

Effect of Photobiomodulation therapy (PBMT) on post-operative pain after extraction of Impacted 3rd molar- a literature review

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Abstract: Pain and discomfort followed by removal of impacted 3rd molar is a common phenomenon. Also, in many occasions pain is accompanied by swelling and trismus. To control such post-operative signs and symptoms, many pharmacological aids been tried in the past and still in practice including analgesics, corticosteroids, etc. although the exposure to excessive biomolecules and the drug toxicity and adverse effects has to be taken into account. Also, the non-compliance from patients with drug intake is of importance in controlling post-operative inflammation. In recent times, Low-Level Laser therapies are in practice with vast application array. One among those is application of photobiomodulation (PBMT) through low level frequency laser therapy in controlling post-operative signs and symptoms. Many such

studies are conducted in past to evaluate the efficacy and effectiveness of the same and current review article focuses on the same to discuss further in narrative form.

Keywords: photobiomodulation, low-level laser therapy, extraction, swelling, pain.

Introduction: Impacted tooth removal is one of the most common procedures which endeavours to cure several distinct difficulties emerging due to its eruption, but surgical extraction of impacted 3rd molars is frequently associated with post-operative pain and discomfort.¹ Pain is at its peak 4-5 hours after the extraction as the effect of anaesthesia starts to fade off and it continues for the next couple of days and eventually diminishes over the seventh day. This pain is usually associated with swelling which commences 24 hours after the surgery that persist up to 4th or 5th day and trismus may or may not be accompanied.²

Numerous post-operative medicinal analgesics, corticosteroids and anti-inflammatory drugs (NSAIDs) are prescribed in order to subdue the pain, discomfort and reduce swelling post extraction of impacted 3rd molars,³ but some of these medications are prone to be responsible for many side effects on the gastrointestinal tract and causes irritation, allergic reactions and bleeding tendencies. Hence some adjunct or substitute must be established that helps relieve pain and swelling without any adversities.⁴ The choice of therapy is widely influenced by the intensity of pain hence pain evaluation should be measured. VAS (visual analog scale) and NRS (numeric rating scale) 101 are type of scales that aids in evaluation of pain. Estimation of the severity of pain makes it easier to assess the viability of the therapy.⁵

Modern dentistry deals with provision of assistance and treatment that enables the best results with minimal extent of discomfort to the patient.⁶ Lasers are the technology that serves this purpose in the elite possible way. The overview about lasers in dentistry was first put forth by Miaman in the year 1960.⁷ Although the field of lasers has its prevalence in dentistry for about a few decades now, but has been breaking grounds since past 6-7 years.⁷ The aim of this review is to study the application of photobiomodulation therapy (low level laser therapy) in reducing post-operative pain and discomfort. Photobiomodulation (PBM), Laser phototherapy (LPT), biostimulation therapy (BT), and low-intensity laser treatment (LILT) are other names for LLLT.⁸

Low-level lasers (LLL) emit short-wavelength red or infrared light that can reach a depth of 3 mm to 15 mm in both soft and hard tissues and stimulates the body's cells by delivering direct biostimulation light energy to them.⁸ At lower dosages (2J/cm²) application of lasers stimulates proliferation while at higher dosages (16J/cm²) it is suppressive.⁹ The lasers used for this purpose are GaAlAs of 810nm intraorally which helps in reducing postoperative pain.¹⁰

Photobiomodulation(PBM) therapy was accidentally encountered while treatment of cancerous cells using ruby laser which is a 3 level solid state laser and it was randomly found to expedite wound healing rather than killing the tumor cells and this in turn gave rise to the concept of photobiomodulation.¹¹ Subsequently, after further researches, laser therapy marked its foot in dentistry by its numerous applications in wound healing procedures, aphthous stomatitis, mucositis, neural regeneration, postherpetic neuralgia, synovitis, arthritis, temporomandibular joint pathology, acute abscesses, periapical granulomas, chronic orofacial pain, and bone regeneration.¹⁰

Mechanism of Photobiomodulation in relieving pain:

PBM (photobiomodulation) pain relieving impacts are acquired by inducing the synthesis of endogenous endorphins (β -endorphin) which occurs by confining the C-fibres activity and bradykinin generating analgesic effect, diminishing the cytokines and enzyme like compounds, adjusting the pain aggravation limit, prompting morphological neuronal changes, lessening the mitochondrial layer potential, and hindering the quick axonal stream prompting brain conduction blockage.^{10,12} The calming anti-inflammatory impact is because of an increment of the phagocytic action, the number and measurement of lymphatic vessels, decline in the porousness of veins and vessels and reclamation of micro-capillary circulation, normalising the penetrability of the vascular divider, and diminishing the edema.¹⁰

