REVIEW ARTICLE

LASERS IN PERIODONTICS: HOW FAR?

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Abstract

Since the advent of LASERs, the applications of it have revolutionized the treatment modalities in medical field. It has been used as an useful tool for periodontal therapy. So many researchers have studied the usefulness of LASERs in the field of Periodontics. Even though it has some limitations it is now very popular among periodontists. More research is necessary to establish its empire in periodontal therapy. The purpose of this article is to enlighten the uses of LASERs in both non-surgical and surgical periodontal therapies.

Key Words LASER, Non-surgical Therapy, Surgical Therapy, Hemostasis, Healing, Depigmentation, Melanocytes

INTRODUCTION

From the time of invention of LASERs in 1960s, the use of LASERs in the field of periodontics is increasing day by day. It has been applied in both the non-surgical and surgical periodontal therapy.[1,2]

Recently use of LASERs has become a trend.[3] Now the researches are concentrated more on the interaction between hard tissue with LASERs. Despite more researches, controversy remains regarding the beneficial effects of LASERs and unavoidable damage to surrounding structures. Whether LASER therapy is useful in non- surgical therapy, or it is only a surgical weapon, is still to be explored. Whether LASER therapy in periodontal diseases would be useful over the conventional therapy is still to be established.

USE OF LASER IN NON-SURGICAL THERAPY:

In periodontal pockets, bacteria and bacterial toxins contaminate root cementum, and cause inflammation of tissue. So the complete removal of plaque and calculus is necessary for periodontal health. Basically the aim of periodontal therapy is to restore the healthy condition of root surfaces and make it favorable for new attachment for periodontal tissues.

SCALING AND ROOT PLANING:

Interactions between LASERs and the root surface : LASERs can induce melting and solidification of surface mineral yielding a nonporous glaze that histologically appears hypermineralized.[4] In vitro fibroblast attachment was suppressed on LASER-treated surfaces and Fourier transform infrared photoacoustic spectroscopy showed a decreased protein: mineral ratio.[5] A subsequent paper by Thomas et al. showed the in vitro fibroblast attachment problem associated with lased root surfaces to be reversible if specimens were treated by root planing or an air-powder abrasive slurry.[6]

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LASER and calculus and microbial interactions:

As shown in Table 1, there are various studies to say that LASER therapy prevents accumulation of plaque and has bactericidal effects. Both CO2 and Nd:YAG LASERs can meltdown calculus, but complete removal are not possible. LASER has appeared to separate calculus from underlying cementum (Fig. 1).

Redirection of penetrating LASER energy along the interface of two dissimilar tissues causes the separation of calculus from cementum. But for complete removal further scaling is needed. So LASER therapy can not be an alternative to scaling and root planing. Access to areas such as furcations, concavities, grooves for conventional mechanical debridement is limited. The advantage of LASERs is that it can reach sites that are nearly inaccessible to conventional mechanical instruments. In that case it can be used as adjunct.

USE OF LASERS IN SURGICAL THERAPY:

LASERs are useful for frenectomies (especially lingual frenectomies)[21], biopsies (especially from mucosa, tongue, and palate), gingivoplasty, and gingivectomy, excision of growth in oral cavity.

Crown Lengthening Procedure[22]:

Recently, LASERs have been promoted for esthetic crown lengthening, including flap and osseous surgery. But ostectomy is required for crown lengthening procedure. LASER does not work as well for bone removal as does a bur. Callahan[11] has suggested that the healing delay may result from thermal alterations in matrix proteins, inactivation of normal cellular signaling mechanisms, and inhibition of osteoclast, macrophage and osteoblast activity. There is no added advantage over conventional procedure.

Table 1 : Published literature on hard tissue interaction with lasers:

AUTHOR	TYPE OF LASER	REMARKS
Nuss et al.[7]	Nd:YAG	Effects on bone when used for resection
Iwase et al.[8]	He-Ne	Inhibition of plaque accumulation in hamsters
Frentzen & Koort[9]	ArF	Removed plaque, calculus and cementum in vitro
Tseng & Liew[10]	Nd:YAG	Separated calculus from root surface
Callahan[11]	CO_2	Osseous healing was delayed compared with bur cuts
Rayan et al.[12,13]	CO_2	Effects on cortical bone show 3 layers of heat injury
Latif et al.[14]	Nd:YAG	Laser effects during bone surgery
Trylovich et al.[15]	Nd:YAG	Fibroblast attachment suppressed on lased surface
Spencer et al.	Nd:YAG	Fourier transform infrared photoacoustic spectroscopy showed decreased ratios, lased root surface changes are reversible by planning
Cobb et al.[16]	Nd:YAG	*In vivo* suppression of microbial flora lasted up to 7 days in periodontal pockets.
Renton-Harper & Midda[17]	Nd:YAG	Successful reduction in dentinal hypersensitivity
Morlock et al[18]	Nd:YAG	Separated cementum from dentin
Rizoiu & Levy[19]	Nd:YAG	Water cooling lessened damage to underlying bone
Williams et al.[20]	CO_2	Degranulation of infrabony defects in dogs

