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Effects of low-level laser therapy on ROS homeostasis and expression of IGF-1 and TGF-β1 in skeletal muscle during the repair process.

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Abstract

The aim of the present study was to determine the effects of low-level laser therapy (LLLT) on the homeostasis of reactive oxygen species (ROS) and expression of IGF-1 and TGF-β1 in the gastrocnemius muscles of rats following contusion. Muscle regeneration involves cell proliferation, migration, and differentiation and is regulated by growth factors. A growing body of evidence suggests that LLLT promotes skeletal muscle regeneration and accelerates tissue repair. Adult male Sprague-Dawley rats (n=96) were randomly divided into three groups: control group (no lesion, untreated, n=6), contusion group (n=48), and contusion-plus-LLLT group (n=42). Gallium aluminum arsenide (GaAlAs) laser irradiation (635 nm; beam spot, 0.4 cm(2); output power, 7 mW; power density, 17.5 mW/cm(2); 20 min) was administered to the gastrocnemius contusion for 20 min daily for 10 days. Muscle remodeling was evaluated at 0 h and 1, 2, 3, 7, 14, 21, and 28 days after injury. Hematoxylin and eosin and Van Gieson staining were used to evaluate regeneration and fibrosis; muscle superoxide dismutase (SOD) and malondialdehyde (MDA) were detected via biochemical methods; expression of transforming growth factor beta-1 (TGF-β1) and insulin-like growth factor-1 (IGF-1) were investigated via immunohistochemistry. The results showed that LLLT markedly promoted the regeneration of muscle and reduced scar formation. LLLT also significantly enhanced muscle SOD activity and significantly decreased muscle MDA levels 1, 2, and 3 days after injury. LLLT increased the expression of IGF-1 2, 3, and 7 days after injury and decreased the expression of IGF-1 21 and 28 days after injury. LLLT decreased the expression of TGF-β1 3 and 28 days after injury but increased expression at 7 and 14 days after injury. Our study showed that LLLT could modulate the homeostasis of ROS and of the growth factors IGF-1 and TGF-β1, which are known to play important roles in the repair process. This may constitute a new preventive approach to muscular fibrosis.

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Low-level laser therapy (808 nm) contributes to muscle regeneration and prevents fibrosis in rat tibialis anterior muscle after cryolesion.

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Abstract

Muscle regeneration is a complex phenomenon, involving replacement of damaged fibers by new muscle fibers. During this process, there is a tendency to form scar tissue or fibrosis by deposition of collagen that could be detrimental to muscle function. New therapies that could regulate fibrosis and favor muscle regeneration would be important for physical therapy. Low-level laser therapy (LLLT) has been studied for clinical treatment of skeletal muscle injuries and disorders, even though the molecular and cellular mechanisms have not yet been clarified. The aim of this study was to evaluate the effects of LLLT on molecular markers involved in muscle fibrosis and regeneration after cryolesion of the tibialis anterior (TA) muscle in rats. Sixty Wistar rats were randomly divided into three groups: control, injured TA muscle without LLLT, injured TA muscle treated with LLLT. The injured region was irradiated daily for four consecutive days, starting immediately after the lesion using an AlGaAs laser (808 nm, 30 mW, 180 J/cm(2); 3.8 W/cm(2), 1.4 J). The animals were sacrificed on the fourth day after injury. LLLT significantly reduced the lesion percentage area in the injured muscle ($p<0.05$), increased mRNA levels of the transcription factors MyoD and myogenin ($p<0.01$) and the pro-angiogenic vascular endothelial growth factor ($p<0.01$). Moreover, LLLT decreased the expression of the profibrotic transforming growth factor TGF-β mRNA ($p<0.01$) and reduced type I collagen deposition ($p<0.01$). These results suggest that LLLT could be an effective therapeutic approach for promoting skeletal muscle regeneration while preventing tissue fibrosis after muscle injury.

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Effects of low-level laser therapy on skeletal muscle repair: a systematic review.

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Abstract

A review of the literature was performed to demonstrate the most current applicability of low-level laser therapy (LLLT) for the treatment of skeletal muscle injuries, addressing different lasers, irradiation parameters, and treatment results in animal models. Searches were performed in the PubMed/MEDLINE, SCOPUS, and SPIE Digital Library databases for studies published from January 2006 to August 2013 on the use of LLLT for the repair of skeletal muscle in any animal model. All selected articles were critically appraised by two independent raters. Seventeen of the 36 original articles on LLLT and muscle injuries met the inclusion criteria and were critically evaluated. The main effects of LLLT were a reduction in the inflammatory process, the modulation of growth factors and myogenic regulatory factors, and increased angiogenesis. The studies analyzed demonstrate the positive effects of LLLT on the muscle repair process, which are dependent on irradiation and treatment parameters.

The findings suggest that LLLT is an excellent therapeutic resource for the treatment of skeletal muscle injuries in the short-term.

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Effects of low-level laser therapy on expression of TNF-α and TGF-β in skeletal muscle during the repair process.

