Research Paper Medical Science

LASER : The Wonder Tool

Dr Tim Peter | Senior Lecturer, Department of Oral Medicine & Radiology, KMCT Dental College, Manassery, Calicut, Kerala.

ABSTRACT

Lasers have been used for oral soft tissue dental procedures for more than 30 years and have been researched since the middle 1960 s. Their reported benefits over conventional treatment modalities include: reducing the number of appointments, reducing stress, improving visibility, improving patient comfort and reducing patient complications. Critics have commented that most of these advantages are anecdotal and need to be sustained with further research. This article briefs the available information on lasers in the field of dentistry and its potential to become a wonder tool, which can revolutionize the field of dentistry in the years to come.

KEYWORDS Lasers

INTRODUCTION:

Lasers are devices that produce intense beams of light which are monochromatic, coherent and highly collimated. The wavelength (colour) of laser light is extremely pure (monochromatic) when compared to other sources of light, and all of the photons (energy) that make up the laser beam have a fixed phase relationship (coherence) with respect to one another. Light from a laser has very low divergence. It can travel over great distances or can be focussed to a very small spot with a brightness which exceeds that of the sun. Because of these properties, lasers are used in a wide variety of applications in all walks of life.

The basic operating principles of the laser were put forth by Charles Townes and Arthur Schalow from the Bell Telephone Laboratories in 1958, and the first actual laser, based on pink ruby crystal was demonstrated in 1960[1] by Theodor Maiman at Hughes Research Laboratories.

The term LASER is an acronym for (L)ight (A)mplification by (S) timulated (E)mission of (R)adiation. Light is an electromagnetic radiation ranging from 1 nm to 1000 μ m in wavelength.

The visible spectrum ranges from 0.4 μ m to 0.7 μ m. The wavelength range from 0.7 μm to 10 μm is considered as near Infrared (NIR) and anything beyond is far Infrared (FIR). Conversely 0.2 μm to 0.4 μm is called Ultraviolet; below 0.2 μm is the deep ultraviolet (DUV).

TYPES OF LASERS:

Gas lasers : Neutral atom lasers, Ion lasers, Metal vapour lasers, Molecular lasers, Excimer lasers, Nonlinear mixing, Chemical lasers.

Solid state lasers : Transition metal ion lasers, Rare earth ion lasers, Colour centre lasers, Frequency shifters

Liquid lasers : Organic dye lasers, Rare earth ion lasers, Inorganic rare earth liquid lasers.

Semiconductor lasers.

PRINCIPLE:

The oral cavity contains a variety of soft tissue types including but not limited to dental pulp, mucosa, keratinized and non-keratinized gingiva.[2]But specific difference can exist for each tissue type, depending on location, tissue thickness and degree of health.[3]

Depending on the wavelength of the laser device, following interactions can be seen in varying degrees:

Reflection : no interaction occurs as the beam reflects off the surface

Transmission : no interaction occurs as the beam passes directly through the tissue

Scattering: an interaction as the beam disperses in a non uniform manner throughout the tissue

Absorption: light radiation is absorbed by specific tissue elements.

The predominant laser interactions within oral soft tissue are absorption and scattering. Tissue composition, laser emission mode, fluence and thermal relaxation also affect tissue interaction.

Wavelength and tissue type:

Laser wavelengths have been shown to be absorbed by different components such as hemoglobin, melanin, water and hydroxyapatite. Currently available dental lasers operate in the visible or near infrared region (532-1340 nm) near the boundary of the mid infrared (2780 and 2940 nm) and far infra red (10,600 nm) regions of the electromagnetic spectrum. With respect to the ligh radiation interacting at the tissue surface (incident beam), interaction is primarily determined by the laser irradiation affinity for specific chromophores compromising the tissue.[4]

A chromophore is a molecule or substance capable of absorbing specific laser wavelengths.

