Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 91.86

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Effectiveness of Low Laser Level Therapy in Oral and Maxillofacial Disorders: An Original Research

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ABSTRACT:
Background: Oral and maxillofacial disorders encompass a wide range of conditions that significantly affect patients' quality of life. This original research aimed to investigate the effectiveness of low-level laser therapy (LLLT) in the management of oral mucositis, temporomandibular joint (TMJ) disorders, and postoperative pain following maxillofacial surgeries. **Methods:** A prospective, randomized, controlled design was employed, including 120 participants aged 18-65, diagnosed with oral mucositis, TMJ disorders, or postoperative pain. Participants were randomly assigned to receive 10 LLLT sessions or serve as controls. LLLT parameters included a 660 nm wavelength, 100 mW power output, 5-minute treatment duration, and daily sessions. Outcome measures included mucositis severity, pain levels, oral function, TMJ pain, jaw range of motion, and quality of life. Statistical analysis was performed using t-tests or non-parametric equivalents. **Results:** LLLT significantly reduced oral mucositis severity, pain levels, and improved oral function. In TMJ disorders, LLLT led to decreased pain levels, increased jaw range of motion, and improved quality of life. Postoperative pain was substantially reduced with LLLT, accompanied by lower rescue analgesia usage and high satisfaction with pain control. **Conclusion:** LLLT demonstrated significant potential in the management of oral and maxillofacial disorders, with improvements in symptom severity, pain levels, and quality of life. This non-invasive and well-tolerated modality holds promise for enhancing patient outcomes and warrants further exploration in clinical practice.
Keywords: Low-level laser therapy, oral mucositis, temporomandibular joint disorders, postoperative pain, effectiveness.

Received: 16 October, 2021 Accepted: 22 November, 2021

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This article may be cited as: Neha, Cherukuri P, Kurtadikar KJ, Bajwa G, Tiwari R, Dixit H. Effectiveness of Low Laser Level Therapy in Oral and Maxillofacial Disorders: An Original Research. J Adv Med Dent Scie Res 2021;9(12):206-210.

INTRODUCTION

Oral and maxillofacial disorders represent a diverse spectrum of conditions that affect the structures of the mouth, face, and neck. These conditions can encompass a wide range of pathologies, from benign oral mucosal lesions to severe maxillofacial trauma. Such disorders often lead to substantial discomfort, impaired oral function, and diminished overall quality of life for affected individuals. Effective treatment approaches are essential to alleviate symptoms, promote healing, and restore normal function [1-3].

One emerging modality that has attracted significant attention in the field of oral and maxillofacial medicine is low-level laser therapy (LLLT). LLLT, also known as photobiomodulation therapy, is a non-invasive, low-risk, and painless treatment option that utilizes low-energy laser or light-emitting diodes to stimulate biological processes at the cellular level. It has gained recognition for its potential to modulate inflammation, accelerate tissue repair, reduce pain, and enhance tissue regeneration. LLLT's application in various medical disciplines has shown promise, and

its utility in oral and maxillofacial disorders is a topic of growing interest [4-6].

The primary objective of this original research is to investigate the effectiveness of LLLT in managing three distinct categories of oral and maxillofacial disorders: oral mucositis, temporomandibular joint (TMJ) disorders, and postoperative pain following maxillofacial surgeries. These conditions were chosen due to their prevalence and the potential benefits LLLT may offer in their management. This research intends to contribute to the expanding body of evidence surrounding the use of LLLT in oral and maxillofacial medicine [4-9].

Oral Mucositis: Oral mucositis is a common and distressing side effect of chemotherapy and radiation therapy for cancer. It results in painful ulcerations and inflammation of the oral mucosa, compromising oral intake and the patient's overall well-being. Conventional treatments for mucositis are often limited in their efficacy, making the search for alternative, effective modalities crucial.

Temporomandibular Joint Disorders: Temporomandibular joint disorders, encompassing a range of conditions affecting the TMJ, manifest as pain, joint noises, and restricted jaw movement. They can significantly impair a patient's ability to chew, speak, and maintain proper oral hygiene. The complex and multifactorial nature of these disorders has made their management challenging, with a need for non-invasive, pain-relieving interventions.

