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Effect of Low-Level Laser on The Pain PerceptionFollowing Dental Extraction

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Abstract

The goal of this study was to determine the effectiveness of a single dose of low-level laser therapy (LLLT) on the pain of patients after tooth extraction. Thirty patients in total were divided into two treatment groups. Each group consists of fifteen patients. Group A received a single dose of LLLT 20 minutes after tooth extraction with (0.3 W, 30 sec, 9 J/cm2) diode laser. The irradiation was extra-orally 1 cm away from the site of interest. Group B is the control group. The patients' level of pain was assessed. Visual analog scale (VAS) was utilized to quantify pain intensity in the 2nd and 7th days after extraction. Results indicated that (Group A) had significantly decreased VAS values than (Group B) on postoperative day 7. The current study suggested that there is a significant effect of single dose (LLLT) on lowering pain following tooth extraction.

Introduction:

The term (Laser) is an expression of light amplification through the stimulated emission of radiation. It is a device that generates a high intensity, seemingly parallel beam of monochromatic electromagnetic radiation (single wavelength) (1). According to (Albert Einstein) prediction back in 1917, photoelectric amplification might produce a stimulated emission or single frequency. This prediction set the foundation for the invention of the laser and its progenitor, the maser.

Theodore Maiman created the world's first operational laser by combining helium and neon. A laser made of Yttrium aluminum garnet crystals coated with (1 to 3%) neodymium (Nd: YAG) was created in 1961. While in 1962 argon laser was invented. In 1963, the ruby laser was the 1st laser to be used in the medical field and showed the ability to coagulate retinal lesions. Patel at Bell Laboratories created

the Carbon dioxide (CO2) laser in 1964, which is commonly used in dentistry nowadays (2). Laser is a monochromatic form of light with a single wavelength. A laser device is composed of three major components: a source of energy, an optical resonator made up of two or more mirrors and an active lasing medium. A pumping mechanism, such as a flash-lamp strobe device, supplies energy to the laser system so that amplification can take place. An optical resonator is used to pump this energy into an active medium, which causes photons to spontaneously emit. Then, as photons are reflected back and forth through the medium by the optical resonator's highly reflective surfaces before leaving the cavity via the output coupler, amplification by stimulated emission takes place (2). Target tissue can respond to a laser's light energy in four different ways, depending on the tissue's optical qualities and the wavelength used. (3), (4) When laser light strikes the tissues, it can be reflected, scattered, absorbed, or transmitted to adjacent tissue. Absorption significantly influences the amount of reflection, scattering, and transmission that occurs; wavelength is the key factor of absorption. The CO2 laser wavelength is uniformly absorbed by most materials and tissues, but Nd-YAG laser wavelengths are absorbed preferentially by pigmented tissues. The wavelength, power, waveform, optical qualities, and thermal parameters of the tissue all contribute to the initial tissue effect (5). Lasers used in dental practice include: (Carbon Dioxide Laser) owing to the laser wavelength's high affinity for water, it is capable of rapidly removing soft tissue and achieving hemostasis with little penetration depth. Although the CO2 laser has the highest absorption rate of any other laser, its disadvantages include its relatively large size, being expensive, and harmful interactions with hard tissue. (6) Neodymium Yttrium Aluminum Garnet Laser is another type of laser that's used in dentistry, Due to the great absorption of (Nd: YAG) laser wavelengths by the pigmented tissues, it is a highly efficient surgical laser for oral soft tissues cutting & coagulation with excellent hemostasis (2). Another type is known as (Erbium Laser) Erbium lasers are classified into two wavelength families: Er, Cr: YSGG (yttrium-scandium-gallium-garnet) and Er, YAG (yttrium-aluminum-garnet) (7). Also, there is (Diode Laser) the diode laser's active medium is a semiconductor with solid state comprised of arsenide, gallium, aluminum, and indium are occasionally used., which produces electromagnetic waves of about 810-980 nm (8). A relatively new area of medicine called low level laser therapy (LLLT) employs low-power lasers to stimulate and improve cell function or to treat pain. Numerous studies have shown how effective LLLT is at reducing pain and swelling, enhancing nerve function, encouraging revascularization, and accelerating the healing of wounds (9,10).

