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REVIEW ARTICLE

LASERS IN ORAL AND MAXILLOFACIAL SURGERY

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ABSTRACT

The word 'LASERS' is an acronym for " Light Amplification by stimulated emission of radiation." Since the advent of lasers in the 1960's by Theodore Maiman, lasers have been an important treatment modality in the field of dentistry. It has revolutionized treatments in all fields of dentistry, such as periodontal treatments, dental implants, oral and maxillofacial surgery etc. Several new technologies have been innovated in the field of lasers. The objective of this article is to emphasise the applications of lasers in oral and maxillofacial surgery.

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INTRODUCTION

The term LASERS is the acronym for 'Light Amplification by the stimulated emission of radiation.' It was in the year 1960, that the first laser was introduced by Theodor Maiman (Gaspar, 1994). This was the first solid state ruby laser, which emitted a deep red coloured beam from a ruby crystal. In the 1970's and the 1980's, other lasers such as the CO and Neodymium YAG (Nd: YAG) laser were introduced. The difference between lasers and other sources of light is that, lasers emit light which 'coherent'. The three additional characteristics of laser include 'collimation, coherency and efficiency.' Lasers were introduced into dentistry by Goldman *et al* in the year 1965 (Goldman, 1966). He studied the effects of laser on dental and soft tissues. It was in the year 1985 that the first invivo study to assess the effect of lasers in caries removal was carried out by Myers and Myers (Myers, 2000). The laser used for this was the Nd: Yag laser. Traditionally, Lasers have been used in oral and maxillofacial surgery for preprosthetic surgery, excision of benign and malignant lesions, treatment of coagulopathic patients and in the excision of vascular lesions etc. Strong *et al*. used carbon dioxide lasers in the early 1970's for the excision of malignant and premalignant lesions (Strong *et al*., 1972). Kaplan *et al*. removed benign tumours and superficial oral cavity cancers, using the argon laser (Kaplan, 1974).

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Apfelberg removed vascular lesions such as hemangiomas (Apfelberg, 1987). Ackermann (Ackerman, 1984) introduced the usage of neodymium: yttrium –aluminium – garnet for oral surgical procedures in hemophilic patients, which has proven to be highly beneficial. Thus lasers have created a pathway for several treatment procedures in oral and maxillofacial surgery. Today, lasers have replaced scalpels and thereby have also led to the possibility of laser skin resurfacing, etc. Many procedures which can also be carried out through the routine treatment modality, are now carried out using lasers due to its tremendous benefits in hemostasis, decreased scarring and post operative pain. The usage of lasers has been extended to dental implantology, management of temperomandibuar disorders, sleep apnea. This article is a brief review of the various applications of lasers in oral and maxillofacial surgery.

Classification of Lasers

According to Robert Strauss (Robert, 2004), lasers can be classified as follows:

- Gas Lasers :
- Helium Neon
- Carbon Dioxide
- Argon
- Solid Lasers :
- Ruby
- Neodymium YAG
- Neodymium glass

- Semiconductor
- Molecular Lasers :
- Excimer
- Free electron Lasers

Lasers can also be classified as

- Hard tissue lasers
- Soft Tissue lasers

Lasers in oral and maxillofacial surgery: The lasers used for oral and maxillofacial surgical procedures are of several wavelengths. The most widely used laser is the carbon dioxide laser (CO) because of its excellent affinity for water based soft tissues. The Carbon Dioxide laser has a wavelength of 10,600 nm. It is used for both intraoral and extraoral soft tissue surgical procedures. As Robert Strauss quoted (Robert, 2004), in the 1980's, the hollow wave guided technology was introduced thereby making the usage of CO_2 lasers easier. Romanos *et al*. stated that most oral surgical procedures can be carried out without local anaesthesia using Nd:YAG laser, as this had a pulse duration shorter than the time required to initiate a nerve action potential (Romanos, 1994). White *et al*. concluded that Nd:YAG laser can be used for intraoral soft tissue applications without anaesthesia and with minimal bleeding (White, 1991). The erbium: YAG laser has a wavelength of 2940 nm, and is highly useful for dental implant and cosmetic facial surgical procedures, as stated by R. Strauss[8]. The holmium: YAG laser is used for TMJ disorders treatment. Romanos found that the diode lasers have higher precision than the CO_2 and Nd:YAG lasers.

Application of lasers in oral and maxillofacial surgery

Incisional and excisonal procedures: The most common and essential use of lasers in oral and maxillofacial surgery is as a replacement to the conventional scalpels. As Robert Strauss (Robert, 2004) quoted, the 'Focused mode' technqiue is used to make an incison, wherein a small spot of 0.1-0.5mm size is created using a power of 4 to 10 W. The usage of lasers has the advantage of minimal bleeding and scarring and hence does not require suturing, unless it is required for the purpose of cosmesis. Lesions such as fibroma, mucocele, papilloma, gingival lesions, tongue lesions, benign salivary gland lesions, salivary stones and procedures such as incisional and excisional biopsy, vestibuloplasty etc. are carried out using lasers.