LASER DEVICES CURRENTLY AVAILABLE TO THE DENTAL PROFESSION				
Laser Device	Wave length(s)	Emission mode(s)	Delivery system	Primary soft tissue chromophore
KTP (Potassium Titanyl Phosphate)	532 nm	Continuous Wave (CW) / gated CW	Optic fiber	Melanin / Hemoglobin
Diode	810,940, 980, 1064 nm	CW / gated CW	Optic fiber	Melanin / Hemoglobin
Neodymium (Nd): YAG	1064 nm	Free-running pulsed (FRP)	Optic fiber	Melanin / Hemoglobin
Nd: YAP ($YAlO_3$ Perovskite)	1340 nm	FRP	Optic fiber	Melanin / Hemoglobin

Erbium Chromium (Er, Cr): YSGG	2780 nm	FRP	Optic fiber	Water
Er.YAG	2940 nm	FRP	Wave-guide / Optic fiber, Articulated arm	Water
CO_2	10,600 nm	CW / gated CW	Wave-guide, Articulated arm	Water

APPLIED ASPECTS:
The inclusion of lasers in oral and maxillofacial surgery has been in use since the mid 1960 s. Lasers have been used as scalpels for tissue removal in the facial region and in oral cavity.

Several types of lasers are used in oral and maxillofacial surgery. The effect of the laser beam on biological tissue depends on the wavelength of the monochromatic light that can be reflected, scattered or absorbed. Different components of biological tissue absorb light in different wavelength regions, followed by a deposition of energy in the tissue. Surgical lasers in oral and maxillofacial surgery are generally used in two different modes in terms of beam characteristics. On the one hand, the laser can be used in a focused mode, concentrating the energy on a very small region of 0.1 – 0.5 mm. in size. This kind of laser beam is used for incisions and excisions, as a non-contact laser scalpel.

On the other hand, the laser can be used in a defocused mode, extending thediameter of the laser beam to approximately 1-5 mm in size. In this mode, the laser beam can be used to exactly ablate superficially spreading tissue areas, layer by layer. This superficial and areal ablation technique is a unique surgical procedure that uses a laser technique for the vapourization of spots detected to be a precancerous growth in the oral cavity. In addition, the total energy that is deposited in the tissue with both modes depend on the time of application and the chosen power, characteristics that are different for each type of laser.

SALIENT FEATURES:
1. Minimally invasive
2. Improved hemostasis when compared to scalpel
3. Reduce bacterial contamination
4. Healing by photo biomodulation
5. Reduces pain
6. Avoiding complications
7. Anatomical aspects
8. Soft tissue considerations
9. Safety aspects

LIMITATIONS:
Histological evidence might be tarnished following the use of laser in operative cases. Thermal alteration may range from transient heating to protein denaturation, evaporation of water, carbonization or complete thermal destruction in terms of tissue burning. Several lesser parameters have an impact on the extent of the thermal alteration

CONCLUSION:
The use of laser technology has been shown to be a viable and effective adjunct to conventional dental surgical techniques, and a useful alternative in certain situations. Because of its documented advantages laser technology should be utilized wherever clinically indicated in soft tissue procedures. When the practitioner adheres to sound principles and good technique, the benefits of laser use that have been proven with valid research can be seen clinically by the dental personnel and by the ultimate beneficiaries – the patients.

REFERENCES

1. Myers TD, Myers WD, Stone RM. First soft tissue study utilizing a pulsed Nd:YAG dental | laser. Northwest Dent 1989;68(2):14-7. | 2. Ball K A. Lasers: The perioperative challenge. 3rd Edition. Denver, Colo 2004:14-8. | 3. Kao RT, Pasquinelli K. Thick versus thin gingival tissue: A key determinant in tissue | response to disease and restorative treatment. J Calif Dent Assoc 2002;30(7):521-6. | 4. Manni J G. Dental applications of advanced lasers (DAAL). Burlington Mass.:JGM | Associates, Inc.,2007:5-5. |