Low Level Laser Therapy and Improved Wound Healing

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ABSTRACT

The use of laser light at different power levels that are capable of direct tissue change has been advocated in diverse branches of medicine and dentistry. In dentistry, many new developments can be applied in order to increase the success of treatment and patient comfort. For this purpose, Low-Level Laser Therapy (LLLT) applications have been widely used in periodontology. The use of LLLT in periodontology can be helpful in the treatment of periodontitis and also in avoiding the side effects of treatment. Various studies have established that inflammatory, hard and soft tissue healing processes, postoperative pain and dentinal hypersensitivity therapies may be affected positively from LLLTs. This article gives an overview of the efficiency of low power lasers in periodontal wound healing.

KEYWORDS: Low Power Lasers, Wound Healing, Photodynamic Therapy

INTRODUCTION

Low power lasers namely infrared and red lasers are light used in modern dentistry for various applications .These lasers are less expensive, with smaller biological effects and normally operate in the range of 1-500 milli watts. The lasers used for medical purposes are known by different names such as therapeutic lasers, soft lasers and low intensity level lasers. Similarly the therapy has been referred as "Low level laser therapy" (LLLT), "biostimulation" and "biomodulation". The latter term is more accurate because it can not only stimulate, but also suppress biological processes.[1]

Properties of low power lasers: According to Posten et al. properties of low level lasers are:

- Power output of lasers being 0.001- 0.1 Watts.
- Wave length in the range of 300-10,600 nm.
- Pulse rate from 0, meaning continuous to 5000 Hertz (cycles per second).
- Intensity of 0.01-10 W/cm^2 and dose of 0.01 to 100 J/ cm^2.[2]

These properties are responsible for cell stimulation, proliferation, and improved wound healing. The underlying mechanism is as the energy penetrates the tissues, there is multiple scattering by both erythrocytes and microvessels, and thus both blood rheology and distribution of microvessels influence the final distribution of laser energy.[3]

Above all the property of low power laser is the light coherence energy. It has been proved that short coherence (diode laser) has improved periodontal wound healing. The main reason behind the term 'low level' is that the levels of energy density delivered are very less when compared to other forms of laser therapy practised during ablation, cutting, and thermal coagulation.[4]

Biological effects of low power lasers in periodontal wound healing.

- **Cell proliferation:** Low power lasers have a stimulatory effect on fibroblast proliferation. The range of radiation dose at which proliferation is observed is 0.45-60 J/cm^2. Efficient wavelength for cell proliferation has been observed with infrared lasers and red lasers with λ =780,809,812 nm. These low power lasers influence on fibroblast maturation and locomotion through the matrix and this in turn contribute to the higher tensile strength for wound healing.[5] There are several mechanisms by which they stimulate the proliferation of fibroblasts. One such mechanism which has been suggested is that lasers stimulate the production of basic fibroblast growth factor (bFGF),a multifunctional polypeptide which in turn supports proliferation and differentiation of fibroblasts.. Transformation of fibroblasts into myofibroblasts is responsible for wound contraction.[6]

- **Growth stimulation:** Azevedo et al tested two power density (428.57 and 142.85 mW/cm^2) for same dose (2J/cm^2, λ=66nm) and found that the low power laser density caused high cell growth stimulation.[7] Both infrared and red laser exposures have been shown (λ =809, 830 and 904 nm) to cause higher proliferation of PDL and gingival fibroblast that a single exposure with same energy density.[5] They influence the macrophages and thereby promoting the secretion of factors which enhance fibroblast proliferation. This is thought to facilitate

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debridement of the wound and thereby establish conditions necessary for the proliferative phase of the healing response to begin.

CLINICAL EFFECTS OF LLLT IN PERIODONTICS

Even though high power lasers received much attention due to their inability in reducing periodontal pathogens and also in removing epithelial lining of periodontal pocket, therapeutic lasers received less attention. However, recent studies suggest that LLLT can decrease pocket inflammation and it can be used by combining with traditional methods.Irradiation can decrease post-operative pain and discomfort,but increased number of irradiations are required to produce tissue regeneration. LLLT has no germicidal effect and if used in combination with a suitable dye,a photodynamic effect can be achieved.

Clinical evidence have proven that the effect of low power lasers on periodontal wound healing can also been seen for irradiation after oral prophylaxis, gingivectomy and gingivoplasty.This shows significant better healing in those sites treated with laser despite of various methods for measurement.Several studies have done to observe changes by low power lasers before & after surgery.[8] Amorium et al. observed the laser irradiated sites (4 J/cm^2, λ =685nm) had probing depth significantly lower than control sites at 21 and 28 days after surgery.[6] Another study showed that sites receiving LPT (4 J/cm^2, λ=588nm) had faster surface epithelization than control sites in 3, 7 and 15 days after surgery.[9] Coagulation due to low power laser lead to better visualization of the surgical field and increased patient acceptance. Indeed it has been suggested that faster healing of laser soft tissue wounds appear to be wavelength specific & highly sensitive to energy density. Based on tissue histology, it was determined that high power , long pulse duration, high repetition rates and long interaction times, duration of target exposure all increased the risk of detrimental outcomes.[8]

It has been suggested that in areas of difficult access,such as furcations, invaginations, and concavities, the use of manual curettes, or ultrasonics are not enough to ensure the eradication of periodontal pathogens, The advantage of low power lasers when compared to high power lasers have reduced tissue temperature and antimicrobial effect and in association with extrinsic photosensitizers results in production of highly reactive oxygen species that cause damage to membranes, mitochondria and DNA culminating in the death of the microorganisms.[5]

ANTIMICROBIAL PHOTODYNAMIC THERAPY

Antimicrobial PDT can be considered as an adjunctive to normal mechanical therapy. It is the association of low power lasers with photosensitizers. The liquid photo-sensitizer which is placed in the periodontal pocket can access the entire root surface before activation by laser through an optical fiber placed in the pocket. Because of the simplicity in technique and bacterial killing, PDT in the treatment of periodontal diseases has been studied extensively. It is considered a safe co adjuvant in non surgical treatment of periodontitis as it is proved to reduce signs of inflammation and microbial infection without any harmful effects on adjuvant periodontal tissues. The topical application of anti-microbial photodynamic therapy allows a local and specific action in the disease active sites, without any effects on the microflora at other sites of oral cavity, and reduces probability of side effects that are associated with systemic administration of antimicrobial agents.[10]

CONCLUSION

The low power lasers have been increasingly studied due to its clinical effects in reducing periodontal inflammation and biomodulation. There is sufficient evidence which supports soft tissue applications in dental practice. However more clinical trials are required to provide a solid scientific basis for the clinical outcomes of LLLT in periodontitis. The conventional periodontal treatment cannot be discarded, and LLLT can be used as an adjuvant therapy which may have an additional benefit for previously well treated periodontal tissue.

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