Effect of low power laser on incisional wound healing

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Abstract

Introduction: This study was carried out to evaluate low power laser effects on incisional wound healing.

Materials and Methods: Incisional wound was produced on thirty-six mature male guinea pigs under general and local anesthesia. In half of the animals, He-Ne laser radiations were used for five minutes and the rest of the animals were left untreated. Animals were divided into six groups of six animals each that were killed after 3, 5 and 14 days. After histopathology processing and H&E staining, specimens were examined for acute and chronic inflammations, epithelial cell migration, epithelial seal and barrier formation, fibroblast migration, fibrosis, clot formation and granulation tissue formation.

Results: Based on histopathologic results and using, Mann Whitney-U and the Wilcoxon tests statistically significant differences were found between fibroblast migration, acute and chronic inflammation of radiated groups and the control group at 5 day interval.

Conclusion: This study showed that He-Ne laser had beneficial effects on incisional wound healing particularly at 5 day-intervals; however, further research on chronic ulcers has been recommended.

Keywords: He-Ne laser, Healing, Incisional wound, Low power laser.

Received August 2004; accepted March 2005

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Introduction

LASER is an acronym for light amplification by stimulated emission of radiation and has been used in medicine since 1960s. Laser dentistry is often associated with high power lasers that burn or disintegrate tissues (1,2). Little has been published about the use of low power lasers in dental practice. Initially, Mester et al. published a report on beneficial effect of this type of laser (3). Low power lasers do not affect tissue thermally but act to increase the rate of repair of injured tissue (4). Studies have shown that low power lasers can affect the biological functions of macrophages (5), angiogenesis (6) and Low power lasers such as Helium - Neon (He-Ne), Ruby, Gallium - Aluminum-Asnium (Ga- Al- As) has been reported to leave beneficial effects on tissue wound healing in animals as well as in human tissue culture (7,8).

Laser therapy could be useful as a treatment modality in myofascial pain syndrome because of its noninvasiveness, ease, and short-term application (9). Also it was reported to reduce post extraction pain and swelling and to increase rates of wound healing (2). However, a number of studies in which red spectrum laser were used, produced confusing data and conflicting results. Some of these studies indicated that the bio-stimulation effect did not occur in all but some cases of laser irradiation

(2, 7, 8, 10). Few controlled studies were carried out in order to identify the beneficial effects of He-Ne laser bio-stimulation. Ethical concern, bulky equipment and difficulties with sound study design have precluded a precise evaluation of laser bio-stimulation (11). Most of earlier studies on oral tissues were observational (12) or clinical data collection on pain, swelling or discomfort (2,13,14). Therefore, the purpose of this study was to determine the histopathological effect of the He-Ne laser on oral surgical wound healing.

Results

Two laser and one control specimens at 3 day interval were excluded because of processing problem. Histopathologic results of the remaining specimens were as follows:

3- Day intervals

All specimens in both control and laser irradiated groups showed epithelial migration and crust between two edges of surgical incision area. Epithelial seal could be observed in one specimen of LR specimens. In the rest of the specimens the epithelial seal and barrier did not form. Polymorphonuclear (PMN) cells, macrophages and plasma cells were observed in both control and experimental groups with no significant differences found between them.

5- Day intervals

Significant differences were observed between 3 and 5 days in both LR and control groups. Healing in all 5 day specimens were better than 3 day animals. There was significant differences between LR and control group in relation to the fibroblast migration, acute and chronic inflammation, clot formation and fibrosis ($p<0.05$) (Table-1). The number of inflammatory cells in LR group was lower than control group (Figs. 1-2). Plumped fibroblasts (Fig. 3) were very evident in the LR specimens ($p<0.05$). Although specimens of control group showed more tissue maturation than radiated group, there were no statistical differences between epithelial seal and barrier formation between LR and control groups ($p>0.05$).

14- Day intervals

There was no significant difference between LR and control groups at 14 days. Epithelial barrier was completed and inflammation and fibrosis were similar in both groups.

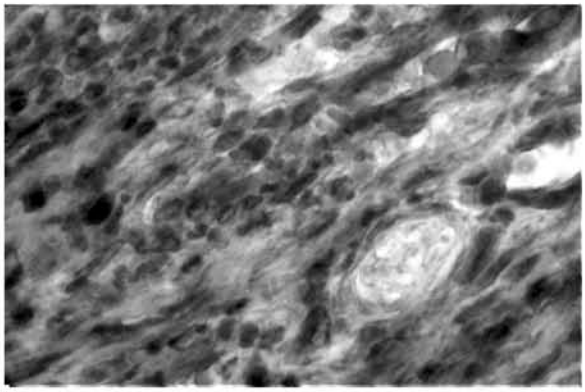

Fig1- Inflammatory cells in 5-day non radiated group showing smaller fibroblast and more inflammatory cells (x20).