Postoperative Pain: Following maxillofacial surgeries, patients commonly experience postoperative pain, which can be severe and limit their ability to resume regular activities. Effective pain management is paramount for postoperative recovery and patient satisfaction. LLLT offers a potential solution in this context by promoting tissue healing and reducing discomfort.

The utilization of LLLT in managing these conditions is underpinned by the principle that specific wavelengths of light energy can stimulate cellular processes, such as increasing the production of adenosine triphosphate (ATP), enhancing blood flow, and modulating inflammation. These effects may collectively promote tissue repair, reduce pain, and improve overall outcomes in patients with oral and maxillofacial disorders [6-10].

In addition to exploring the effectiveness of LLLT for these specific conditions, this research will also consider the safety and tolerability of LLLT in the oral and maxillofacial region. Addressing the safety profile of LLLT is crucial, as adverse effects could outweigh potential benefits, and ensuring patient well-being is paramount.

As the utilization of LLLT in oral and maxillofacial medicine is a relatively novel concept, this research aims to contribute to the existing body of knowledge by providing valuable insights into the potential of LLLT as a non-invasive, effective, and well-tolerated therapeutic option. By examining these three distinct areas of application, this study seeks to not only benefit patients suffering from oral and maxillofacial disorders but also guide healthcare practitioners in making evidence-based decisions regarding the incorporation of LLLT into their treatment protocols.

MATERIALS AND METHODS

Study Design: This original research employed a prospective, randomized, controlled design to investigate the effectiveness of low-level laser therapy (LLLT) in managing oral and maxillofacial disorders. The study adhered to the principles outlined in the Declaration of Helsinki and received ethical approval from the Ethical Committee Name.

Participants: The study included a total of 120 participants, aged between 18 and 65, who were diagnosed with one of the following conditions: oral mucositis, temporomandibular joint (TMJ) disorders, or postoperative pain following maxillofacial surgeries. Participants were recruited from a tertiary care hospital and dental clinics. Written informed consent was obtained from all participants, and they were randomly assigned to either the LLLT group or the control group.

Low-Level Laser Therapy Parameters: The LLLT protocol utilized in this study consisted of the following parameters:

1. **Wavelength:** A diode laser with a wavelength of 660 nm was used.
2. **Power Output:** The laser delivered 100 mW of power.
3. **Duration of Treatment:** Each LLLT session lasted for 5 minutes.
4. **Frequency of Treatment:** Participants received LLLT daily for a total of 10 sessions.
5. **Spot Size:** A 3 mm spot size was used for laser application.
6. **Application Technique:** The laser was applied in direct contact with the affected area.
7. **Total Number of Sessions:** Each participant received 10 LLLT sessions.

Outcome Measures: The effectiveness of LLLT was assessed using the following outcome measures:

1. **Oral Mucositis:** For participants with oral mucositis, the severity of mucositis was evaluated using the WHO Oral Toxicity Scale. Pain levels were assessed through a VAS, and the impact on oral function was measured using the FOIS.
2. **Temporomandibular Joint Disorders:** For participants with TMJ disorders, pain levels and joint function were evaluated through a VAS, jaw range of motion measurements, and clinical assessments of joint noises and crepitus. Quality of life was assessed using the TMD-PDQ.
3. **Postoperative Pain:** Participants undergoing maxillofacial surgeries were assessed for postoperative pain levels using a VAS. The need for rescue analgesia and overall satisfaction with pain control were recorded.

Randomization and Blinding: Participants were randomly assigned to the LLLT group or the control group using computer-generated randomization. Due to the nature of the intervention, blinding of participants and therapists was not feasible. However, outcome assessors were blinded to group allocation to minimize bias.

Statistical Analysis: Descriptive statistics were used to summarize participant demographics and baseline characteristics. For continuous variables, means and standard deviations were calculated, and categorical variables were summarized using frequencies and percentages. To compare the effectiveness of LLLT, independent t-tests or non-parametric equivalents were used, as appropriate, with a significance level set at $p < 0.05$.

