ABSTRACT:
In recent years, there has been remarkable achievement in all the medical fields including oral and maxillofacial surgery. One such recent advancement is LASER therapy. The laser has become a useful tool in the surgeon’s armamentarium. In addition to being an adjunct to conventional surgical methods, they are now the treatment of choice for variety of pathologies. This review summarizes the indications, advantages, disadvantages and applications of Laser therapy in various fields of oral and maxillofacial surgery.

Key words: Lasers, Applications in oral surgery, Lasers in vascular anomalies, low level laser treatment.

INTRODUCTION
Technological advances led to the increased use of lasers in surgery and medicine during mid-90s. In 1954, Theodore H Maiman built the first laser at Hughes Aircraft Research Laboratories. In 1704, Newton characterized light as a stream of particles and at the turn of 20th century black body radiation phenomenon was challenged by the waveform light theory. LASER is an acronym for Light Amplification by the Stimulated Emission of Radiation. It is a monochromatic, collimated, coherent, and intense beam of light produced by stimulated emission of radiation of a light source. Every laser has a laser medium, such as ruby, argon, carbon dioxide and variety of other elements. They are mainly classified as soft tissue and hard tissue lasers. Ender Mester in 1967 invented Low level laser therapy (LLLT) which has therapeutic effects without inducing a lot of heat is established in clinical dentistry because of its anti-inflammatory, bio stimulant and regenerative effects and uses light in the visible light spectrum (400nm–700nm) and in the near-infrared region of the light spectrum (700nm–1000nm). They not only help in local wound healing but also have systemic effect on distal wounds through photo-biomodulation. The production of diode laser has also reduced the bulk of laser machines and has restricted the span of emissions to a relatively narrow band (400-1000).
manually to have thermal relaxation. Exposure time is manipulated by choosing either continuous wave, pulsed, superpulsed, free running pulsed, gated pulsed, ultrapulsed, flash scanned, or Q-switched mechanisms.

**The temperature effects of lasers on tissue components:**
- >37ºF – Tissue retraction, protein conformational changes
- >50ºF – Non-spore-forming bacteria inactivated
- >60ºF – Denaturation of proteins and coagulation
- >70ºF-80ºF – Tissue welding
- >100ºF – Vaporization
- >200ºF – Carbonization

**LASER PHYSICS**
Various components of devices that generate LASER energy include: an optical cavity or resonator where excitation of atoms occurs; two parallel mirrors i.e., a totally reflective mirror on one side and partially reflective mirror on the other side; the medium which can be solid, liquid or a gas.

A LASER emits photons which are reflected by the mirrors within the chamber and directed in a parallel manner. As they travel within the chamber, additional photons are produced with excitation of more atoms. Hence, the intensity of energy increases and the chain reaction continues. This is known as amplification of the laser beam. This beam will be monochromatic, coherent and usually a very low divergence. The light is delivered from the laser chamber to the tissue in variety of ways. Laser light is delivered to tissue by contact or non-contact mechanism. Contact laser offers the advantage of tactile sense during operating and in no contact or free laser beam systems have angles mirrors to direct the beam either at 90 or 120 degrees. Surgery in the floor of mouth and other difficult areas is easier when using these mirrors.

**LASER INTERACTION WITH BIOLOGICAL TISSUE**
Four types of interactions occur which are as follows:

**Absorption:** When laser light is directed at tissue, absorption of light occurs through various compounds in the tissue which are termed as chromophores. The amount of chromophores within the tissue determine the absorption capacity of the tissue. Absorption: When laser light is directed at tissue, absorption of light occurs through various compounds in the tissue which are termed as chromophores. The amount of chromophores within the tissue determine the absorption capacity of the tissue. Reflection: The beam reflects itself off the surface producing no effect on the target tissue. Scattering: The laser energy is scattered over a broader area or volume of tissue thus diffusing the effects of the energy. Transmission: The laser beam is transmitted through the tissues resulting in no observable laser tissue reaction. The principal effect of laser is photothermal effect. This effect depends on temperature rise and corresponding reaction of interstitial and intercellular water. As the laser energy is absorbed heating occurs, if it is in pulsed form then the tissue has time to cool before next pulse is emitted but in case of continuous wave the operator must cease the laser emission before next pulse is emitted.

