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Original Research Paper

Dental Science

# A BREADTH OF VIEW FOR LASERS IN ORAL AND MAXILLOFACIAL SURGERY

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**ABSTRACT** Lasers have been used in dentistry for diagnosis and therapeutic purposes for more than 30 years, and are an indisputable in any modern dental surgery. The use of lasers enables new treatment methods to be employed in order to meaningfully supplement traditional therapies. The purpose is to overview the use of lasers as use widely.

**Objective:** The aim of this review is to summarized the role of lasers in different oral and maxillofacial diseases by review of literatures. Oral and maxillofacial surgery is a vast branch of dentistry which includes procedures ranging from simple extraction to pathologies of both hard and soft-tissues.Based on extensive review of literature, certain conclusion can be made regarding the use of lasers.

**Material and methods:** A search for literature on the effect of laser treatment in various oral conditions was done. A comprehensive search to identify all relevant studies, within the parameters of the study being a PubMed indexed review, published in English between till 2015 was undertaken. A wide range of databases and other sources for the identification of relevant studies were explored.

**Results:** 7PubMed indexed studies were identified that dealt with the various treatment modalities using lasers and were included in the review.

**Conclusion:** It was concluded that in most of the cases, laser treatment proved to be either at par or better than the conventional treatment method in the treatment of various oral conditions.

**KEYWORDS :** Lasers in oral surgery,Laser around implants,Oral diseases,Photochemical effect,Biostimulation

## INTRODUCTION

Lasers are becoming the standard of care for many oral and maxillofacial procedures, and they are being introduced as an efficient instrument for a variety of new applications within the specialty.Lasers are becoming increasingly popular due to the advent of office-based lasers, which are small, portable, and easy to manipulate within the oral cavity. Based on manufacturer estimates, approximately 10% to 20% of all oral and maxillofacial surgeons use a laser in office-based practice, and most have access to lasers in the hospital.[1]

The acceptance of lasers as viable alternatives to traditional methods in medicine was one of the events that created an explosion of interest in the last decade in the role of lasers in dentistry.[2]

In 1960, Theodore Maiman, developed the first working laser device, which emitted a deep red-colored beam from a ruby crystal. During the next few years, dental researchers studied possible applications of this visible laser energy. Studies in the 1970s and 1980s turned to other devices, such as $CO_2$andneodymium YAG (Nd:YAG), which were thought to have better interactionwith dental hard tissues. The medical community in the mid to late 1970shad begun to incorporate lasers for soft-tissue procedures, and oral surgeonsadded the technology in the early 1980s. Numerous instruments have been made available for use in dental practice, and more are being developed.[3]Many of the studies that have been carried out have been based simply on empirical use of available lasers and an examination by various techniques of their effect on dental hard or soft tissues.[4]

In the last 15 years, a number of laserwavelengths have been brought to the profession for various procedures. The$CO_2$, Nd: YAG, diode, argon, and holmium wavelengths are primarily softtissue lasers. The enthusiasm by laser users has been significant; however, vactual market penetration by the technology has been slow. The introduction of the erbium family of wavelengths, with its ability to safely remove hardtissue, has stimulated a new wave of interest in laser therapy in the dentalprofession. Continuing research on all of these wavelengths has brought new opportunities for use in the clinical environment.[5]

## METHODOLOGY

### Search Strategy:

The search strategy of this systematic review was fabricated to address the question: 'can LASERS be used as an effective treatment modality in the oral and maxillofacial surgery and whether it is better than the conventional treatment modalities available.'

### Criteria for considering studies for this review

#### Types of studies

Only reviews on lasers, till the time period of 2015 and published in the English language were included.

#### Types of participants

All individuals with any modality that could be treated with lasers, irrespective of race, gender, age, socioeconomic status, health status or geographical location were included.

#### Types of interventions

Studies investigating any laser, such as erbium laser, diode laser, $CO_2$ laser and all types of treatment procedures in oral and maxillofacial surgery were taken into consideration.

