



# Lasers Awaken: Harnessing the Force in Oral and Maxillofacial Surgery

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## KEYWORDS

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## ABSTRACT:

**Introduction:** In oral and maxillofacial surgery, various laser types are employed; the impact of these lasers on biological tissue varies according to the wavelength of light. Water is the primary absorber of CO<sub>2</sub> and Er:YAG lasers, which makes it easier to remove both hard and soft tissues. Despite their deeper penetration, Nd:YAG lasers have the potential to cause more collateral damage because of coagulation.

**Methods:** Electronic searches turned up 357 articles, and searches for the term "lasers in oral and maxillofacial surgery" in the dental literature on Medline, PubMed Central (PMC), PubMed, and Google yielded results. References to a number of articles and review papers were included.

**Results:** Laser technology has revolutionized oral and maxillofacial surgery, offering various benefits in different applications. CO<sub>2</sub> and Er:YAG lasers serve as precise scalpels for tumour excision and vaporize superficial tissue and precancerous lesions. Nd:YAG lasers are effective in tissue resection during haemorrhage cases. In dental implant procedures, lasers provide advantages such as improved haemorrhage control, reduced trauma, infection prevention, decreased inflammation, pain, and enhanced healing. Low-level laser therapy (LLLT) offers pain relief, inflammation reduction, and healing stimulation for temporomandibular joint disorders. Diode or Er:YAG lasers effectively reduce the size of oral and maxillofacial haemangiomas and vascular malformations without compromising function or aesthetics. Laser technology is also utilized in cosmetic surgery for skin resurfacing, facial rejuvenation, tumour surgery, scar revision, and dermatologic procedures. Furthermore, photodynamic therapy (PDT) shows promise in treating head-and-neck tumours in specific regions. Overall, lasers have significantly contributed to advancing treatment options and outcomes in oral and maxillofacial surgery.

**Conclusions:** Lasers have expanded surgical possibilities, fostering the emergence of new procedures in OMFS. Advancements in laser technology will undoubtedly drive innovation and play a crucial role in the future of OMFS.

## 1. Introduction

Miaman introduced laser into dentistry in the 1960's. Laser stands for light amplification by stimulated emission of radiation, which is a type of electromagnetic radiation. Due to its ease of manipulation in the oral cavity and the introduction of office-based portable setup lasers have become increasingly popular. Lasers are of the following types gas lasers (argon laser, helium-neon lasers, Zenon ion laser etc.), Solid state lasers (Ruby laser). Visible beams like Argon laser and invisible beams in the infrared range like CO<sub>2</sub>, Ho:YAG, Er:YAG

, Er-Cr: YSGG, ND:YAG, Diode are being used in dentistry.

Lasers can be classified as hard tissue and soft tissue lasers. Hard tissue lasers are longer in wavelength use ablation to cut the tissue and mostly used for bone and tooth application whereas soft tissue lasers use coagulation, vaporization and carbonisation to cut the tissues. Different laser types used in oral and maxillofacial surgery, with their effects on biological tissue dependent on the light's wavelength. CO<sub>2</sub> and Er:YAG lasers are primarily absorbed by water, which



has minimum depth of penetration and fast heating facilitating the removal of soft and hard tissues. The CO<sub>2</sub> lasers are primarily used for the excision and removal of tumours in the soft tissue and are also used to remove precancerous lesions. Er:YAG lasers can be used on both soft tissues and we'll as hard tissues and they cause minimum damage to the surrounding areas. Nd:YAG lasers, though able to penetrate deeper in comparison to CO<sub>2</sub> and Er:YAG lasers, may cause more collateral damage due to coagulation.

## 2. Methods

The following databases was searched for published articles and studies in English language over a period of one month: PubMed, PubMed Central (PMC), Medline, Research Gate and Google. The following terms were used to generate a search: lasers, lasers in dentistry, lasers in oral and maxillofacial surgery, laser in oral surgery. 54 articles were found on PubMed out of which 6 articles were selected by citation matching. 10 articles were identified addressing the topics related to our key characteristics. There were references to numerous publications and review papers

## 3. Results

Laser technology has revolutionized oral and maxillofacial surgery, offering various benefits in different applications. CO<sub>2</sub> and Er:YAG lasers serve as precise scalpels for tumour excision and vaporize superficial tissue and precancerous lesions. Nd:YAG lasers are effective in tissue resection during haemorrhage cases. In dental implant procedures, lasers provide advantages such as improved haemorrhage control, reduced trauma, infection prevention, decreased inflammation, pain, and enhanced healing. Low-level laser therapy (LLLT) offers pain relief, inflammation reduction, and healing stimulation for temporomandibular joint disorders. Diode or Er:YAG lasers effectively reduce the size of oral and maxillofacial haemangiomas and vascular malformations without compromising function or aesthetics. Laser technology is utilized in cosmetic surgery for skin resurfacing, facial rejuvenation, tumour surgery, scar revision, and dermatologic procedures. Furthermore, photodynamic therapy (PDT) shows promise in treating head-and-neck tumours in specific regions. Overall, lasers have significantly contributed to advancing treatment options and outcomes in OMFS (Oral and Maxillofacial surgery).

