ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 1(A), pp. 22888-22892, January, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

LASER - A RAY OF NEW HOPE

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DOI: http://dx.doi.org/10.24327/ijrsr.2018.0901.1356

ARTICLE INFO

Article History:

Received 05th October, 2017
Received in revised form 21st November, 2017
Accepted 06th December, 2017
Published online 28th January, 2018

Key Words:

Laser, Periodontics, Diode laser, Clinical applications

ABSTRACT

The advent of newer modalities of treatment heralds a change in dentistry. One such modality, lasers have been widely researched. Lasers have various periodontal applications including frenectomy, fiberotomy, gingivectomy/gingivoplasty, second stage implant surgery, soft tissue biopsy, de-pigmentation, etc. This case series gives us a summary of the unique intra-operative and post-operative features of lasers which makes the procedures more acceptable to the patients, helping them overcome the fear of conventional surgeries.

INTRODUCTION

The use of laser based treatment modalities have become a common phenomenon in medical field. With the recent advances and developments of wide range of laser wavelengths and different delivery systems, researchers suggest that lasers could be applied in various aspects of dentistry such as periodontal, restorative and surgical management. From the end of the 20th century until now, there has been a continuous upsurge in the development of laser-based dental devices. In fact, the French postal service released a memorial stamp showing laser as one of the five greatest innovations of science in the 20th century. The numerous advantages of lasers have made dental treatment more patient friendly with increased patient acceptance.

Based on the Albert Einstein theory of spontaneous and stimulated emission of radiation, Maiman developed the first laser prototype in 1960[1]. His laser device was named as Maser. The first application of a laser to dental tissue was reported by Goldman *et al* in 1964 but it was a failure[2]. In 1984 Meyer *et al* reintroduced laser into dentistry describing the in-vivo removal of dental caries using a modified ophthalmic Nd:YAG laser. Laser is an acronym of light amplification by stimulated emission of radiation[3]. Laser is monochromatic, unidirectional, coherent and collimated.

Components of laser device

There is an optical cavity at the centre of the laser device and two parallel reflective mirrors on either side. The core of the cavity is comprised of an active medium which may be solid, liquid, gas or semiconductors based upon which lasers are classified. All these are covered by an aluminium reflecting cylinder. When the laser is activated through the optical, electrical, or chemical source, the electrons are excited and then return back to the ground state. This results in the emission of photons which are reflected by the mirrors and stimulates other electrons to emit photons. A chain reaction of photons begins and laser begins to lase[4].

Laser action on tissues

Laser can be reflected, transmitted, scattered, or absorbed in tissues. However, it is absorption which has beneficial effects on the tissues. The photobiological effects of laser may be photothermal, photochemical, biostimulation, photoacoustic, photodynamic, photovaporolysis, or photoplasmolysis. Photothermal effects and biostimulation play a major role in periodontics.

Due to the photo thermal effect, the absorbed light energy is converted to heat and leads to three primary laser tissue interactions. When the focal spot is of small size it leads to incision or excision. When the focal spot is wider it leads to

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ablation or vapourisation. When the laser is out of focus mode it leads to haemostasis or coagulation.

Lasers are generally classified into two types, depending on their wavelength, as follows:

- Where the laser light penetrates the tissue more deeply (such as Nd:YAG and diode lasers).
- Where the laser light is absorbed in the superficial layers (such as CO2, Er:YAG and Er,Cr:YSGG lasers).

Depending on the penetration depth, the performance of each laser on soft tissue is different.

Laser can be classified based upon the active medium, wavelength, type of the tissues to which they are appliedas summarized in Table 1.

Table 1 Various types of lasers

Laser	Wavelength	Tissues
Diode	800nm-900nm	Soft and Hard
Nd:YAG	1064 nm	Soft
Er:YAG	2940nm	Hard
ErCr:YSGG	2780nm	Hard
CO2	10600 nm	Soft
Argon	514 nm	Soft

Based on the emission modes it may be continuous or pulsed[5]. In pulsed mode, the targeted tissue has time to cool before the next pulse of laser energy is emitted. Based on clinical mode, it may be in contact or non-contact mode. In non-contact mode tip is kept 0.5 to 1 mm away from tissue so that laser energy delivered at the surface is reduced.

