

## **Efficacy of Low-Level Laser Therapy in the Management of Oral Lesions: An In Vivo Study**

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### **Abstract**

**Background:** Low-level laser therapy (LLLT) is widely used in oral medicine for pain relief and enhanced healing  
**Aim:**

To assess efficacy of LLLT in treating minor aphthous ulcers and oral leukoplakia.

### **Materials and Methods:**

This clinical study included eight patients, of whom six presented with minor aphthous ulcers and two with oral leukoplakia. Treatment was carried out using a diode laser with a wavelength of 680 nm. Aphthous ulcers were managed using 0.5 W power in non-contact mode, while leukoplakia cases were treated at 2 W in contact mode using either excision or ablation techniques

### **Results:**

Patients with aphthous ulcers demonstrated marked reduction in pain and lesion size after initial therapy, with complete healing observed within 5–10 days and no evidence of scar formation. In leukoplakia cases, lesions treated with excision healed completely within 15 days without scarring, whereas ablation resulted in partial healing accompanied by scar formation.

### **Conclusion:**

LLLT is an effective, minimally invasive approach for managing aphthous ulcers, providing rapid symptomatic relief and enhanced healing. Laser excision appears to be more favorable than ablation in the treatment of leukoplakia

### **Keywords:**

Low-level laser therapy, Aphthous stomatitis, Oral leukoplakia, Diode laser, Photobiomodulation, Ablation, Excision.

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## **I. Introduction**

Oral ulcers are painful lesions that negatively affect quality of life by interfering with speaking, eating, drinking and hygiene. When they are large, chronic, or poorly healing, conventional therapy may be insufficient. Photobiomodulation therapy (PBMT), also known as low-level laser therapy (LLLT), has shown promise in accelerating healing, reducing pain and modulating inflammation in various oral ulcerative conditions.<sup>1</sup>

Low-level laser therapy (LLLT), also known as photobiomodulation, has emerged as a significant advancement in modern dental practice. It utilizes low-intensity laser light to stimulate cellular activity, enhance tissue repair, and reduce inflammation without causing thermal damage. Over the past few decades, LLLT has gained widespread acceptance due to its non-invasive nature, minimal side effects, and ability to improve patient comfort.<sup>2</sup>

In oral medicine, conditions such as recurrent aphthous ulcers and oral leukoplakia present therapeutic challenges due to pain, recurrence, and potential malignant transformation risks. Aphthous ulcers are among the most common oral mucosal lesions, characterized by recurrent, painful ulcerations that interfere with mastication, speech, and quality of life.<sup>3</sup> On the other hand, leukoplakia is a potentially malignant disorder associated with risk factors such as tobacco use, alcohol consumption, chronic irritation, and microbial infections. Recent advances suggest that LLLT promotes wound healing by enhancing mitochondrial activity, increasing ATP production, modulating cytokine release, and improving microcirculation. These biological effects make it a promising modality for managing oral mucosal lesions effectively and safely.<sup>4,5</sup>

Dentistry has entered an exciting era of high technology. The dental laser offers the dentist not only a window, but a door into this high-tech, rewarding and potentially profitable.<sup>6,7</sup>

Laser technology offers significant benefits, such as increase precision, reduce bleeding, and enhance patient comfort. Oral mucosal conditions such as aphthous ulcers and leukoplakia are frequently encountered in routine dental practice. Recurrent aphthous ulcers are characterized by painful ulcerations that can interfere with essential functions like eating and speaking, thereby impacting patient well-being.<sup>8</sup>

"In 2005, WHO defined leukoplakia as "a white plaque of questionable risk having excluded other known diseases or disorders that carry no increased risk for cancer". Numerous etiological factors have been implicated with leukoplakia, such as tobacco, alcohol, viral infections, candidiasis, and chronic irritation associated with dentures and cheek biting.<sup>9</sup>

Leukoplakia, in contrast, is recognized as a potentially malignant disorder that necessitates prompt diagnosis and appropriate intervention.<sup>10</sup>

Therefore, the present in vivo study was undertaken to evaluate the clinical efficacy of diode laser therapy in the management of minor aphthous ulcers and oral leukoplakia by assessing pain reduction, healing response, lesion resolution, and postoperative tissue outcomes.

## **II. Materials and Methods**

### **Study Design**

A prospective in vivo clinical study was carried out involving patients diagnosed with oral mucosal lesions.

### **Sample Characteristics**

A total of eight patients were included:

- Six patients with minor aphthous ulcers
- Two patients with oral leukoplakia

### **Laser Specifications**

- **Type of laser:** Diode laser
- **Wavelength:** 680 nm

### **Treatment Protocol**

#### **For Aphthous Ulcers:**

- Power output: 0.5 W
- Application mode: Non-contact
- Technique: Photobiomodulation

#### **For Leukoplakia:**

- Power output: 2 W
- Application mode: Contact
- Techniques used:
  - Surgical excision
  - Tissue ablation

### **Procedure**

The clinical procedure was carried out under standardized aseptic conditions. Prior to laser application, a thorough clinical examination was performed. The lesion site was gently cleaned and isolated to ensure optimal visibility and prevent contamination. Protective eyewear was provided to both patient and operator during all procedures.