## Applications of Lasers in Oral Surgery:

### a) Excision of Oral Lesions :

In a study, the use of potassium-titanyl-phosphate (KTP) laser at 532nm with low-level parameters helped to evaluate postoperative and intraoperative pain. The result of the study showed that potassium-titanylphosphate laser at low parameters could be used to perform surgery with better wound healing and excellent pain control.

### b) Oral Leukoplakia :

In a randomised clinical trial use of CO<sub>2</sub> and cold knife was compared for the excision of oral leukoplakia. It concluded that carbon dioxide laser can be an alternative method in the treatment of patients with oral leukoplakia as the pain and swelling caused was minimal.

### c) Oral Lichen Planus :

A study assessed the efficiency of diode laser to control oral Lichen Planus. The results revealed that diode laser could be an effective treatment to relieve the symptoms of oral lichen planus. CO<sub>2</sub> lasers were compared with low-level laser in the treatment of oral lichen planus. The results showed that low-level laser could be an alternative to CO<sub>2</sub> laser therapy.

### d) Gingival Pigmentation :

In a histologic and clinical study comparison of surgical stripping with aluminium, garnet, carbon dioxide laser for depigmentation was done, the repigmentation after the depigmentation procedure is due to the histological changes in the density of melanin pigments and the activity of the melanocytes. It displayed that surgical stripping was the benchmark for gingival depigmentation.

### e) Soft Tissue Excision :

As compared to scalpel, bleeding caused by lasers is minimal which leads to a blood less field. Lasers also coagulate the surrounding area due to their thermal effects.

### f) Haemostasis :

Lasers cause coagulation by the collagen contraction in the vascular wall of the blood vessels. It leads to control in bleeding, as there is reduction in the vascular diameter. Haemorrhage can be controlled and vascular defects can be treated.

### g) Laser Ablation :

Treatment of hyperplastic lesions, hyperkeratosis and contouring of gingiva can be done with the help of laser ablation.



## h) Frenectomy :

High frenal attachment can be excised using lasers. The minimal bleeding caused by lasers facilitates its use in the highly vascular lingual region.

## i) Recurrent Aphthous Ulcer :

Lately low level laser therapy are being used for treating Recurrent Aphthous Ulcer. In a study, it was discovered that 75% of the patients had significant pain relief post laser treatment and the lesion reverted completely in 4 days. Bladowski et al. reported that use of low-level lasers reduced the healing time up to half as compared to use of any pharmacological drugs.

## j) TMJ Arthroplasty :

Holmium laser can be used for TMJ arthroscopic procedure. Holmium laser with minimum amount of time and energy can execute tissue ablation, removal of degenerated fibrocartilage, incision, cauterization and excoriation of tissue.

## k) Lasers in Oral Implantology :

The bloodless field provided by the haemostatic effect of lasers facilitates impression taking immediately after second stage surgery. The tissue shrinkage post laser surgery is minimal which guarantees that the margins of the tissues will remain alike after healing as they are after the laser procedure.

### • Implant Site Preparations :

In patients with bleeding problems Lasers can be used to place many implants. Ailing implants can be decontaminated and repaired with laser. Example; diode and CO2 laser. Removal of granulation tissue can also be done.

### • Socket Sterilisation :

After extraction of the tooth socket can be sterilised immediately without any pain.

### • Peri-implantitis :

Vaporising effect of laser can be used on granulation tissue to clean the implant surface, as the heat produced by the laser is not damaging. This results in positive guided tissue regeneration allowing extended use of implant by the patient.

### Advantages of Laser:

- Laser provides sterilisation of the field of operation.
- Its use reduces the need for anaesthetics.

- Reduces the chances of failure of the surgery
- It provides minimal postoperative swelling, pain and scarring of the tissue.
- There is contact free incision and minimal mechanical trauma caused.
- Lasers provide haemostasis, which leads to a bloodless operating field.
- The need for placement of sutures is reduced.
- Wound healing is better than surgical procedures.
- Its property of ablation and control on depth penetration leads to increase in accuracy and precision.

### Drawbacks of Laser:

- The rate of healing maybe delayed.
- Higher cost and operator training is required.
- There are health hazards to the operator, patients and assistants because of the scattering and reflected laser beams.
- The vapours generated can be harmful to people in the operating room.
- There are chances of postoperative pain after 4-5 days.

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