Certain in vivo studies based upon analgesic effect of photobiomodulation on the nerves supplying the oral cavity states/asserts that the firing frequency of the nociceptors are reduced by photobiomodulation, with the threshold effect seen in terms of the irradiance required to exert maximal suppression.¹³ One such study claims that ,for successful pain relief or analgesia post extraction of impacted 3rd molar or any surgical procedure the appropriate wavelengths used ranges between 632nm and 904nm.⁹Lasers having wavelength of 810nm are considered as the most versatile ones in comparison to others due to its remarkable application in analgesia, soft tissue surgery, periodontology, endodontics, implantology and tooth whitening.¹⁴

Efficacy of PBM in pain:

Table 1 represents 9 clinical studies reporting reduction in pain and swelling and 2 studies reporting only pain reduction , when lasers were used both intraorally as well as extraorally having parameters of 810 to 1064nm and power of approximately 100-500mW, 4 studies reporting no statistical difference in pain reduction where the lasers having wavelength of 550, 660 and 810nm but combined with different powers and energies.

Table 1. Clinical studies showing varying outcomes after Photobiomodulation therapy.

SI No.	Author and year of publication	Laser wavelength	Laser power	Results
1.	Ferrante et al. (2013) ²	980 nm	300 mW	Reduction in pain and swelling
2.	Hamid et al. (2017) ¹⁰	810 nm	100 mW	Reduction in pain
3.	Landucci et al. (2016) ¹⁵	780 nm	10 mW	Reduction in pain and swelling
4.	Asutay et al. (2018) ¹⁶	810 nm	300 mW	Reduction in pain and swelling
5.	Feslihan et al. (2019) ¹⁷	810 nm	300 mW	No significant difference
6.	Santos et al. (2020) ¹⁸	780 nm	70 mW	Reduction in pain
7.	El Saeed et al. (2020) ¹⁹	980 nm	500 mW	Reduction in pain and swelling
8.	Girismk et al. (2021) ²⁰	980 nm	100 mW	Reduction in pain and swelling
9.	Biaanchi de Moraes et al. (2020) ²¹	660 nm	30 mW	No significant difference
10.	Hadad et al. (2021) ²²	810 nm	100 mW	Reduction in pain and swelling
11.	Fraga et al. (2020) ²³	808 nm	100 mW	Reduction in pain and swelling
12.	Tuk et al. (2017) ²⁴	660 nm	198 mW	No significant difference
13.	Farhadi et al. (2017) ²⁵	550 nm	100 mW	No significant difference
14.	Scarano et al. (2021) ²⁶	1064 nm	1000 mW	Reduction in pain and swelling
15.	Gururaj SB et al. (2022) ²⁷	810,660 nm	100 mW	Reduction in pain and swelling

Furthermore, a collection of systematic reviews of clinical trials revealed that the PBMT does have positive effects on pain after tooth extraction.²⁸ Patients were evaluated by a visual analog scale (VAS) both on the 2nd and 7th day following the extraction where substantial changes such as pain depletion and diminished swelling were observed.²⁹ A trial study stated that there was significant reduction in pain post two days of the surgical procedure where in the patients were in constant assessment of pain for 6, 24, 48 hours after the extraction.^{30,31} Statistically significant results were obtained on application of laser possessing wavelengths in the range of 660-905nm,³² moreover lasers falling in the infrared category ranging from 780nm to 904nm with a power output of 100mW proved to show excellent outcome due to its greater tissue penetrating and healing property.^{33,34,35,36} Further study indicated success when patients were operated with 780 nm and 810 nm wavelength.³⁶ According to statistical implication, application of these lasers intraorally exhibited far more superior results as opposed to extra-oral usage.³³ In addition to this, photobiomodulation therapy has also proved to supplement the impact of NSAID's and promote & accelerate healing of soft tissue and bone following third molar extraction surgery, therefore curtailing potential complications.^{15,37,38} In contrast to these results there are also a few reviews and meta-analysis that found no difference in pain reduction on statistical inspection.^{39,40,41} which may imply that pain evaluation is a relative concept that depends upon patient's threshold and differs from person to person.³³

Conclusion: Recovery of the patients post-surgical procedures is usually accompanied with pain and discomfort. This review includes certain studies stating that although surgical extraction of impacted 3rd molars is a complex procedure which involves extensive post-operative pain and inflammation due to bone guttering technique; the use of PBM therapy after extraction can alleviate pain and swelling and also works as an adjunct to analgesic therapy after extraction. However further standardised studies and randomized clinical trials would serve to better advice patients and doctors about the use of PBM after undergoing extraction of impacted 3rd molars.

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