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Abstract

The aim of the present study was to determine the effect of low-level laser therapy (LLLT) on the expression of TNF-α and TGF-β in the tibialis anterior muscle of rats following cryoinjury. Muscle regeneration involves cell proliferation, migration and differentiation and is regulated by growth factors and cytokines. A growing body of evidence suggests that LLLT promotes skeletal muscle regeneration by reducing the duration of acute inflammation and accelerating tissue repair. Adult male Wistar rats (n = 35) were randomly divided into three groups: control group (no lesion, untreated, n = 5), cryoinjury without LLLT group (n = 15), and cryoinjury with LLLT group (n = 15). The injured region was irradiated three times a week using an AlGaInP laser (660 nm; beam spot 0.04 cm(2), output power 20 mW, power density 500 mW/cm(2), energy density 5 J/cm(2), exposure time 10 s). Muscle remodeling was evaluated at 1, 7 and 14 days (long-term) following injury. The muscles were removed and total RNA was isolated using TRIzol reagent and cDNA synthesis. Real-time polymerase chain reactions were performed using TNF-α and TGF-β primers; GAPDH was used to normalize the data. LLLT caused a decrease in TNF-α mRNA expression at 1 and 7 days following injury and in TGF-β mRNA expression at 7 days following cryoinjury in comparison to the control group. LLLT modulated cytokine expression during short-term muscle remodeling, inducing a decrease in TNF-α and TGF-β.

PMID:21053039[PubMed - indexed for MEDLINE]

Lasers Med Sci. 2011 Nov;26(6):803-14. doi: 10.1007/s10103-011-0951-9. Epub 2011 Jul 15.

Phototherapy with low-level laser affects the remodeling of types I and III collagen in skeletal muscle repair.

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Abstract

The purpose of this article was to analyze the photobiomodulator role of low-level laser therapy (LLLT) on the skeletal muscle remodeling following cryoinjury in rats, focusing the types I and III collagen proteins. Laser phototherapy has been employed to stimulate repair in different tissues. However, its role in skeletal muscle remodeling is not yet well clarified, especially its effect on the collagen component of the extracellular matrix. Fifty adult Wistar rats were divided into four groups: control, sham, cryoinjury, and laser-treated cryoinjury. Laser irradiation was performed three times a week on the injured region using the InGaAlP (indium-gallium-aluminum-phosphorous) laser (660 nm; beam spot of 0.04 cm(2), output power of 20 mW, power density of 0.5 mW/cm(2), energy density of 5 J/cm(2), 10-s exposure time, with a total energy dose of 0.2 J). Five animals were killed after short-term (days 1 and 7) and long-term (14 and 21) durations following injury. The muscles were processed and submitted to hematoxylin and eosin (H&E) and immunohistochemical staining. The histological slices were analyzed qualitatively, semi-quantitatively, and quantitatively. The data were submitted to statistical analysis using the Kruskal-Wallis test. The qualitative analysis of morphological aspects revealed that the muscle repair were very similar in cryoinjury and laser groups on days 1, 14 and 21. However, at 7 days, differences could be observed because there was a reduction in myonecrosis associated to formation of new vessels (angiogenesis) in the laser-treated group. The analysis of the distribution of types I and III collagen, on day 7, revealed a significant increase in the depositing of these proteins in the laser-treated group when compared to the cryoinjury group. InGaAlP diode laser within the power parameters and conditions tested had a biostimulatory effect at the regenerative and fibrotic phases of the skeletal muscle repairs, by promoting angiogenesis, reducing myonecrosis, and inducing types I and III collagen synthesis, following cryoinjury in rat.

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Efficacy of high and low level laser therapy in the treatment of Bell's palsy: a randomized double blind placebo-controlled trial.

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Abstract

The aim of the present study was to investigate and compare the effects of high intensity laser therapy (HILT) and low level laser therapy (LLLT) on the treatment of patients with Bell's palsy. Forty-eight patients participated in and completed this study. The mean age was 43 ± 9.8 years. They were randomly assigned into three groups: HILT group, LLLT group, and exercise group. All patients were treated with facial massage and exercises, but the HILT and LLLT groups received the respective laser therapy. The grade of facial recovery was assessed by the facial disability scale (FDI) and the House-Brackmann scale (HBS). Evaluation was carried out 3 and 6 weeks after treatment for all patients. Laser treatments included eight points on the affected side of the face three times a week for 6 successive weeks. FDI and HBS were used to assess the grade of recovery. The scores of both FDI and

HBS were taken before as well as 3 and 6 weeks after treatment. The Friedman test and Wilcoxon signed ranks test were used to compare the FDI and HBS scores within each group. The result showed that both HILT and LLLT significantly improved the recovery of patients with Bell's palsy. Moreover, HILT was the most effective treatment modality compared to LLLT and massage with exercises. Thus, both HILT and LLLT are effective physical therapy modalities for the recovery of patients with Bell's palsy, with HILT showing a slightly greater improvement than LLLT.

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