Dental extraction (also termed tooth extraction, exodontia, or exodontias) is the process of removing teeth from the dental alveolus (socket) in the alveolar bone (10). The last step of treatment for severe oral disorders is tooth extraction. Despite the fact that there are many causes for tooth extraction, gum disease and tooth decay are the most prominent globally (10).

While tooth extraction techniques can be simple or surgical, performing tooth extraction requires paying attention to a series of rules inherent in all surgical practices. However, even with excellent knowledge of the patient and mastery of the surgical method, many operations can result in unpredictable problems that can emerge during or after the intervention. (10) According to the study by (Miclotte et al.), the three most common complications following tooth extraction were wound infection (2%), unexplained pain (1%), and oroantral communication (1%). Additionally, they reported that patients who had their third molar removed had a higher risk of complications than those who had only simple tooth extractions (11). Regarding the impact of laser therapy on lowering the potential complications following tooth extraction, there are a few contentious reports. Studies have shown that using a laser after the surgical extraction of impacted third molars in the lower jaw can help to reduce pain, swelling, and trismus. Other studies showed that the use of LLLT

accelerated bone mineralization and healing in the sockets of rats exposed to diode laser radiation (12).
However, some studies found no additional advantages of using low-level lasers over a placebo in a number of conditions, including relieving pain after the extraction of primary 24 and permanent 25 teeth and reducing pain and swelling after third molar surgery (13), (14). The previous study was carried out to investigate LLLT's effectiveness in reducing discomfort and speeding up the healing of the tooth socket following the removal of lower molar teeth (15).

Aims:

The purpose of this study is to determine the single dose's effectiveness ofLLLT on postoperative extraction pain.

Materials and Methods:

A total of 30 patients, aged 18 to 30 years were invited into the trial; each subject signed a consent form after being informed of the potential risks associated with both the experimental procedure and tooth extraction.
The 30 patients fulfilling the inclusion criteria had the following characteristics: age range of (18 to 30) years old, apparently healthy, any tooth indicated for extraction. Whereas exclusion criteria included contraindications to laser therapy, systemic illness, local infection, tobacco usage, oral contraceptive use, and pregnancy.
A case-control study was conducted in which patients were randomized into two treatment groups, each with 15 patients: an experimental group (laser) referred to as **Group A**; and a control group (receiving no-laser), which is referred to as Group B.
All patients were treated at the educational clinics at Tikrit University, College of Dentistry, Department of Surgery, in order to remove the teeth indicated for extraction by the surgeon.
The dentist who administered the Low level laser therapy (LLLT) to patients in **Group A** was different from the surgeon.
During this trial, Group A received LLLT, and **Group B** received only routine management. The laser was administered extraorally, 1 cm away from the area of involvement by using a ruler, 20 minutes following tooth extraction.
The EpicX (diode laser) device with a continuous wavelength of 940 nm was utilized in this study; its power was set at 0.3 W and the energy level was adjusted to 9J for 30 seconds.
After the procedure, a visual analog scale (VAS) of 10 points was utilized to assess pain level. The scale ranged from 0 (no discomfort) to 10 (very severepain) (16).

