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The effect of 980 nm diode laser in relieving the periodontal pocket symptoms: a clinical study

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The Effect of 980 nm Diode Laser in Relieving the Periodontal Pocket Symptoms: A Clinical Study

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Abstract

Introduction: **Periodontal Pockets are pathological spaces located between the teeth and the adjacent soft tissue. Some Periodontal pockets asymptomatic, while others my have significant symptoms. Patients with active periodontal pockets may feel pain, bleeding and swollen gingiva (adjacent to pocket). These symptoms appear because of a microbial invasion to this space and the accumulation of food debris.**

Objective: **This study aims to explore the effect of diode lasers in relieving the symptoms of active periodontal pockets.**

Materials and methods: **The method is based on irradiating the active periodontal pocket by using 980 nm diode laser and recording the condition of the patients before and after laser therapy. Ten patients visited the dental clinic suffering from various degrees of pain, bleeding, gingival swelling, and bad odor (active periodontal pocket symptoms). All those patients were subjected to the same laser protocol. The laser beam was used to irradiate the infected periodontal pocket to eradicate the microbes, removing the infected epithelial lining, and enhance tissue healing. All the patients came to the dental clinic two weeks later for evaluation.**

Results: **The diode laser showed good results in relieving the pain and reducing gingival swelling and bleeding with about 90% of the patients feeling better. Nine patients felt no pain after laser therapy, the gingival swelling and bleeding started to decrease gradually and disappeared completely after 15 days.**

Conclusion: **Based on the results of this study, the diode laser was a good choice for relieving active periodontal pocket symptoms.**

Keywords: Bleeding, Dental clinic, Diode laser, Pain, Periodontal pocket

Introduction

The periodontal pocket is a space located between the teeth and the surrounding gingival tissue. This space may be filled by bacteria, food debris and a lot of microorganisms causing local infection This space may deepen and extend apically causing damage to the surrounding periodontium (Gehrig et al., 2020).

There are many types and classifications for the periodontal pockets, according to its depth, location, bone damage, attachment loss, and whether it is associated with symptoms or not (Gehrig et al., 2020).

On clinical examination, there is an increment in the probing depth (exceeding 2 mm). The signs and symptoms of active pocket include pain, discomfort, bad odor, bleeding, and swollen red gingiva (Bathla, 2021).

There are some cases where surgical treatment of the active periodontal pocket should be postponed, delayed, or contraindicated for various reasons. Here comes the need for soothing therapy, and the laser is promising option.

Laser is an acronym for (light amplification by stimulated emission of radiation) there are many types and classifications for lasers with different properties and uses. The diode laser is a semiconductor laser invented by Robert N. Hall in 1962. The lasing mechanism is based on pumping the diode with an electrical current, and the lasing will occur. The diode laser is available with different wavelengths (Hideaki, 2020).

There are a lot of applications for the laser in dentistry and medicine. Pain relieving and soothing is one of the important uses of the laser. The 980 diode laser has been widely used for such purposes (Nadhreen et al., 2019).

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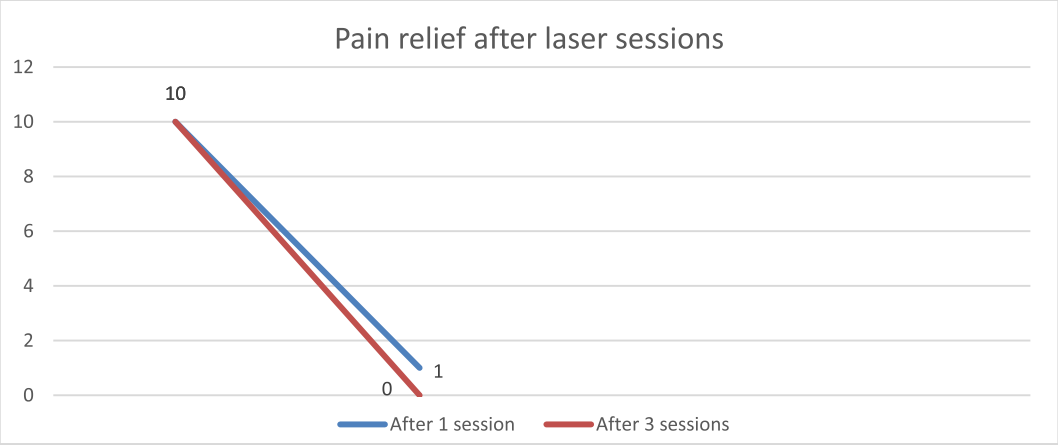

Fig. 1. Graphic chart shows number of patients who felt better after laser therapy. The 1st group represented by blue line, from total of 10 patients, 9 patients felt better after one session of treatment and only one have not. The 2nd group represented by red line. All patient felt better after 3 sessions.

The laser used in pain relief id called low-level laser, which means that it has very little energy with no damaging thermal effects on the native tissues. The mechanism of the laser relieving effect can be explained on the basis of the low-level laser interaction with the gingival tissue cells. There are photo-acceptors that will absorb the laser light, and the absorbed light will make some changes inside the cells by enhancing certain chemical reactions (Nambi, 2021).

There are direct reactions that occur immediately during laser irradiation, these reactions will change the redox status of the cell and lead to oxidation or reduction (Hassan et al., 2021).

The other reactions happen after laser irradiation. These reactions affect protein synthesis inside the cell, leading to increase cellular reproduction and the formation of new cells (Dompe et al., 2020).

The other mechanism of laser pain relief is by eradicating the periodontal pocket bacteria that invade and habitat the sulcular epithelium. Those bacterial accumulations deposit toxins and metabolic byproducts inside the native tissue and causes inflammation (Chen et al., 2019).