Safety and Adverse Events: Adverse events, if any, were recorded throughout the study. The safety profile of LLLT was assessed, and any unexpected or adverse effects were documented.

RESULTS

Oral Mucositis: In the LLLT group, participants with oral mucositis (n=40) showed a significant reduction in mucositis severity from a baseline score of 3.5 (SD = 1.2) to 1.8 (SD = 0.7) after 10 LLLT sessions ($p < 0.001$). This reduction in mucositis severity was accompanied by a notable decrease in pain levels, as reflected by the VAS score, from 7.6 (SD = 1.9) to 3.2 (SD = 1.5) ($p < 0.001$). Additionally, the LLLT group experienced an improvement in oral function, with the mean FOIS score increasing from 3.2 (SD = 0.8) to 4.8 (SD = 0.6) ($p < 0.001$). Table 1

Temporomandibular Joint Disorders: Participants with TMJ disorders (n=40) in the LLLT group exhibited significant improvements in pain levels, with the VAS score decreasing from 6.9 (SD = 1.7) to 2.9 (SD = 1.4) after 10 LLLT sessions ($p < 0.001$). Jaw range of motion also improved, with an increase in maximum interincisal opening from 29.8 mm (SD = 4.3 mm) to 38.2 mm (SD = 3.9 mm) ($p < 0.001$). Clinical assessments revealed a decrease in joint noises and crepitus. Furthermore, quality of life, as measured by the TMD-PDQ, demonstrated a notable improvement, with the mean score decreasing from 68.3 (SD = 12.7) to 41.6 (SD = 8.4) ($p < 0.001$). Table 2

Postoperative Pain: Participants (n=40) in the LLLT group who underwent maxillofacial surgeries experienced a significant reduction in postoperative pain levels, with the VAS score decreasing from 8.2 (SD = 2.1) to 3.5 (SD = 1.8) after 10 LLLT sessions ($p < 0.001$). The need for rescue analgesia decreased, and a high level of overall satisfaction with pain control was reported. No adverse effects related to LLLT were observed during the study period. Table 3

Control Group: The control group, consisting of 40 participants for each condition, did not receive LLLT treatment. In all three conditions, participants in the control group showed minimal changes in symptom severity, pain levels, and quality of life over the study period.

Table 1: Changes in Oral Mucositis Severity, Pain, and Oral Function

Parameter	Baseline Mean (SD)	Post-LLLT Mean (SD)	p-value
Mucositis Severity	3.5 (1.2)	1.8 (0.7)	<0.001
Pain (VAS)	7.6 (1.9)	3.2 (1.5)	<0.001
Oral Function (FOIS)	3.2 (0.8)	4.8 (0.6)	<0.001

Table 2: Changes in TMJ Pain, Range of Motion, and Quality of Life

Parameter	Baseline Mean (SD)	Post-LLLT Mean (SD)	p-value
TMJ Pain (VAS)	6.9 (1.7)	2.9 (1.4)	<0.001
Jaw Opening (mm)	29.8 (4.3)	38.2 (3.9)	<0.001
Quality of Life (TMD-PDQ)	68.3 (12.7)	41.6 (8.4)	<0.001

Table 3: Changes in Postoperative Pain and Satisfaction

Parameter	Baseline Mean (SD)	Post-LLLT Mean (SD)	p-value
Postoperative Pain (VAS)	8.2 (2.1)	3.5 (1.8)	<0.001
Rescue Analgesia Use	8/40	2/40	N/A
Satisfaction with Pain Control	High	High	N/A

DISCUSSION

The results of this study demonstrate the significant potential of low-level laser therapy (LLLT) as an effective and non-invasive treatment modality for various oral and maxillofacial disorders. The discussion will provide a comprehensive analysis of these findings, considering the implications for clinical practice and comparing them to existing literature.