Results:

In the current experiment, a (0.3 W, 30 sec, 9 J/cm2) diode laser device was used extra-orally, according to our analytic study between all values of VAS for patients from (group A & group B) 2 & 7 days after extraction & after LLLT applications results appear as shown in Table (1), and (2) : One-way ANOVA: 2D.EX., 7D.EX., 2D.LLLT., 7D.LLLT

Group A demonstrated significant reduction in pain intensity in the 2nd and the 7th postoperative days.
Those in **Group A** reported less discomfort at the LLLT-treated area than patients in Group B. Results showed that the 940 nm diode laser has great significance in accelerating the healing of the extraction area.
Although single dose has beneficial effects on reducing the severity of pain, a substantial decrease in pain was only observed on the 7th postoperative day.
Whereas in **Group B**, receiving merely routine care with ice application and analgesics if necessary, patients reported periods of pain and some experienced dry socket

Discussion:

In the early 1970s, LLLT was originally used in the field of dentistry and oral surgery, and since then has spread to a variety of medical specialties (17). Overall, our findings indicate that low-level laser therapy promotes wound healing and reduces pain and discomfort post surgically. This result is consistent with many other studies that reveal that low-level laser therapy accelerates wound

healing after tooth extraction (2), (12), (15). Koparal et al. (18) has reported that the results of their study have shown that LLLT was effective in reducing pain intensity only on day seven following surgery. Ferrante et al. (17) demonstrated that LLLT was effective in reducing swelling and postoperative trismus after third molar surgery.

On the other hand, these results are the reverse of other studies that indicated no advantages to using low-level lasers in a number of situations, such as reducing pain after tooth extraction (13,14). López-Ramírez et al. (19) reported that LLLT (GaAlAs; 810 nm; energy density of 5 J/cm2) had no beneficial effects in reducing pain following tooth extraction. Another study carried out by Amarillas-Escobar et al. (20) In order to evaluate the therapeutic effect of LLLT, no significant differences in pain reduction were seen in either the laser-treated or control groups, and these findings might be the consequence of incorrect laser parameters being used in the experiments.

Conclusions:

Under the conditions employed in this study, LLLT with a 940 nm with (0.3W, 30 s, and 9J/cm2) had a significant impact on pain relief and wound healing speed following tooth extraction.

Ethical Considerations:

The treatment procedure was discussed properly with the patients, and written consent was obtained before the study.

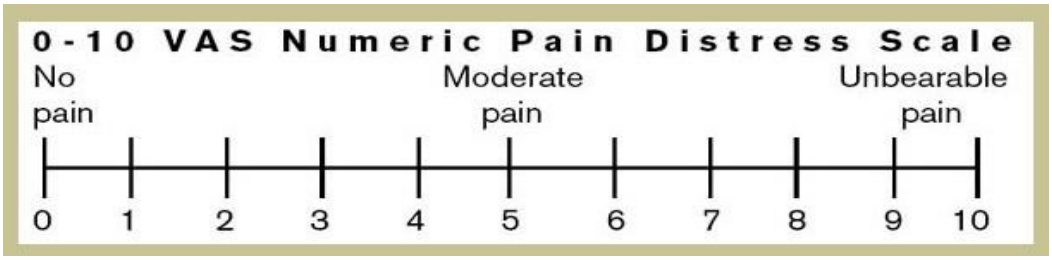

Figure (1): Visual Analogue Scale to measure for pain. (18)

Patients were instructed to keep track of their pain intensity during thepostoperative period (2–7 days).

