PERSONIFICATION OF LASERS IN ROOT BIOMODIFICATION REVISITED
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ABSTRACT
Numerous modalities have been advocated for periodontal regeneration and restoring the periodontal health, including, the modification of the root surface that is biomodification procedures in order to detoxify, decontaminate, and demineralised the root surface. Laser therapy has been investigated for a wide range of dental applications, although its effect as a root conditioning agent is yet to be explored. Hence, to explore the same, EBSCO HOST was searched for entries since 1966 – 2014, which included:- Journal of Periodontology, Annals of Periodontology, Periodontology 2000, Journal of Clinical Periodontology, International Journal of Periodontics and Restorative dentistry, Journal of Indian Society of Periodontology and Journal of Periodontal Research. A total of 11 studies were reviewed, out of these 11 studies, only, 2 reported evidence of regeneration for lasers. It was found that the role of lasers as a root conditioning agent in regeneration is still controversial and questionable.

KEYWORDS: Root biomodification, lasers, root conditioning

INTRODUCTION
Periodontitis is an inflammatory process of bacterial origin that affects the periodontal tissues, provokes the destruction of supporting tissues of the teeth, producing substantial changes on the root surface which is referred to as ‘pathologically exposed’ root surface. Various cytotoxic substances, plaque and calculus penetrate the pathologically exposed root surface and act as physical barrier inhibiting the new attachment and providing a substrate for bacterial growth. Such surfaces are not biocompatible with periodontal cells, the proliferation of which is paramount for periodontal wound healing. These barriers cannot be eliminated by scaling and root planning alone. Rather, root planning often leads to the formation of smear layer, which itself act as an obstacle for new attachment.

Hence, modification of the root surface by various means, known as biomodification procedures, has been introduced by using a variety of agents, in order to detoxify, decontaminate, and demineralise the root surface, thereby removing the smear layer and exposing the collagenous matrix of dentin and cementum.

Recently, laser therapy has been investigated for a wide range of dental applications. A number of commercially available laser systems are available namely, carbon dioxide laser, Nd: YAG (Neodymium: Yttrium, aluminium and garnet) and Er: YAG (Erbium: Yttrium, aluminium and garnet) lasers. Few studies have reported evidences of new attachment after root conditioning with lasers.

MATERIALS AND METHODS


To identify studies not found in the databases search, certain issues of the following journals were searched manually: Journal of Periodontology, Journal of Clinical Periodontology, Journal of Indian Society of Periodontology and Journal of Periodontal Research.

Inclusion criteria:- Randomized controlled trials in systemically healthy human subjects; comparative, histology and animal studies, narrative reviews published in English; presenting any modality of root surface biomodification.

Exclusion criteria:- Studies lacking baseline–outcome comparisons; with insufficient data; with more than one variable in addition to root surface biomodification; and case reports, because of their weaker clinical evidence.

RESULTS AND DISCUSSION
The word LASER is the acronym for Light Amplification by Stimulated Emission of Radiation. A laser is a device that emits light through a process called stimulated emission, featuring collimated (parallel) and coherent (temporally and spatially constant) electromagnetic radiation of a single wavelength.
A total of 11 studies were reviewed, out of these 11 studies, only, 2 reported evidence of regeneration for lasers. It was found that the role of lasers as a root biomodification agent in regeneration is still controversial and questionable.

Laser light is produced by pumping (energizing) a certain substance, or gain medium, within a resonating chamber. The process of lasing occurs when an exited atom is stimulated to emit a photon before the process occurs spontaneously. Spontaneous emission of a photon by one atom stimulates the release of a subsequent photon and so on. This stimulated emission generates a very coherent and synchronous wave, of a single wavelength and in a collimated form (parallel rays) of light.

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The CO2 laser has a wavelength of 10.6 µm and can be used in either pulsed-wave or continuous-wave modes. Patel et al. were the first to develop carbon dioxide laser. With the CO2 laser, the performance advantages are the rapid and simple vaporization of soft tissues with strong haemostasis, which produces a clear operating field and requires no suturing and they are also capable of ablating the calcified tissues effectively. Several studies reported major thermal side effects, such as melting, cracking or carbonization when CO2 lasers were used directly on root surface. However, these negative effects were avoided when irradiation was performed in a pulsed mode with a defocused beam. The defocused mode of the CO2 laser has root conditioning effects, such as smear layer removal, decontamination and the preparation of a surface favourable to fibroblast attachment.