### Search methods for identification of studies

A comprehensive search to identify all relevant studies, within the parameters of the study being a pubmed indexed review, published in English till 2015 was undertaken. A wide range of databases and other sources for the identification of relevant studies were explored.

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### Electronic searches

- Detailed search strategies were developed for each database to be searched for the identification of studies included or considered for this review. These were based on the search strategy developed for MEDLINE but revised appropriately for each database. The following databases were searched
- The Cochrane Library
- Embase
- Medline
- EBSCOHOST
- Science direct

### Searching other resources

Those journals not registered with the above mentioned databases were manually searched. Also reviews where the full text article was not available online were sought. The reference lists of all the included articles to identify any additional studies were also looked into.

### Data collection and analysis

### Selection of studies

All the records obtained from each database were considered and compiled together. All potentially relevant articles identified when searching other sources and the records located from searching these (non-electronic) sources were also included in the main list. One review author independently assessed the titles and abstracts of all articles and excluded duplicate records . Hard copies of the full text of studies that possibly fulfilled the inclusion criteria were obtained. All studies meeting the inclusion criteria then underwent data extraction and a risk of bias assessment.

### Data extraction and management

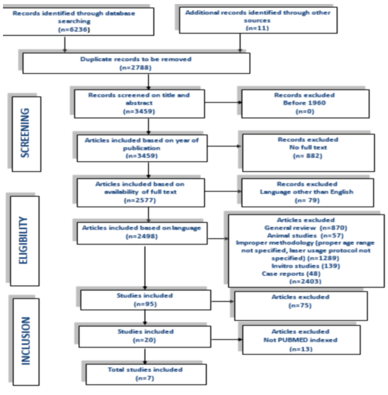
One review author independently extracted data. Information was collected regarding review characteristics (year of publication, country of the study), patient's characteristics (number of participants, age range, and sex), intervention characteristics (type oflaser, laser beam characteristics, laser intervention), comparator characteristics (type of comparator: none or conventional therapy) and outcomes characteristics.

### Assessment of risk of bias in included studies

Onereview author independently assessed the risk of bias of all studies that were considered eligible for the review using The Cochrane Collaboration's risk of bias tool described in Chapter 8 of the Cochrane Handbook. The following seven domains of risk of bias were assessed in each included study.

Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants and personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias

### STUDY FLOW CHART




| | Er:YAG 2940nm (least haemostasis) | Er,Cr:YSGG 2780 nm | CO2 10600 nm | KTP 532 nm | Diode 810-980 nm | Argon 488 and 515nm | Nd:YAG 1064nm (most haemostatis) |
|---|---|---|---|---|---|---|---|
| Minor soft tissue surgery | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ |
| Major soft tissue surgery | | | ✔ | | | | |
| Surgical treatment of large vascular lesions | | | | | | ✔ | |
| Bone cutting | ✔ | ✔ | | | | | |
| Implant exposure with bone removal | ✔ | ✔ | ✔ | | | | |

### SAFETY WITH LASERS[7]

Laser devices have to be classified by the manufacture according to their hazard to enable the user to choose the right protective arrangements. The three different classes are defined in the international safety standard IEC 60825-1 and in the European standard EN-60825-1.

### Class 1

Safe laser devices are referred to as class1. Very low output power devices that remain under the MPE values even at long irradiation times. Under high output power devices they are fitted with a protective housing that prevents the radiation from emerging to the outside under all normal operative conditions.

Below 40 mW in blue and 400 mW in red.
Eg: CD players, range finders
No protective arrangements and precautions required.

### Class 1M

They are safe to the naked eye but bearing safety hazard for the use of optical instruments like magnifying instruments ( M: magnifying). Contain a warning sign. Do not view directly with optical instruments.

### Class 2

Only defined for visible wavelengths. Natural reaction of a person to turn away is sufficient for eye protection from an exposure of 25 sec. These devices are safe as long as the reflex of turning away is not suppressed. Eg: laser pointers, targeting lasers.

