

## Effect of low energy laser on inflammatory cells.

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### Opinion Article

An experimental study was done on laboratory mice to investigate the effect of low energy laser (790-805 nm) on skin wound healing. The histological finding revealed the following observations:

#### Neutrophil

Neutrophil predominance is the most characteristic cellular feature of the early inflammatory phase of wound healing [1]. These cells play a key role in protecting the tissue against infections through phagocytosis, the anti-bacterial effects of oxygen radicals, and the activation of complements [2]. The acute inflammatory reaction characterized by the presence of neutrophils and lymphocytes, hence neutrophils were distributed along the wound surface, particularly within the fibrous exudates membrane but is generally agreed that the number of neutrophils soon decreases [3]. However, their number in the control group was substantially greater than that of macrophages during the first 24 hours, and also they were proportionally more numerous than macrophages at day 3 and 14 post-wounding. Neutrophil accumulation was observed to be mainly at the superficial region of the wound bed and also in close proximity to the regenerating epidermis. It has been reported that neutrophils could have an additional role in the repair process by their production of TNF- $\alpha$ , a cytokine that stimulates the process of re-epithelialization, during wound healing in mice [1]. These cells were present in the wounds throughout the 14 days of the study. Although the possibility of the presence of microscopic foci of infection cannot be excluded, the prolonged presence of neutrophils supports the theory that they may have other functions in addition to bacterial phagocytosis [4]. This agreed with the results of many other studies [5], who found an early acute inflammatory response in injured skin is characterized by abundance of neutrophils at wound gap. In day one the number of neutrophil in lased group as compared with the control group; was more but less in day 3, 7, and 14 which indicates earlier acute inflammatory response and more rapid resolution resulting in earlier phase of regeneration; which agreed with [6-8] who found that LLLT (Low Level Laser Therapy) was able to promote wound healing by reducing inflammation without compromising the proliferation of fibroblasts and keratinocytes. In the present study the lased group in day 3 demonstrated that laser therapy was significantly accelerating inflammatory process. Neutrophils infiltration in the wound was significantly different from the control group which indicates that long persistence of neutrophils might not affect the healing of injured tissue; which was in agreement with [3] who found that there was remarkable significant faster healing in neutropenic mice than the control group. On the contrary; the prolonged persistence of

neutrophils at the wound site associated with delayed healing or impaired healing due to subsidence of inflammatory cells may in fact retard wound closure [9].

#### Lymphocytes

The participation of lymphocytes in wound healing process is largely associated with their production of cytokines (lymphokines) and growth factors which play a role in wound healing [10]. T-helper cells secrete cytokines to cause further T-helper activation and division and increasing inflammation, enhance vasodilatation and vessel permeability, and increase macrophages activity [11,12]. In this study; lymphocytes in the control group were found to migrate to the wound bed in low numbers early during the inflammatory phase of wound healing at day 1. Their accumulation continued in a distinctively progressive pattern to reach their maximum by day 7 post-wounding. These results are compared with those of other workers [13] who observed histologically that lymphocyte infiltration into healing skin wounds reached their peak at about day 6 post-wounding while [14] mentioned that the dynamics of lymphocytes and their subsets during healing of skin wounds were present in the highest level in the superficial portions of the wounds from day 5-7 post-wounding. Even though there is variation between the different experimental models and the different factors (local, systemic or environmental) that could have an influence on the type and number of wound cellularity, the dynamics of lymphocytes reported in this work are closely similar to those observed in the above mentioned previous work. However the current study gave a more detailed picture of the distribution of cells during cutaneous wound healing and related this to that of the other immuno-inflammatory cells. The series of time points investigated here covers the most important stages of the healing process. In this study; the histopathological results showed that the higher level of lymphocytes was in day 7 in the control group but less than neutrophils. While in the lased groups the higher level was in day 1 which means earlier infiltration than the control group and there was no significant difference between the two groups which indicates that LLLT has anti-inflammatory effect on lymphocytes, this agreed with [3] who stated that LLLT reduces acute inflammatory response earlier than control group and cause more switching of lymphocytes to plasma cells.

#### Macrophage

As the number of neutrophils begins to decline the macrophages' number increases to replace the neutrophils as predominant wound phagocytes as well as playing a central role in the transition between inflammation and proliferation phase of wound repair as they mediate both wound fibroplasia and neovascularization, the release of growth factors and cytokines [15]. Mononuclear

phagocytes appeared early during the inflammatory phase of wound healing in this study, accumulated to reach a maximum during granulation tissue formation at day 7, in the control group and then gradually decreased in number to a low level by the end of the study (14 day post-injury). These results agree with the findings of [13]. The temporal sequence exhibited by these cells supports their proposed pivotal role in the transition between inflammation and wound repair and the variation in the kinetics of emigration and accumulation of different types of leucocytes, such as neutrophils and monocytes, may be explained, at least in part, by the selective effects of different inflammatory mediators and differences in expression or configuration of leucocyte/endothelial cell adhesion molecules and their ligands [16]. The lased group showed earlier migration to the wound site than control group with maximum level by day 7. This due may be to anti-inflammatory effect of LLLT on wound healing, because the presence of wound macrophages is a marker that the inflammatory phase is ended [17].

### Eosinophil

Eosinophils are the type of granulocytes that associated with allergic immune reaction mainly; but their association with wound healing is obvious through their expression of transforming growth factors (TGF  $\alpha$  and  $\beta$ ) [18] who demonstrated significant number of eosinophils within and adjacent to incisional wound in rat skin and seems to play a role in cellular make-up of the wound healing process and generating pro-inflammatory cytokines [19]. The results of our study showed more eosinophils infiltration in day 14 in control group more than other days of healing. This agreed with [19] who stated that eosinophils seem to play a role in cellular makeup of the wound healing. In lased group; there was early infiltration of eosinophils to the wound area in a count more than the control group, with highly significant correlation between eosinophils count and both neutrophils and lymphocytes count. This agreed with [20] who showed the increase in eosinophil count is T-lymphocytes dependent and with cytokine-stimulated eosinophils to secrete IL-1 local in the wound.

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