



ORIGINAL ARTICLE

Photobiomodulation vs NSAIDs in the management of postoperative dentoalveolar pain



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Abstract *Background:* Postoperative pain, the most common complication of dentoalveolar surgery, is routinely controlled by non-steroidal anti-inflammatory drugs (NSAIDs). However, despite its proven efficacy, the long-term consumption of NSAIDs is associated with several serious and adverse effects. As a result, photobiomodulation (PBM) or low-level laser therapy (LLLT) is used in many treatment modalities to reduce pain, inflammation, and promote healing.

Aim of the study: To compare the analgesic effects of LLLT and Ibuprofen after surgical dental extraction.

Materials and methods: A clinical trial study was conducted at Umm Al-Qura University Dental Clinics, involving 46 healthy patients between 20 and 60 years of age. The recruited patients were divided into two groups of 23 patients each. Group 1 (positive control group) was prescribed Ibuprofen and Group 2 (experimental group) was treated with LLLT. The pain was measured on days 1, 2, and 7 using the Numeric Pain Rating Scale (NPRS).

Results: The mean level of pain decreased with both treatments. On the first postoperative day, the pain level in the laser therapy group was significantly lower than in the control group ($U = 62.5$, $p = 0.024$). The results indicated a significant decrease in pain level on the second postoperative day for both the control and experimental groups ($Z = -3.61$, $p < 0.005$, and $Z = -3.1$, $p = 0.002$, respectively). However, the pain level was lower in the control group, although the difference was not statistically significant ($U = 79$, $p = 0.102$).

Abbreviations: NSAID, Non-steroidal anti-inflammatory drugs; PBM, Photobiomodulation; LLLT, Low-level laser therapy

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Conclusion: Considering the constraints of this study, NSAIDs were found to be significantly better at reducing pain than LLLT.

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1. Introduction

The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” (IASP, 2022). Pain is a subjective feeling influenced by biological, psychological, and social factors (Raja et al., 2020). Around 23 million people worldwide suffer from postoperative pain (Correll, 2017).

After dentoalveolar surgery, pain typically occurs during the first 24 h, reaching a peak intensity at 6–8 h after the procedure (Seymour and Walton, 1984). Such postoperative pain has been conventionally managed by NSAIDs. However, long-term consumption of NSAIDs may cause serious side effects, such as acute renal failure and myocardial infarction. Moreover, NSAIDs can exaggerate certain conditions, such as hypertension, as well as the effects of some drugs, such as warfarin (Marcum and Hanlon, 2010). Therefore, for at-risk patients, the prescription of Acetaminophen or Paracetamol is preferred and has been found to be effective (Moore et al., 2000).

PBM uses light in the far-red to near-infrared spectrum region (630–1000 nm) to regulate several cellular functions (Desmet et al., 2006). Studies have found that LLLT improved wound healing efficacy, treated inflammatory and painful conditions, and improved alveolar bone remodeling pain and swelling after third molar extractions (Field and Allan, 2003; Hamid, 2017; Limpanichkul et al., 2006; Migliorati et al., 2013). However, there are no established guidelines on its application method, irradiation parameters, and exposure time. If PBM could replace routinely prescribed analgesics, it would have a significant effect on pain management. Therefore, the purpose of this study was to compare the effects of photobiomodulation therapy and Ibuprofen on pain caused due to surgical dental extraction.

2. Materials and methods

This non-randomized clinical trial was granted ethical clearance by Umm Al-Qura University institutional review board (#136-19) and was conducted between 2019 and 2020 at the Oral and Maxillofacial Surgery Clinic, College of Dentistry, Umm Al-Qura University, Makkah, KSA.

A total of 46 patients were recruited for the study, all of whom were informed about the experimental treatment and signed an institutionally approved consent form. The 46 patients meeting the inclusion criteria had the following characteristics: male or female gender, 20 to 60 years of age, healthy (or having controlled diabetes), and teeth in need of surgical extraction. Meanwhile, the exclusion criteria included any contraindications pertaining to laser therapy, systemic illness, local infection, tobacco use, oral contraceptives, pregnancy, and lactation. All surgical procedures were performed in the university teaching clinic under the supervision of oral

surgeons. The patients were distributed into two groups, an experimental group (laser) and a control group (Ibuprofen) consisting of 23 patients each, and were instructed to avoid any analgesics 12 h before the procedure. Surgical extraction is defined as an invasive procedure associated with postoperative pain, that may involve tooth sectioning, bone removal, flap elevation, and suturing.