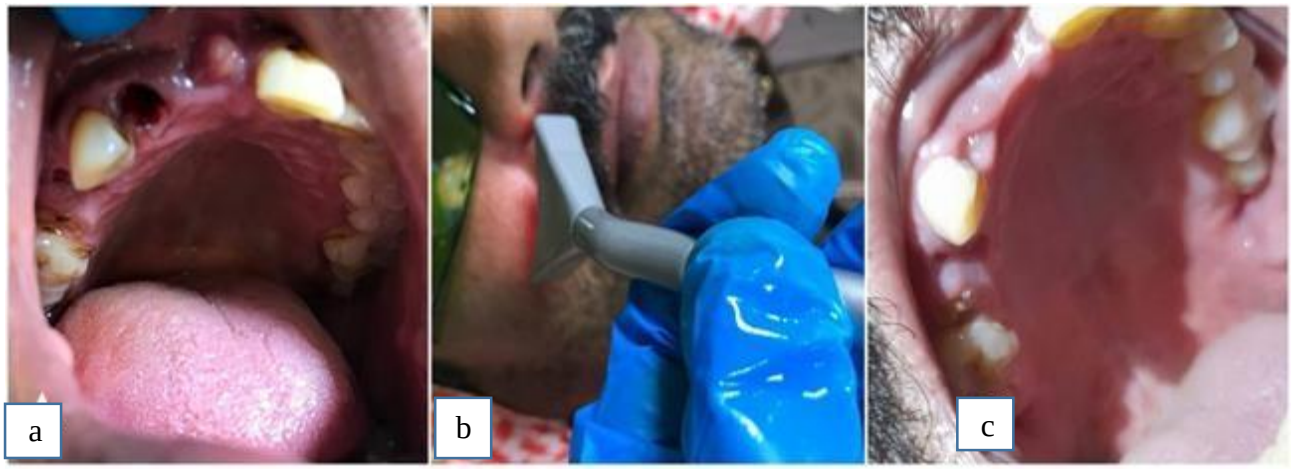

Figure (2): Showing a patient from Group (A) which received LLLT. (a) Showing the initial situation of the socket. (b) Is during LLLT Administration. Whereas (c) is 7 daysafter LLLT which shows complete healing of the socket.

Whereas in Group B, receiving merely routine care with ice application and analgesics, if necessary, patients reported periods of pain and some experienced dry socket

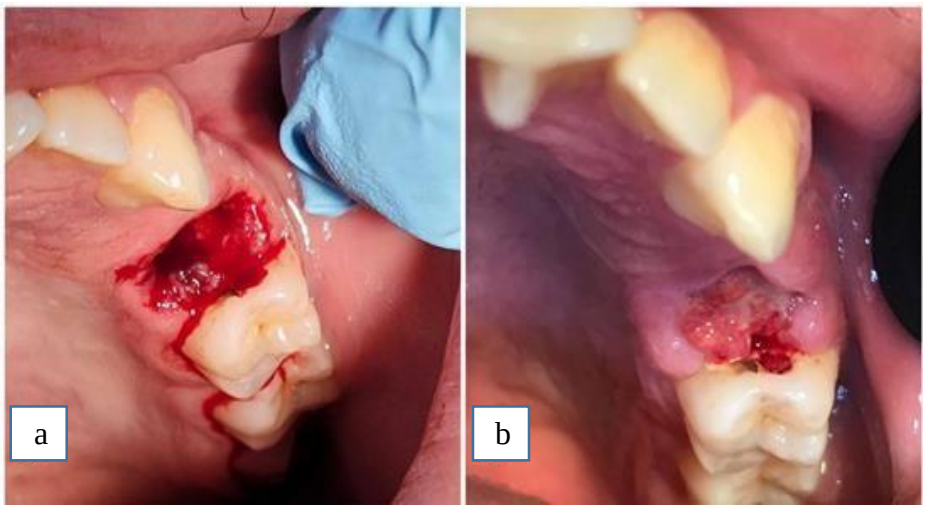

Figure (3): Showing a patient from Group (B) which received routine management only. (a) Showing the initial situation of the socket. Whereas (b) Showing the socket 7 days afterroutine care only.

Table (1): The Means

Factor	N	Mean	StDev	95% CI
2 Days. A	15	4.000 b	0.845	(3.595, 4.405)
7 Days. A	15	1.933 c	0.799	(1.529, 2.338)
2 Days. B	15	6.133 a	0.743	(5.729, 6.538)
7 Days. B	15	4.400 b	0.737	(3.995, 4.805)

Pooled StDev = 0.782243 the same letters mean no differences between them.

Table (2): Variance Analysis

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	133.92	44.6389	72.95	0.00004
Error	56	34.27	0.6119		
Total	59	168.18			

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