Oral Mucositis: The observed reduction in oral mucositis severity, pain levels, and improvement in oral function following LLLT is consistent with the growing body of evidence supporting LLLT in the management of mucositis [1]. The notable decrease in mucositis severity (from 3.5 to 1.8) reflects a substantial improvement in the condition, potentially minimizing the need for additional interventions. This result is in line with studies that have reported a

reduction in mucositis severity and pain associated with LLLT [2].

The decrease in pain levels (from 7.6 to 3.2) following LLLT is of particular clinical significance. Pain management is a primary concern for individuals undergoing cancer treatments that often induce oral mucositis. The reduction in pain levels can lead to improved patient compliance with treatment and enhanced overall well-being.

The improvement in oral function, as measured by the Functional Oral Intake Scale (from 3.2 to 4.8), is a crucial outcome. It suggests that LLLT not only reduces the discomfort associated with oral mucositis but also allows patients to maintain a more regular diet, potentially reducing the risk of malnutrition. These findings align with previous research showing that LLLT may facilitate quicker recovery of oral function [3].

Temporomandibular Joint Disorders: The results pertaining to TMJ disorders also suggest the therapeutic potential of LLLT. Participants in the LLLT group experienced a substantial reduction in pain levels (from 6.9 to 2.9), a notable increase in jaw range of motion (from 29.8 mm to 38.2 mm), and improved quality of life (TMD-PDQ scores reduced from 68.3 to 41.6).

The reduction in pain levels is consistent with previous studies that have reported pain relief and improved quality of life in TMJ disorder patients treated with LLLT [4]. Additionally, the increased jaw range of motion signifies a positive effect on joint mobility, which is crucial for oral function and overall comfort.

The improvements in quality of life as measured by the TMD-PDQ are particularly noteworthy. These findings underscore the potential of LLLT in enhancing the well-being of individuals with TMJ disorders, who often experience significant discomfort and limitations in their daily activities. While LLLT's mechanism of action in TMJ disorders is not yet fully understood, these results support its use as a therapeutic option.

Postoperative Pain: In the context of postoperative pain following maxillofacial surgeries, the results demonstrate a significant reduction in pain levels (from 8.2 to 3.5) with LLLT. Importantly, this reduction was accompanied by a decrease in the need for rescue analgesia.

Effective postoperative pain management is crucial for patient recovery and satisfaction. The reduction in pain levels achieved through LLLT is in line with previous studies that have reported a decrease in postoperative pain and analgesic requirements in various surgical contexts [5]. The high level of overall satisfaction with pain control highlights the clinical significance of this finding, as satisfied patients are more likely to report a positive surgical experience and better adherence to postoperative instructions.

Comparative Literature: The outcomes observed in this study align with a growing body of research supporting the use of LLLT in the management of oral and maxillofacial disorders. Similar improvements in pain, function, and quality of life have been reported in studies on mucositis [1], TMJ disorders [4], and postoperative pain [5]. While the precise mechanisms of action underlying LLLT's efficacy in these conditions are not yet fully elucidated, it is likely due to its ability to modulate inflammation, promote tissue repair, and reduce pain.

Limitations: Several limitations should be acknowledged. First, this study was conducted over a relatively short time frame, and longer-term effects of LLLT were not assessed. Additionally, blinding of participants and therapists was not possible due to the nature of the intervention. Lastly, the study did not explore the effects of different LLLT parameters, which could provide insights into the optimal treatment protocols for specific conditions.

CONCLUSION

In conclusion, the findings of this study underscore the effectiveness of LLLT in the management of oral and maxillofacial disorders, including oral mucositis, TMJ disorders, and postoperative pain. The results demonstrate significant improvements in symptom severity, pain levels, and quality of life, and suggest that LLLT has the potential to enhance patient outcomes in these conditions. As a non-invasive and well-tolerated therapeutic modality, LLLT presents a promising avenue for improving the quality of care in the field of oral and maxillofacial medicine.

The clinical application of LLLT in oral and maxillofacial medicine warrants further investigation, including long-term follow-up studies and exploration of optimal treatment parameters. The potential benefits for patients and the growing body of supportive evidence highlight the importance of considering LLLT as an integral part of treatment plans for these disorders.

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