The control group received routine management with Ibuprofen 600 mg every-eight hours for two days, while the experimental group received LLLT through a medical device (Laser HF® “Comfort,” Hager & Werken, Germany) (Fig. 1). The exposure was conducted immediately after surgery by placing the diode at a distance of 1 cm from the involved area and running three cycles of 45 s each—aiming the light at the center of the wound, followed by the mesial side and, lastly, the distal side to ensure complete coverage (Fig. 2). The LLLT was carried out using a 320 µm diameter fiber tip with a wavelength of 660 nm and an output power of 100 mW. The total irradiation time was 135 s, the energy density was 13.2 J, while the pulse was set to continuous.

After the procedures, all patients were asked to pay attention to their pain intensity. The patients were contacted 6–8 h after the procedure on the first day, followed by additional calls on the second and seventh days to document the pain scale using a Numerical Pain Rating Scale (NPRS).

3. Statistical analysis

All the data were analyzed using SPSS software vr.23. The data were not normally distributed, as verified by the Shapiro-Wilk test. Consequently, a non-parametric approach was employed. The data were further compared using the Mann-Whitney *U* test. Additionally, the Wilcoxon signed-



Fig. 1 Diode laser device (Laser HF® “Comfort”).

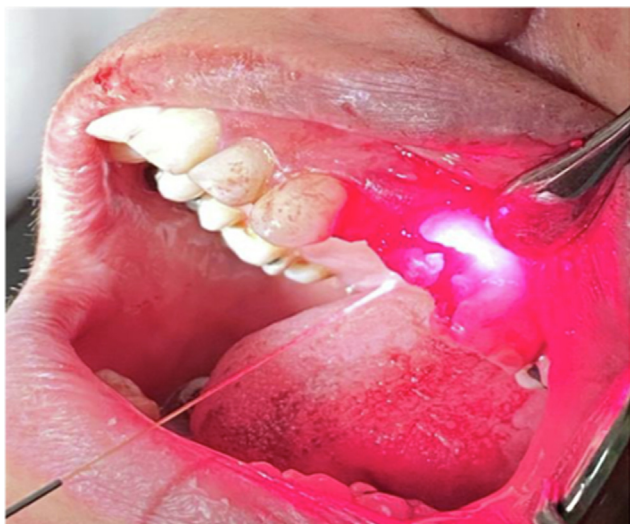


Fig. 2 Intraoral laser application.

rank test was implemented to analyze differences in pain levels on Days 1 and 2 for each group. A p -value < 0.05 was set as statistically significant.

4. Results

The Wilcoxon signed-rank test showed a significant decrease in the pain level on Day 2 for both groups ($Z = -3.61$, $p < 0.005$; $Z = -3.97$, $p < 0.005$, respectively). The mean levels of pain decreased for both treatments. However, the experimental group recorded a higher pain intensity than the control group (Fig. 3). Furthermore, the Mann-Whitney U test indicated that on Day 1, the pain level in the control group was significantly lower than in the experimental group ($U = 62.5$, $p = 0.024$). On the second day, pain levels were lower in the control group, but were not statistically significant ($U = 79$, $p = 0.102$).

It was noted that the use of Ibuprofen resulted in significant reduction of postoperative pain compared to the LLLT on the first day after the extraction. Both groups recorded no pain on the seventh day. The mean values of pain intensity are depicted in Table 1.

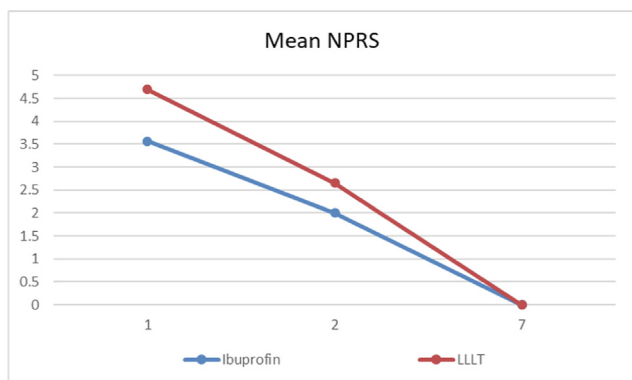


Fig. 3 Mean pain measurement of both groups over time.