Clinical applications in periodontics[6]

- Initial non-surgical pocket therapy
- Frenectomy
- Gingivectomy
- Soft tissue grafting
- De-pigmentation
- Desensitization removal of granulation tissue
- Osseous recontouring
- Crown lengthening
- Surgery- implants
- Peri-implantitis
- Operculectomy
- Management of oral pre-malignant lesions[7]

Case reports

Case 1

A 15 year old male patient reported with the chief complaint of difficulty in speech. Patient had difficulty in articulating certain alphabets. He had high lingual frenal attachment (Figure 1A). Lingual frenectomy was planned under laser. An anchoring suture was put at the tip of the tongue and lingual frenum was relieved using laser in 2.5 watts power. The site was bloodless during surgery (Figure 1B). There was no need for sutures. Bloodless surgical field and perfect haemostasis was achieved in laser surgery compared to conventional method. Healing was good even on day one after surgery (Figure 1C). Patient was then referred for speech therapy. Tongue exercises were taught to him. After 8 weeks he was able to raise his tongue and touch the palate (Figure 1D).

Figure 1 A) High lingual frenalattachment B) Intra operative view showing bloodless surgical field C) Healing on day one post operatively D)Eight weeks post-operative view showing improved tongue movements.

He was able to put the tongue out of the mouth crossing the lower lip which touched only the tips of lower incisors pre operatively.

Case 2

A 27 year old female patient reported with a growth in the left buccal mucosa near the angle of the mouth for past one year. She had the habit of cheek biting. Based on the history and clinical examination, the case was provisionally diagnosed as traumatic fibroma (Figure2A). Laser excision was planned. An anchorsuture was put at the base of the growth and was excised using laser in 2.5 watts power (Figure2B) and the specimen was sent for biopsy. The field of surgery was bloodless and there was no need for sutures(Figure2C). The tissue was sent for histopathology and the report confirmed the clinical diagnosis. The surgical area healed almost on the very next day and there was no sign of surgery on the seventh day (Figure2D). There was no evidence of recurrence during the six months follow up period.