### Class 2M

The new laser safety standards define a new class for laser devices being safe for the naked eye upto 0.25 sec. Exposure time but bearing safety hazards for the use of optical instruments called class 2M.

### Class 3A

Exposure is similar to class2 in the visible range and class 1 in the invisible range without the use of magnifying instruments. If optical instruments are used damage can occur within 0.25 sec as a result of focusing.

eg: laser for measurements and building grounds.

### Class 3B

In certain cases eyes and even skin are endangered. Damage can occur even with very short irradiation times. No risk at diffuse reflections.

Eg: laser for measurements and laser shows.

### Class 3R
R: relaxed
This denotes a junction between class 2 and class 3B .
Eg: targeting laser, laser for building sites

### Class 4
Eye and skin are endangered even at diffuse reflections. Fire hazards for flammable material in the beam path.
Eg: lasers for material processing, medical therapeutic use, and tissue ablation.

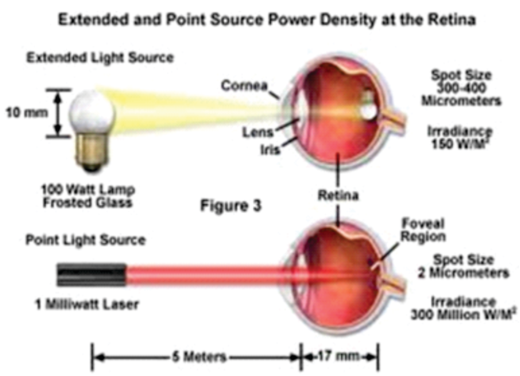
## SECONDARY HAZARDS
### Mechanical hazards
They can be caused by high pressure in the tubes or low pressure in laser cavity. There is also a danger of explosion during exchange service of flash lamps used in solid state lasers.

### Electrical hazards
Subsequent alterations to the device can affect the electrical security. If an external cooling water circuit has to be installed a close contact should be avoided.

### Chemical hazards
Mostly caused by the materials used in laser construction. Toxic fluorine and chlorine used as laser medium in excimer lasers. The gas containers have to be stored under secure conditions. Contact with skin and inhaling of vapours must be avoided.

### Fire hazards
Flammable materials represent a fire hazard during operation of lasers with high output power mainly because of flammable material in the beam delivery system on the operation area and in the surrounding system.

### Specific hazards
Specific hazards include plasma, $CO_2$, vapour, dust, metals and organic matter.




## PROTECTIVE MEASURES[8,9]
### Protective eyewear
The international standard IEC 60825-1 and European standard EN 207 requires a safety level for protective glasses where by not only the laser radiation is attenuated to MPE values but the filter material withstand the special laser fields.
EN 207 requires that

1. The goggles must transmit at least 20% of the visible radiation otherwise the manufacturer has to inform about it in written
2. The goggles must not lose their protective grid even at longer radiations
3. The goggles have to keep their protective effect even at high temperatures and humidity.
4. Wavelength and protective grade must be specified


### Labelling[10,11]
EN 207 demands the following labelling
1. DIR: operation mode
2. 1060: wavelength in nanometres
3. L6A: protective level
4. Rh: sign of manufacturer
5. DIN: testing standard

Operation modes for labelling laser protective eyewear

| | Operation modes (simplified) | Pulse duration |
|---|---|---|
| M | Mode-coupled lasers | $<10^{-9}$ s |
| R | Q-switched lasers | from $10^{-9}$ s to $10^{-7}$ s |
| I | Pulsed laser | from $10^{-7}$ s to $5 \times 10^{-7}$ s |
| D | Continuous wavelasers | from 0.1s [if 315 nm - 100 nm, then > 0.5 ms] |

## ORGANISATIONAL PROTECTIVE ARRANGEMENTS
Nomination of a laser safety officer ( LSO) is necessary when using a class 3B, 3R or 4 laser. It is his responsibility to check the scheduled updates, defects, failures, incidents and accidents, and acceptance to rules in the staff as well as patient cooperation. He must be in contact with authorities.

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