The laser beam will destroy the colonies of the pathologic bacteria and reduce the number of colonies to the minimum level. The infected sulcular epithelium will also be removed during this process (Mokhtari et al., 2021).

The goal of this study is to explore the relieving effect of the diode laser on active painful pockets.

Materials and method

1) Patient selection

Ten patients were subjected to laser treatment, 7 males and 3 females, their ages range from 28 to 40 years old. All those patients have at least one active periodontal pocket (pain, bleeding, bad odor) at the time of the treatment. The probing depth was at least 5 mm in all cases. All calculus has been removed prior to laser treatment. All the patients advised to keep brushing at least twice daily and have been told to avoid using antibiotic before laser treatment. The excluded patients were: Those with systemic disorders, pregnant females, smokers, old ages (above 60 years), mouth breathers, and patients with ill-fitted crowns and restorations. All those patients were excluded because of their medical status that may interfere with the result of the treatment.

2) Laser device technical specifications

The treatment was done using H1 diode laser machine (PIOON Technology Co. Ltd, China). This device has 1.5 Meter optical fiber with 400 μm diameter. The device generates a laser beam with 980 Nanometer and a maximum power 10 Watts. The laser beam could be used in continuous mode or pulsing mode.

3) Laser parameters

All the pockets were irradiated by the laser beam with 980 nm wavelength and 2.5 Watts output power in pulse mode. The pulse duration was 20 ms and the frequency was 25 Hz.

4) Working method

The tip of the optical fiber was inserted into the periodontal pocket and the laser was activated. All sides of the tooth were irradiated individually (buccal, palatal or lingual, mesial, distal). The optical fiber moved vertically on the root surface parallel to

the long axis of the tooth. The movement started from the apical direction and continued coronally in a sweeping motion. The average laser exposure time was 4 s for each side of the tooth, with more time in the deep pockets and less time in shallow ones.

Results

Nine of the patients that participated in this study showed significant pain relief (various degrees of relief) after one session of laser treatment. The severity of pain decreased to the minimum (or no pain at all). All the results were recorded after 48 h of the treatment. No need for analgesics was reported. The patients still complained of some discomfort in the pocket during eating after laser session with very little pain. No patient felt pain after 3 sessions of treatment (as shown in the Fig . 1 below). The other symptoms (bleeding on probing, bad odor) were disappeared gradually after laser treatment along with patient commitment to oral hygiene instructions.

Discussion

This study aims to show the relieving effect of the 980 nm diode laser. The laser in dental field is a very promising and valuable tool in various surgical and therapeutic modalities. The ease of delivery of the laser beam inside the periodontal pocket and its powerful made it a very successful method of treatment.

Decreasing pocket depth means less space for the pathogenic bacteria to grow. It is proof that the pathogenic invaders were eradicated and that the periodontal tissues regenerated, again. Samir Nammour et al. tested the 980 nm diode laser as a non-surgical treatment for the periodontal pocket and the result showed significant improvement (decreasing pocket depth, pain relief) (Nammour et al., 2021).

Gingival bleeding is one of the first signs of inflammation. Diminished bleeding after laser irradiation gives a clue that the inflammatory response has disappeared. Dagmar E. Slot et al. used the thermal effect of the 980 nm diode laser for periodontal pocket debridement (bacterial eradication and pocket lining removal) and achieved good results in pain relief and decrease bleeding (Kamatham & Chava, 2022).

The infected sulcular epithelium is the habitation of the pathogenic microorganisms that cause periodontal infection, and the removal of this habitation is important to promote healing. George E. Romanos examined the ability of 980 nm diode laser in removing infected sulcular epithelium in animal experimental models. He examined the soft tissue biopsies under the microscope and found that the laser was very effective in the removal of all the infected lining of the pockets without any damages to underlying connective tissue (Romanos et al., 2004).

The pathogenic bacteria are the main cause of the pain in the periodontal area, and decreasing the number of these bacterial colonies will return the tissue to its normal condition. To prove that, Mirjana Gojkov-Vukelic et al. used 980 nm diode laser to irradiate the pockets of 24 patients and tested the bacterial load in those pockets before and after irradiation by using real time PCR method. According to their results, the bacterial load was effectively decreased and the symptoms of the active pockets were relieved (Gojkov-Vukelic et al., 2013).

Despite all these benefits, there is some risks and limitations when using laser as a therapeutic tool (even if they are rarely reported). Charles M. Cobb et al. said (in an article published in 2012) that irradiation of periodontal pockets by diode laser may put the root surface in risk of heat-induced surface fracturing and crazing (regardless of the laser power setting) which in turn affects the vitality of the tooth. He irradiates an extracted tooth with different power sets of diode laser (0.5–2 Watt) and examined this tooth under SEM. He found multiple heat-affected areas and concluded that the laser may jeopardize the pulp vitality and damage the periodontium (Cobb et al., 2012).

Conclusion

With all limitations of this study, the results refer to the efficiency and importance of 980 nm diode laser in relieving periodontal pocket pain by reducing the bacterial load and removing the infected sulcular epithelium. Also, the laser is very technique-sensitive. Any improper use of the device setting or treatment method will cause adverse side effects such as severe pain and necrosis.

Ethics approval and consent to participate

This study was conducted in the National University of Science and Technology, Dhi-Qar, Iraq, between October 2022 and March 2023. All subjects participated voluntarily in this study and received a small compensation. The study was approved by the College of Dentistry, National University of Science and Technology, Dhi-Qar, Iraq.

Data availability

The authors confirm that the data supporting the finding of this study are available within the article.

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Authors' contributions

Both authors contributed equally to the design and implementation of the research, to the practical work, to the analysis of the results, and to the writing of the manuscript.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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