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EFFECTS OF VISIBLE AND NIR LOW INTENSITY LASERS ON IMPLANT OSSEOINTEGRATION IN VIVO

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The purpose of this study is to determine whether the process of bone integration of implants placed in rabbit tibia is changed in any way if the region is radiated with laser, as compared to the time required for the bone integration process without radiation. Thirty adult male white New Zealand rabbits were submitted to implant surgery, for subsequent evaluation of the removal torque and resonance frequency. Each animal received two implants of pure titanium (Frialit-2-Friadent, Mannheim-Germany), one in each proximal metaphysis of the tibia, which were inserted with a 40 Ncm torque, and their initial stability was also monitored by means of a resonance frequency analyzer. The rabbits were then divided into 3 groups: one control group and two laser groups. The groups were evaluated in regard to removal torque and resonance frequency of the implants, after 3 and 6 weeks. One of the laser groups was radiated with a laser beam of a wavelength in the infrared range (830 nm) and the other group was radiated with a laser beam emitted in the visible range (680 nm). Ten radiation sessions were performed, 48 hours apart, the first of them during the immediate post-operation period. Radiation energy density was 4 J/cm^2 per point, and there were two points at each side of the tibia. Results of the statistical analysis of the resonance frequency indicated that for both laser groups there was a significant difference between frequency values at the time of implant and the values obtained after 3 and 6 weeks. Furthermore, the results obtained for the removal torque of the three groups showed a statistically significant difference after a period of 6 weeks; removal torque values for the laser groups were, in the average, much greater than those of the control group. From these results it is possible to conclude that implants in rabbit tibia, that were exposed to laser radiation with wavelengths of 680 nm and 830 nm, had a better degree of bone integration than the control group.

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NASA LED PHOTORADIATION INFLUENCES NITRIC OXIDE AND COLLAGEN PRODUCTION IN WOUNDED RATS

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Wound healing is a complex chain of cellular and biochemical events designed to restore tissue integrity and function. Light therapy has been used to promote wound healing despite the lack of a clearly defined mechanism of its effect. This study investigates the effect of phototherapy on NO and collagen production in early wound healing. Sprague-Dawley rats (250–300 g) were anesthetized with ketamine and xylazine and were shaved on the dorsum. Four full-thickness 1 cm incisions were made using a template. Two sterile 8.0 mm PVA sponge discs were inserted into a small pocket on either side of each wound. Wounds were approximated with two 6-0 Prolene sutures. Each group ($n = 3$) was irradiated at 670, 728 or 880 nm daily on days 0–5 post injury using NASA LEDs (Quantum Devices, Barneveld, WI) at fluences of 700 mW/cm^2 and a dose of 7 J/cm^2/session. Animals were sacrificed at 7 days post injury, blood samples were obtained and sponges were excised. Wound fluid was collected and analyzed for total nitrate and nitrite (as markers for NO) and collagen-derived hydroxy-proline content. Redness and inflammation was evident in the control animals but was not seen in the irradiated groups. Wound hydroxy-proline content was 85.8 ± 8.2 μg/ml in the controls, 146.6 ± 7.3 μg/ml, 124 ± 9.2 μg/ml and 124 ± 11.5 μg/ml in the 670, 728 and 880 nm groups respectively. The differences between the control and treated groups were statistically significant ($p < 0.01$). Wound fluid total nitrite was 64 ± 9.6 μM/ml in treated groups and 34 ± 5.6 μM/ml in the controls ($p < 0.05$). Histologic evaluation of the wounds was undertaken after HE staining. Our results demonstrate that single wavelength near infrared phototherapy with the NASA LED device is beneficial during the early phase of wound healing. Further investigation of the effects of the use of combined wavelengths and therapy applied later in the course of wound healing are warranted.

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FGF EXPRESSION INCREASES WITH LOW POWER LASER IRRADIATION DURING HEALING OF CUTANEOUS WOUNDS IN NORMAL AND DIABETIC PSAMMOMYS OBESUS

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The normal healing process is delayed in diabetes and is accompanied by a delay in the expression of several regulatory proteins, including fibroblastic growth factor (FGF). We have found a significant acceleration of wound closure on day 4 post-injury in *Psammomys obesus* (the Fat Sand Rat), an animal model of *type II* diabetes using low power laser irradiation (LPLI) and hypothesize that LPLI alters the expression of FGF in Fat Sand Rats. Bilateral 4 mm biopsy induced full thickness cutaneous wounds were made on the dorsal lumbar region in non-diabetic and diabetic Fat Sand Rats. Only the left wounds of the treatment groups were irradiated (632.8 nm, 4 J/cm^2, 250 seconds, 16 mW). Daily treatment began immediately after wounding. At 36 hours post-injury, the animals were anesthetized and the wounds were excised. Immunofluorescent histochemistry was performed using a primary antibody to bFGF. Images of the fluorescent label were captured, digitized and quantified. A significant difference ($p < 0.001$) was found in the expression of bFGF between control and laser treated, non-diabetic and diabetic Fat Sand Rats. There was a 3.7 fold increase in bFGF expression in diabetic LPLI treated rats and a 2.5 fold increase in the non-diabetic LPLI treated Fat Sand Rats as compared to their respective controls. There was no change in bFGF expression in the wounds excised from the non-irradiated side of control and laser treated rats. LPLI increases the expression of bFGF in diabetic and non-diabetic animals. The mechanism that triggers the expression of genes involved in the healing process appears to be confined to the wound site since the bFGF levels remained unchanged in the wounds on the non-irradiated side.