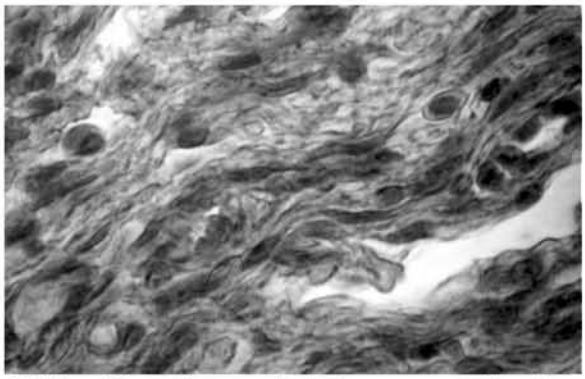

Fig2- Five-day radiated group showing decreasing number of inflammatory cells and enlarged fibroblasts compared with smaller size of non-radiated group (x20).

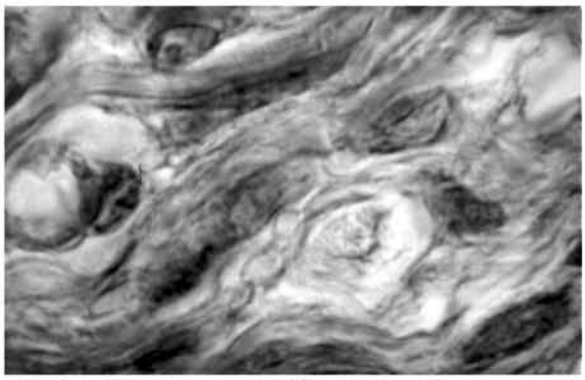

Fig3- Higher magnification of plumped fibroblast (x40).

Discussion

Promotion of healing is of paramount importance in medicine, particularly in diabetic and immuno-compromised patients (16). There have been various studies performed on low power laser with conflicting results. However,

Table-1: Statistical analysis of laser radiated and control group at 5 days interval

Time intervals	Mean Rank								
	CT	AI	CI	EM	ES	EB	FM	GT	FR
LR Group	6.5	9.5	8.5	5.75	5.25	5.67	8.5	8	6
Control group	1.5	3.5	4.5	7.25	7.75	7.33	4.5	5	7
Significancy	0.00	0.002	0.03	0.386	0.176	0.34	0.019	0.058	0.0317

LR: Laser radiated, CT: clot, AI: Acute Inflammation, CI: Chronic Inflammation, EM: Epithelial Migration, ES: Epithelial Seal, EB: Epithelial Barrie, FM: Fibroblast Migration, GT: Granulation Tissue formation, FR: Fibrosis

and few oral research have motivated the researchers to conduct similar studies. In this study, He-Ne laser was used and the results showed that in LR group particularly at 5 day intervals, healing was more evident than non radiated group. This was similar to the results obtained from some previous studies (13,17-19) although was in conflicted with the results of many other investigations (8,10,11,14). Researchers of previous studies believed that the differences between fluency-energy level in tissues (2,4,13) , frequency of radiation (12), systemic effect (17,20,21)and the type of ulcer(19) would influence the results of low power laser exposures and produced conflicting results.

It is believed that the optimum tissue-healing rates at He-Ne laser exposure levels exist between 1J/Cm² - 20J/Cm² (2). This amount of energy could induce metabolic changes within the cells. In this study, energy level produced in tissue was 2.5 J/cm². Results showed that fibroblast proliferation was significantly more evident in LR than control group in 5- day intervals which was in agreement with previous studies in which low power laser beneficial effects were demonstrated (2).

Studies of Mester et al. and Abergel et al. showed that the frequency of radiation could improve tissue healing rates (3,18). However, in this study, despite a single radiation exposure significant differences were found between LR and control groups in inflammation and fibroblast migration at 5- day intervals. Neiburger and Yu et al. showed the same finding after single laser radiation (2,4). Funk et al. showed those 30 minutes after laser radiation of peripheral mononuclear blood cells, IL1a, IL2, TNFα and INFγ increased significantly (7). It might be one of the reasons that even with one radiation exposure, the beneficial effects of He-Ne laser could be observed in present study.

Systemic effect of these cytokines was confirmed by Belkin & Schwartz as well as Karu & Inoue (17,19,20). Therefore, in many studies, because both the laser radiation and control procedure were performed on the same patient, the laser radiation would not produce precise results (8,14,21), a reason for using different animals for control and LR groups in present investigation.

The type of ulcer could affect radiation response. Many researchers believed that old ulcer, because of low oxygen concentration, PH and nutrients showed a better response to low power laser than fresh ulcer (19). This study as well as others conducted by Abergel (1984), Schenek (1986), Tsuchida (1991) and Neiburger(1997) demonstrated that in fresh ulcers He-NE laser have beneficial effects (2,18,22,23).

Acknowledgement

This study was supported by research center of Kerman University of Medical sciences and health services and Vali-Asr Rafsanjan University. Authors wish to thank Dr. A Olia for translating German article, Dr. AA. Haghdost and Ms. S. Mohammadalizade for their valuable help in statistical analysis.

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