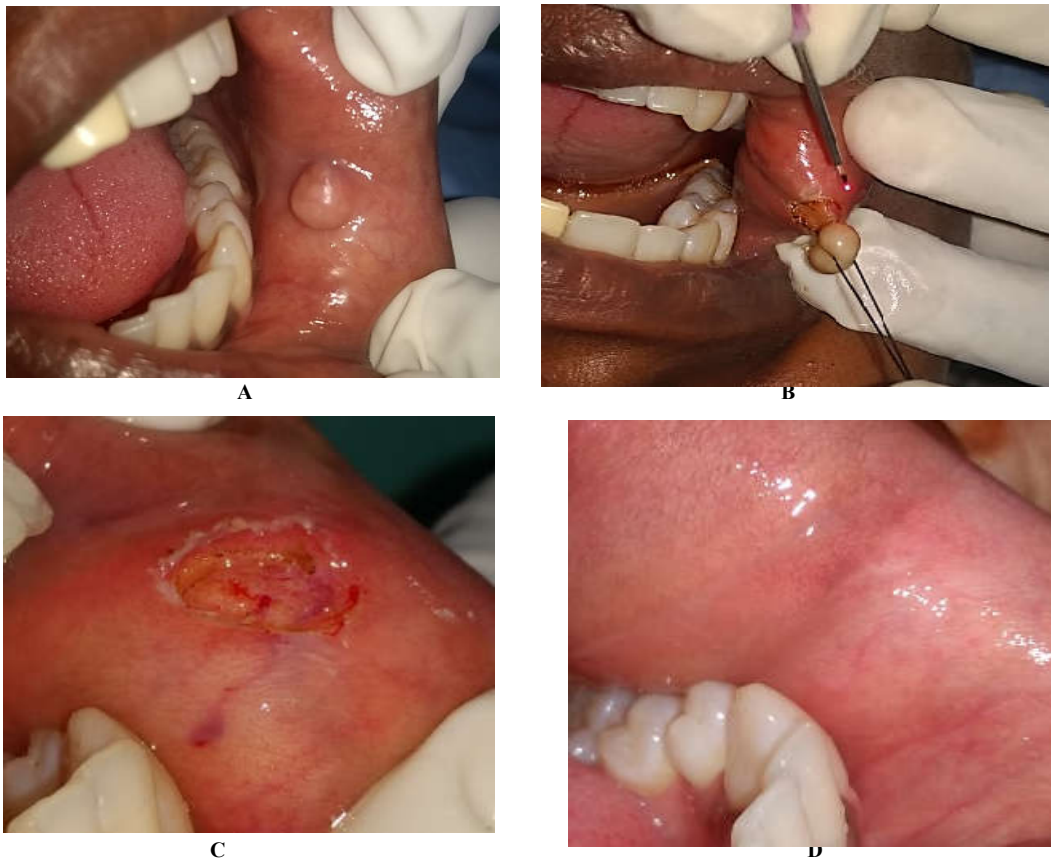


Figure 2 A)Pre-operative view B)Intra operative view C) Immediate post-operativeviewD)Fifth day post-operative view showing no trace of surgery.

Case 3

A 20 year old female patient reported with the chief complaint of dark gums which was evident when she smiled (Figure 3A). Laser de-pigmentation of the anterior esthetic region was planned. The procedure was done quadrant wise from incisors to canine using diode laser in 0.8 watts power(Figure3B).One month post operatively, a satisfactory esthetic transformation was achieved (Figure3C).

Case 4

Twenty year old male patient reported with the chief complaint of swollen gums for past 4 months (Figure4A). On clinical examination the gingival enlargement was fibrous. His medical history was non-contributory. The enlargement persisted even after phase one therapy, hence planned for laser gingivectomy. Gingivectomy was performed using diode laser with the power input of 4watts(Figure4B).Gingivectomy was done with constant sweeping motion to avoid hot tip effect[8].Immediate post op showed a clean bloodless surgical field(Figure4C).We can also see the inadvertent de-pigmentation that happened in this case which made the patient more satisfied(Figure4D)

Diode laser

Diode laser is a solid-state semiconductor laser that typically uses a combination of Gallium(Ga),Arsenide(Ar), and other elements such as Aluminum(Al) and Indium (In). The characteristic features of diode lasers are summarized in Table 2. Diode laser is primarily used for all minor soft tissue surgical procedures[9]. The chief advantage of the diode lasers is that it is a small size, portable instrument.

Advantages[10]

- Sterile surgical field
- Better hemostasis
- Better visualisation
- Easy handling
- No need for sutures
- Lesser surgical time
- Faster healing
- Patient comfort
- Decreased scarring
- Higher esthetics

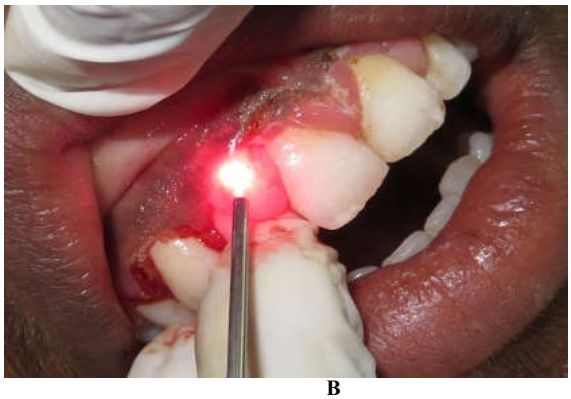
A

B

C

Figure 3 A) Pre-operative view B)1week post-operative view after laser depigmentation of second quadrant C) Post-operative view.

A



B

C

D

Figure 4 A)Preoperative view B) Intra operative view C)Immediate post operative view
D)One month post operative view

Limitations

- Expensive.
- Technique sensitive.
- Inadvertent irradiation.

Precautions[11]

- Glasses for eye protection.
- Use wet gauze packs to avoid reflection from shiny metal surfaces.
- Ensure adequate high speed evacuation to capture the laser plume.
- The diode laser exhibits 'hot-tip' effect caused by heat accumulation at the end of the fiber. To avoid this, a continuous sweeping motion of the laser tip should be employed along with constant removal of the charred tissue from the tip.

CONCLUSION

Application of lasers has opened a new arena in the field of dentistry, and has been very well recognized as an adjunctive or alternative approach to surgical periodontal therapy.The numerous merits of laser have ensured that they will be an integral part of periodontal management strategies and continue to expand its horizon in the future.

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How to cite this article:

Jaishree Tukaram Kshirsagar *et al*.2018, Laser - A Ray of New Hope. *Int J Recent Sci Res.* 9(1), pp. 22888-22892.
DOI: http://dx.doi.org/10.24327/ijrsr.2018.0901.1356

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