Ablation and vaporisation procedures: Vaporisation, also called as 'tissue ablation' is carried out to superifically remove a tissue. This is performed when the lesion is confined to the epithelium alone or the epithelium and the underlying superficial submucosa. Robert Strauss *et al*. described the technique used for this as the 'defocused' method, in which a spot size of 1.5 to 3mm is used (Robert, 2004). The power used is the same as for incisional and excisonal procedures. Ablation is used for the removal of small amounts of tissue. R. Strauss *al*. quoted that apicocectomy can be carried out using the Er: YAG laser initially, followed by the Co_2 laser, which helps in the complete removal of tissue remnants (Strauss, 2000). The lesions that are treated by this procedure include leukoplakias, lichenplanus, papillomatosis, hyperkeratosis, oral melanosis, tissue hyperplasia *et* etc.

Hemostasis: The most important property of lasers is that it provides a bloodless surgical field for the operating surgeon. It is therefore used in order to induce hemostasis in the operating site. The principle behind this property of lasers is that it causes contraction of the vascular wall collagen, which leads to the constriction of the vessel opening thereby causing hemostasis (Robert, 2004).

Cosmetic surgery: Although the usage of lasers was initially confined to basic procedures, in the recent times lasers are being increasingly used for cosmetic procedures such as cosmetic skin resurfacing to treat skin wrinkles and remove facial lesions (Robert, 2004). Lasers will remove only the layers of tissue and do not damage the underlying reticular dermis, hair follicles, sebaceous glands etc. Some of the conditions treated thus are tissue tags, epidermal nevi, skin wrinkles, melasma. Procedures such as endoscopic brow lift, blepharoplasty, scar revision etc are also performed (Robert, 2004).

Laser assisted uvuloplasty: Snoring and mild sleep related disorders are treated by uvuloplasty procedures. Kammami *et al*. in the year 1990 described the usage of lasers for this uvuloplasty procedure (Kamami, 1990). The technique and procedure havenot been widely accepted and is hardly used.

Dental implantology: El Montaser *et al*. suggested the usage of lasers in the hard tissue preparation for implant placement (ElMontaser, 1999). But, lasers are primarily used only for the treatment of peri-implantitis. R. Strauss *et al*. stated that lasers have beneficial properties in soft tissue management surrounding dental implants. Kriesler *et al*. studied the effects of various lasers such Nd:YAG, Er:YAG, Co_2, Ho:YAG on metal surfaces [14]. It was concluded that Nd:YAG and Ho:YAG lasers should not be used for implant surgery as they harm the surface of endosseous implants. They described that Co_2 and Er:YAG lasers should only be used at low power. The usage of lasers in second stage implant surgery is very limited. However, using Er:YAG laser was found to be less traumatic and also aided in decreasing post operative pain at this stage, as studied by Arnabat Dominguez *et al*. (2003). Robert Strauss *et al*. stated that the treatment of peri implantitis is carried out using Co_2, Er:YAG and diode lasers (Robert, 2004).

Temperomandibular joint surgery: The primary treatment modality for internal derangements of temperomandibular joint is arthroscopic surgery. Lasers can be used in these procedures as they provide hemostasis within the joint without causing thermal damage. Robert Strauss quote dthe use of Co, Er:YAG and Ho:YAG lasers for this (Robert, 2004). Procedures such as diskoplasty, diskectomy, synovectomy, eminectomy etc. are carried out using lasers.

Scar revision: In today's world removal of scars and esthetic improvement are of primary importance. Maxillofacial procedures often tend to cause scars. Pulse dyed lasers (PDL'S), Er:YAG and CO_2 lasers can be used for these procedures. Bradley *et al*. described the usage of PDLs for treatment of hypertrophic scars [16]. Atrophic scars are treated with Er:YAG and CO_2 lasers as mentioned by R.Strauss (Robert, 2004).

Pediatric surgery: Strauss quoted that Co_2 lasers are effective in cleft surgery in implants. Congenital vascular malformations such as hemangiomas are treated by argon, Nd:YAG and dye lasers (Strauss, 2000).

Aphthous stomatitis and aphthous ulcers: S.A.Kahraman *et al*. stated that low level laser therapy can be used in the treatment of recurrent aphthous ulcers, aphthous stomatitis, as it promotes wound healing (Sevil, 2004)

Herpes infections: Schindl discovered an immune stimulating effect of low level laser therapy which showed remarkable ffect in the treament of herpes simplex infections (Schindl, 1999).

Advantages of laser surgery:

Laser surgery has the following advantages

- Reduces the need for anaesthesia
- Minimises postoperative swelling, discomfort, pain and scarring.
- Provides a bloodless surgical field as it aids in hemostasis.
- Reduces necessity for sutures
- Improved wound healing

Disadvantages of laser surgery

- Laser equipment are quite expensive, hence it is not always affordable.
- It requires highly trained professionals
- Scattered and reflected laser beams pose a massive health hazard

Conclusion

Lasers have become an essential an indispensable part of oral and maxillofacial surgical procedure. It has enhanced the traditional surgical procedures and has also led to the introduction of several new and pathbreaking treament modalities in the field of surgery. In today's world with esthetics playing a major role, lasers are a boon, as it has enabled treatment of most esthetic concerns, which was previously impossible. Lasers have tremendously improved patient care and has also eased the procedures for the operating surgeons. In the coming years, lasers will definitely see a lot of breakthroughs and advancements.

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