For aphthous ulcers, the diode laser was applied in a non-contact mode at a power setting of 0.5 W. The laser tip was maintained at a slight distance from the lesion surface, and circular sweeping motions were used to evenly distribute (energy) across the ulcer area. Care was taken to avoid prolonged exposure at a single point to prevent tissue damage.

Each session lasted for 60 seconds and 3 cycles were done gap between each cycle is 30 seconds and patients were recalled for subsequent sessions until complete healing was achieved.

For leukoplakia, the procedure differed based on the technique employed. In excision, the lesion was surgically removed using a 2 W diode laser in contact mode, ensuring precise cutting with minimal bleeding.

In ablation, the superficial layers of the lesion were vaporized using controlled laser energy delivery. Postoperative instructions were given, including maintenance of oral hygiene and avoidance of irritants such as spicy foods and tobacco. Patients were followed up periodically to assess healing, pain reduction, and any recurrence.

**Clinical evaluation was based on:**

- Intensity of pain
- Reduction in lesion size
- Changes in surface characteristics
- Rate of healing
- Presence or absence of scar formation

Patients were monitored over successive treatment sessions and followed up for up to 15 days.

### III. Results

#### Aphthous Ulcer Cases

All six cases exhibited:

- Pain relief immediately following initial laser application
- Gradual decrease in lesion size over subsequent sessions
- Transition of lesion surface from erythematous and shiny to a dull appearance
- Complete epithelialization within 5–10 days
- Absence of scar tissue formation

#### Leukoplakia Cases

##### Excision Technique:

- Complete resolution of lesion observed after 15 days
- Healing occurred without scar formation

##### Ablation Technique:

- Healing remained incomplete at 15-day follow-up

Scar formation was evident

| NO. | LESION                                                             | 1 <sup>st</sup> Session                                                                        | 2 <sup>nd</sup> Session          | 3 <sup>rd</sup> Session                             |
|-----|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------|
| 1.  | Minor aphthous ulcer on lateral border of tongue                   | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain | Complete healing of the ulcer<br>No pain<br>No scar |
| 2.  | Minor aphthous ulcer on upper labial mucosa & on tip of the tongue | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain |                                                     |
| 3.  | Minor aphthous ulcer on the lower labial mucosa                    | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain | Complete healing of the ulcer<br>No pain<br>No scar |
| 4.  | Minor aphthous ulcer on the lower labial mucosa                    | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain | Complete healing of the ulcer<br>No pain<br>No scar |
| 5.  | Minor aphthous ulcer on the tip of the tongue                      | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain |                                                     |
| 6.  | Minor aphthous ulcer on the ventral aspect of the tongue           | Size of ulcer reduced<br>Glossy to matte surface area seen<br>Pain reduced<br>Redness increase | Size of ulcer reduced<br>No pain | Complete healing of the ulcer<br>No pain<br>No scar |

#### Tissue excision

| LESION                                             | After 15 days                                                                                                                         |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Oral leukoplakia right buccal mucosa and vestibule | <ul style="list-style-type: none"> <li>• Complete healing of the lesion</li> <li>• No scar</li> <li>• No burning sensation</li> </ul> |

#### Tissue ablation

| LESION                               | After 15 days                                                                                                                                |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Oral leukoplakia right buccal mucosa | <ul style="list-style-type: none"> <li>• Incomplete healing of the lesion</li> <li>• Scar present</li> <li>• No burning sensation</li> </ul> |

### IV. Discussion

The therapeutic effects of LLLT are primarily attributed to its ability to enhance mitochondrial function, resulting in increased ATP synthesis and improved cellular metabolism. Additionally, it modulates inflammatory pathways and provides analgesic benefits.<sup>11,12</sup>

The present study demonstrates significant clinical benefits of LLLT in managing oral lesions. Compared to conventional therapies, LLLT provides rapid pain relief and accelerates healing. Previous studies have reported similar findings, supporting its analgesic and anti-inflammatory effects (2,6). However, the small sample size and lack of control group limit generalizability. Future studies with randomized controlled trials are necessary to validate these findings. Additionally, while excision showed superior outcomes over ablation, long-term follow-up is essential to evaluate recurrence and malignant transformation risk.<sup>13,14</sup>

The findings of the present study

- Rapid alleviation of pain, consistent with earlier clinical trials<sup>4,11</sup>
- Accelerated wound healing in aphthous ulcers, supporting evidence from systematic reviews<sup>3,7</sup>
- Minimal tissue damage and absence of scarring with photobiomodulation
- Improved clinical outcomes with excision compared to ablation in leukoplakia management

These results reinforce the role of LLLT as an effective therapeutic tool in oral medicine.

### V. Conclusion

Low-level laser therapy represents a safe and efficient treatment modality for minor aphthous ulcers, offering faster healing and significant pain reduction. In cases of oral leukoplakia, laser-assisted excision provides more predictable and favourable outcomes compared to ablation.

#### Limitations

- Limited number of participants
- Short duration of follow-up
- Absence of a control group

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