Electron photomicrograph of interface between cementum and calculus. Note how calculus has separated from the underlying cementum surface (arrows). Where the laser beam was not in contact with the calculus, there is no subjacent separation from the cementum (curved arrow). Bar=0.l mm at an original magnification of X 186. Adapted from: Jeffrey A . Rossmann & Charles M .Cobb, Lasers in periodontal therapy, *Periodontology 2000, Vol. 9, 1995, 150-164. (Reproduced with permission from M/S- John Wiley & Sons Ltd, UK).*

Gingival Curettage: It has been well established that gingival curettage offers no additional benefit over scaling and root planing. Earlier it was thought that curettage promotes attachment of new connective tissue after removal of pocket epithelium. But practically in most of the cases long junctional epithelium is formed and is attached to root surfaces which can be achieved by scaling and root planing alone. Following an extensive review in the 1989 World Workshop in Clinical Periodontics, it was concluded that gingival curettage had no justifiable application in the treatment of chronic periodontitis.[23] The poor outcome of curettage may be due to lack of tool for effective soft tissue debridement. Soft tissue ablation effect of LASER along with bactericidal effect may be beneficial. This procedure might be more effective for the treatment of residual pockets after initial therapy and during maintenance.[24] Today LASER has been promoted for gingival curettage as LASER-assisted new attachment procedure. As there is no clear evidence that LASER applications improve clinical outcome due to the action of curettage,[25] further investigations are needed.

Flap procedures: There is no methodology to say the use of LASER is superior in periodontal surgical procedures. There are certain advantages of using LASER in surgery. These are as follows:

i) Reduced need for anesthesia[26]

ii) Hemostasis[27,28,29]

iii) Minimal wound contraction and scarring: There are few myofibroblasts found in the base of the wound during healing (compared with scalpel wounds) and there is a resistance in the disruption of the extracellular structural proteins to the LASER and the slow removal and replacement of the residual matrix. All of these factors lead to very little wound contraction and minimal scarring.[30]

The LASER wound in soft tissue has unique characteristics not found in any other surgically created wound. The cellular disintegration caused at impact does not allow for the release of chemical mediators of inflammation, which leads to a reduced acute inflammatory response compared with scalpel-created wounds. A thin layer of denatured collagen on the surface of the wound also reduces the degree of tissue irritation from oral fluids and serves as an impermeable dressing.

The main disadvantage of LASER surgery is delayed healing. Re-epithelialization of the LASER wound compared with conventional wounds is delayed because of following reasons:

1) The LASER wound margins show thermal necrosis and formation of a firm scar that impedes epithelial migration[31]

2) The decreased wound contraction leaves a larger surface area to cover[32,33]

3) Reduced inflammation in the LASER induced wound may provide less stimulation for epithelial migration[34,35]

Excision of Growth: As because better hemostasis can be achieved by LASER therapy, it would be beneficial to use LASER in excision of growth specially the highly vascular lesions. LASER can help also in blocking blood vessels and causing the arrest of bleeding. Excision of pyogenic granuloma, pregnancy tumor, fibro-epithelial polyp, peripheral giant cell granuloma can be excised precisely in a bloodless field by LASER.

Gingival Depigmentation: Many people are concerned with their unaesthetic appearance of their black gum due to excessive melanin pigmentation. Gingival depigmentation can be performed by conventional surgical method as well as LASER therapy. Recently, LASER ablation has been recognized as the most effective, pleasant, and

reliable technique in removing the gingival pigments.36 Both the soft tissue and all tissue LASER can effectively remove gingival pigmentation. But the main problem is repigmentation after depigmentation. The time period to reappear pigmentation is not predictable. Repigmentation occurs as a result of failure to remove all active melanocytes from the basal cell layer of the epithelium.[37] Laser treatment of gingival melanin pigmentation has a number of advantages over other treatment modalities, including low intra and postoperative pain levels due to the protein coagulum formed on the wound surface acting as a biologic dressing or to the laser's ability to seal the ends of sensory nerves.[38]

CONCLUSION

In summary, LASERs do have importance in selected treatment procedures, especially in surgical procedures. But in recent days the use of LASERs became a trend and it is over-promoted. There should be more investigations regarding the efficacy of LASERs in treatment of periodontal diseases. More advancement is required to increase its effectiveness, avoid damage to surrounding structures.

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