Misra et al. (1999) evaluated the effect of carbon dioxide laser on periodontally involved root surfaces and compared its efficacy with citric acid, EDTA, hydrogen peroxide in removal of root surface smear layer after root planning. Results showed that carbon dioxide laser produced surface charring and carbonization and were totally ineffective in exposing the dentinal tubules. However, in another scanning electron microscopic analysis, it was observed that increased fibroblast attachment occurred after root conditioning with carbon dioxide laser in defocused, pulsed mode with a low power of 2W combined with mechanical instrumentation.

The Nd:YAG laser has a wavelength of 1064 nm and operates in a free running pulsed mode. It is commonly used in periodontal therapy to incise and excise soft tissues as well for the curettage and disinfection of periodontal pockets.

Morlock et al. (1992) showed that the Nd:YAG laser at 1.25-1.50 W, pulse 20 Hz, produced surface pitting and crater formation with charring, carbonization, melting, even when irradiation was performed parallel to root surface. The removal of smear layer from the root surface is obtained only at powers that are not suitable for clinical use, either for a root alteration or for significant intrapulpal temperature rise.

Smith et al. (1995) investigated laser irradiation on untreated and root planed tooth roots to determine whether a cleaning effect and/or removal of smear layer could be achieved without concomitant microstructural or thermal damage. Smear layer elimination was achieved without inducing hard tissue microstructural damage at 5W, using pulse durations and intervals of 0.1 s, a fluence of 0.77 J/cm2, and a total energy density of approximately 700 J/cm2. However, these results were not consistent in all samples. At these parameters, intra-pulpal temperature increases of 9 to 22°C and surface temperature increases of 18 to 36°C were recorded.

Thus, despite of their effectiveness for smear layer removal, these parameters may not be appropriate for clinical use as an adjunct to conventional periodontal therapy.

The Er:YAG laser has a wavelength of 2490 nm. Its light is well absorbed by all biological tissue that contain water molecules, so that Er:YAG laser is indicated not only for soft tissues but also for ablation of hard tissues. In dental hard tissues the Er:YAG laser is absorbed by intrinsic water in apatite crystals and by OH group of the mineral apatite. So, Er:YAG laser has been used in a free-running pulse mode for caries removal and cavity preparation.

Er:YAG laser does not cause carbonization of the irradiated root surface, that becomes chalky due to the mechanical ablation. In particular the layer just beneath the ablated cementum reveals more structural changes and damages, with microstructural degradation and thermal denaturation. The use of a water coolant results in less damage and a cleaner surface.

On periodontal disease root, the Er:YAG laser treatment shows a better attachment and a better condition for fibroblast adherence compared to a diseased root treated only by mechanical means. These better results may be due to detoxification and disinfection obtained by laser and to the absence of a smear layer on the surface.

Schwarz et al. (2001) showed that the clinical use of Er:YAG laser resulted in a smooth root surface, favorable for new attachment. Most probably as a result of the elimination of bacteria and endotoxins on root surfaces, human gingival fibroblasts adhere and grow significantly faster on a Er:YAG pretreated surface than after scaling and root planning.

Cekici et al. (2014) observed blood cell attachment and fibrin network formation following Er:YAG laser irradiation on periodontally compromised root surfaces in comparison to chemical root conditioning techniques in vitro. The results showed that Er:YAG laser application on the root dentin seems to form a suitable surface for fibrin clot formation and blood cell attachment.

Research conducted on lasers so far has indicated the safety and effectiveness of clinical application of the Er:YAG laser for root surface debridement than carbon dioxide and Nd: YAG laser.
CONCLUSION
Within the limitations of this review, it is possible to conclude that the application of laser as a root conditioning agent provide no or minimal clinical benefit with respect to gain in attachment levels or reduction in probing pocket depths. Thus, its role in regeneration is still questionable. Therefore, further studies are required to assess the beneficial effect of laser as a root conditioning agent on regeneration in larger sample size.

REFERENCES