Table 1 Descriptive statistics of postoperative pain.

	Day 1 Mean ± SD	Day 2 Mean ± SD	Day 7 Mean ± SD
Ibuprofen	3.6 ± 1.7	1.7 ± 1.4	0
LLLT (PBMT)	4.6 ± 1.9	2.3 ± 1.3	0

5. Discussion

This study was conducted to evaluate the effect of LLLT on postoperative pain after surgical dental extraction compared to the effect of Ibuprofen. If LLLT could replace routinely prescribed analgesics, it would have a significant effect on postoperative pain management by offering an alternative modality, especially for at-risk patients.

In contrast to most publications, this study found no significant reduction in pain intensity after surgical extraction. A recent review established the recommended PBM settings after tooth extraction at a wavelength of 650–980 nm, power of 4–300 mW, and energy density of 3–85.7 J/cm² (Hosseinpour et al., 2019). Due to varying reports on the effectiveness of PBM at different illumination parameters and the absence of a standard delivery protocol, apart from the wide range of available medical devices, it is difficult to ascertain why the results differ (Hamblin, 2016). However, most publications suggest that PBM is effective in pain reduction (Hosseinpour et al., 2019). Other factors that may influence patients' perceived pain level include the patient's tolerance, psychological factors such as anxiety and depression, demographical factors such as female gender and young age, and surgical factors such as excessive trauma and operation length of more than 3 h (El-Soud and El Shenawy, 2010).

Alan et al. studied the effect of the extraoral application of LLLT on postoperative pain, trismus, and swelling (810 nm, 300 mW, 40 s, and 4 J/cm²). LLLT was applied after the extraction, with the authors reporting no significant difference on the second day, with the laser group exhibiting a significant difference in pain level only on the seventh postoperative day (Alan et al., 2016). Similarly, López-Ramírez et al. (2012) investigated the impact of LLLT on pain after surgical extraction of bilaterally impacted lower third molars and reported no beneficial effect on pain reduction. However, investigations by Eshghpour et al. (2016) regarding the effect of LLLT on pain reduction after the extraction of symmetrically impacted mandibular third molars concluded that pain levels were significantly lower on the laser side compared to the placebo side.

The findings of this study are consistent with those reported by Amarillas-Escobar et al. (2010), who noted no significant reduction in the level of pain for both the control and irradiated groups, using the following settings: 810 nm, 100 mW, and 4 J/cm². Moreover, Farhadi et al. (2017) reported that using 550 nm LLLT in oral surgeries is not clinically helpful in decreasing pain.

The different outcomes of previous studies may be attributed to different laser penetration rates using various wavelengths, output power, duration, location, energy density, and pulse. Meanwhile, the findings in this study can be attributed to its small sample size, method of application, therapy duration, number of sessions, device model, and parameters.

6. Conclusion and suggestions

Considering the limitations of this study, the data suggest that LLLT has no significant effect on reducing pain after surgical tooth extraction compared to Ibuprofen. Accordingly, LLLT can be considered an alternative method of pain management.

Our recommendations for future research are to increase the sample size, apply LLLT for more than one session, and extend exposure duration under the recommended parameters (650–980 nm, 4–300 mW, 3–85.7 J/cm²).

Conflict of Interest Statement

The authors declare no conflicts of interest.

CRediT authorship contribution statement

Alaa Alqutub: Conceptualization, Project administration, Supervision. **Mona Rajeh:** Formal analysis, Supervision. **Sarah Almuwallad:** Project administration. **Haefa Alghamdi:** Project administration. **Nidaa Bifari:** Project administration. **Rahaf Aljabri:** Project administration. **Ruba Zainialmutwkkil:** Project administration. **Abdalmalik O. Ghandourah:** Writing – review & editing.

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