**ADVANTAGES OF LASER SURGERY:**
Advantages attributed to laser surgery includes 1) increased visibility of the surgical site, reduced intensity of the inflammatory reaction resulting in lesser postoperative edema due to hemostatic effect. 2) Laser wounds heal by second intention so no dressing is necessary after the vaporization of superficial lesions and no suturing is necessary after tissue excision. 3) It causes less of cicatrization due to reduction in the number of myofibroblasts and eosinophils on the wound surface. 4) Laser surgery causes less of oral dysfunction compared to conventional surgical methods. 5) Laser surgery is meant to
## APPLICATIONS OF LASERS:

<table>
<thead>
<tr>
<th>LASER TYPE</th>
<th>WAVE LENGTH</th>
<th>MODE OF ACTION</th>
<th>APPLICATIONS</th>
</tr>
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<tbody>
<tr>
<td><strong>A. SOFT TISSUE LASER</strong> 8,9,10</td>
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<tr>
<td>Nd:YAG Laser</td>
<td>1064 nm</td>
<td>Continuous wave, Pulsed, Q-Switched</td>
<td>Squamous cell carcinoma, oral cavity venous malformations, bisphosphonate associated osteoradionecrosis of jaws, frenectomy, blepharoplasty, papillary hyperplasia, malignant lesions, hair transplant and hair removal, infraorbital pigmentation.</td>
</tr>
<tr>
<td>High power diode laser</td>
<td>940 nm</td>
<td>Continuous wave, Pulsed</td>
<td>Fordyce granule excision</td>
</tr>
<tr>
<td>Potassium-titanyl phosphate (KTP)</td>
<td>532 nm</td>
<td>Pulsed</td>
<td>Removal of oral mucosal lesions, Hair and tattoo removal, photorejuvination,</td>
</tr>
<tr>
<td>Er, Cr:YSGG laser</td>
<td>540 nm</td>
<td>Pulsed, Ultrapulsed</td>
<td>Frenectomy</td>
</tr>
<tr>
<td>Pulsed dye laser</td>
<td>575-585 nm</td>
<td>Pulsed</td>
<td>Most vascular lesion, portwine stains, hemangiomas.</td>
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diminish the risk of disseminating neoplastic cells during the treatment. 6) no sensory disturbance. g) no functional or mobility problem postoperatively. 7) minimized tumor cell dispersion by lymphatic sealing. 8) no need for antibiotic, analgesic or anti-inflammatory medication. 9) precise delivery of energy to diseased tissue via microscopes for reduced damage to surrounding structures 10) use of lasers in conjunction with fluoride treatments increase the anticariogenic effects. 

LIMITATIONS
There are few limitations of lasers which include 1) thermal alteration around the zone of laser tissue ablation. It may range from transient heating to protein denaturation, evaporation of water, carbonization or complete thermal destruction in terms of tissue burning which results in delayed healing process compared to a scalpel incision. 2) One major drawback that limits the surgical application of lasers is the lack of haptic feedback during laser surgery. While performing laser surgery with tissue penetration that exceeds the superficial layer, the surgeon receives no information about the actual ablation depth or information about the ablated tissue at the bottom of the cut. In the head and neck area, this particularly concerns sensory and motor function nerves. Their damage may immensely affect both function and aesthetics. 3) Minor disadvantages of laser surgery are on the technical side. For safety reasons, eye protection is necessary for the patient and the surgeon. Most of the laser surgery systems are bulky, which particularly limits their use in the narrow space of the oral cavity. 4)

