditions, such as temporomandibular joint disorders[20,21], inferior alveolar nerve injury[22], oral mucositis[23,24], in orthodontic treatments[25,26], and its effectiveness as an adjuvant in reducing postoperative pain in the extraction of third molars has recently been studied, where it has shown favourable results[27].

Among the limitations of our research are the lack of studies and the heterogeneity of the protocols, to choose the best adjuvant treatment that minimizes pain in patients undergoing third molar surgery. The main bias of the selected studies is the PBM therapy protocol applied. For example, Isolan *et al.*[15] were based on previous protocols where it was proven that postoperative pain decreased in third molar surgeries. While Mohajerani *et al.*[16] applied PBM therapy according to the established parameters used by Opel *et al.*[28] which were not related to third molar surgery, but were related to wound healing, acne treatment, prevention from sunburn and skin rejuvenation. On the other hand, both Momeni *et al.*[17] and Nejat *et al.*[18] carried out their own protocols.

It is remarkable that to date there is no standardised protocol for PBM therapy. Each selected study employed different wavelengths, mean power density, and J/cm^2 energy per point, so the results of our study could be influenced by the lack of standardisation of the PBM therapy protocol. On the other hand, the application of PBM therapy in multiple sessions after third molar surgery has been shown to have positive effects in relieving postoperative pain[29]. However, the articles included in this review were limited to only one postoperative application. Regarding the mode of administration, in a study by Aras & Güngörmüş[30], the administration of extraoral PBM therapy was shown to be more effective compared to the intraoral, for the reduction of trismus and inflammation after extraction of third molars. The mode of administration of PBM therapy that was applied in each RCT varied in each of the articles reviewed, and it is currently unknown if has has an impact on the reduction of postoperative pain.

CONCLUSIONS

The application of PBM therapy as an adjuvant, after third molar surgery, is an effective treatment for reducing postoperative pain. However, it is considered necessary to carry out other studies to establish a standardised protocol for the management of PBM therapy and thus reduce the bias of the results obtained.

CONFLICT OF INTEREST

There are no potential conflicts of interest to declare in this systematic review.

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