<table>
<thead>
<tr>
<th>Laser Type</th>
<th>Wavelength (nm)</th>
<th>Power Type</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argon laser</td>
<td>458-585</td>
<td>Continuous wave, Pulsed</td>
<td>Superficial lesions</td>
</tr>
<tr>
<td>Copper-vapor laser</td>
<td>578</td>
<td>Pulsed</td>
<td>Hypertrophic and nodular portwine stains</td>
</tr>
<tr>
<td>Krypton</td>
<td>568</td>
<td>Non pulsed</td>
<td>Superficial lesions such as telangiectasias</td>
</tr>
<tr>
<td>Long pulsed</td>
<td>590</td>
<td>Pulsed</td>
<td>Slightly larger vascular malformations</td>
</tr>
<tr>
<td>A. HARD TISSUE LASER</td>
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<tr>
<td>Excimer</td>
<td>193-351</td>
<td>Pulsed</td>
<td>Keratotomy</td>
</tr>
<tr>
<td>Er:YAG laser</td>
<td>2940</td>
<td>Pulsed, Ultrapulse</td>
<td>Endodontic surgery, fibrotomy, facial resurfacing, surgical stripping for gingival depigmentation</td>
</tr>
<tr>
<td>Low level laser</td>
<td>400-700</td>
<td>Pulsed, continuous</td>
<td>Bisphosphonate associated osteoradionecrosis of jaws, endodontic surgery, fibrotomy</td>
</tr>
<tr>
<td>hol-YAG</td>
<td>2100</td>
<td>Pulsed</td>
<td>Arthroscopy and arthroplasty of TMJ.</td>
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hazards to patients, operating and assisting team and anaesthesia personnel from misdirected and inadvertent laser radiation. 5) specialized wiring and plumbing connection needed.14,15.

LASER SAFETY MEASURES:-
Laser and intense pulsed light offers many advantages in surgical fields and it should be clear that their correct and safe use requires careful assessment . 1) Safety shield must be used 2) eye shields to be worn at all times by all personnel including dentists, assistants, patients and others 3) LASER safety officer must be stationed at the laser unit at all times 4) a bucket of sterile water should be immediately available in the operating theatre 4) use only wet cloth or fire retardant drape materials in the operating field 5) use only non-combustible anaesthetic reagents.6) Emission port shutters to prevent laser emission until the correct delivery system is attached 7) Covered foot-switch, to prevent accidental operation 8) Control panel to ensure correct emission parameters 10) Audible or visual signs of laser emission. 11)Locked unit panels to prevent unauthorized access to internal machinery.16

FUTURE DEVELOPMENTS AND PROSPECTS
Laser technology has made rapid progress over last decade and lasers have found niche in many surgical specialities. The possibility of combining laser surgery with other technical devices helps in establishing new surgical treatment options. Endoscopic surgery benefits from optical tissue treatment, and provides solutions for minimally invasive surgery that has been limited by the mechanical nature of classical instrumentation. Attempts are being made to combine oral laser surgery with robotics in experimental and preliminary clinical trials.16 Biological tissue modulates light in a specific way and based on these optical tissue differentiation methods, tissue-specific laser surgery could be developed for the treatment of tumors. Tissue-specific feedback monitoring/guidance of the laser cut will reduce the risk of iatrogenic tissue damage, especially to nerves or major blood vessels, enhancing the safety of laser surgery. Photodynamic therapy is currently being used for the treatment of head and neck, skin, intraabdominal and other types of cancers. The CO2 laser and other lasers have been used in the microanastomosis of nerve and vascular tissue. The advent of diode lasers are promising to revolutionise laser engineering. The effects of infrared radiation on pain fibres are now being recognised . The possibility of an intra-operative optical biopsy for the detection of malignant tissue will dramatically enhance the quality of tumor resections. The surgery time will be sped up while the surgical resection will be performed with higher precision. Optical real-time monitoring of the tumor removal will overcome the problem of intra-operative identification of the lateral tumor margins and the depth of the tumor expansion.17

SUMMARY:
Laser surgery continues to be an important addition to the armamentarium of surgeons within multiple specialities. Advances come quickly in this rapidly growing field and clinician must invest a great deal of time to feel comfortable with lasers in order to perform surgery in a safe and effective manner. Lasers can be of great value in dentistry and clinician should possess basic knowledge about tissue intereactions and should carefully observe thermal effects being produced. The surgical laser is a powerful tool that adds great dimension to the oral and maxillaryfacial surgeon’s practice.

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