Laser Therapy and Exercise

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Low-level laser therapy attenuates creatine kinase levels and apoptosis during forced swimming in rats.

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Studies suggest that high-intensity physical exercise can cause damage to skeletal muscles, resulting in muscle soreness, fatigue, inflammatory processes and cell apoptosis. The aim of this study was to investigate the effects of low-level laser therapy (LLLT) on a decrease in creatine kinase (CK) levels and cell apoptosis. Twenty male Wistar rats were randomly divided into two equal groups: group 1 (control), resistance swimming; group 2 (LLLT), resistance swimming with LLLT. They were subjected to a single application of indium gallium aluminum phosphide (InGaAlP) laser immediately following the exercise for 40 s at an output power of 100 mW, wavelength 660 nm and 133.3 J/cm(2). The groups were subdivided according to sample collection time: 24 h and 48 h. CK was measured before and both 24 h and 48 h after the test. Samples of the gastrocnemius muscle were processed to determine the presence of apoptosis using terminal deoxynucleotidyl transferase (TdT)-mediated deoxyuridine triphosphate (dUTP) nick end labeling. (There was a significant difference in CK levels between groups ($P < 0.0001$) as well as between the 24 h and 48 h levels in the control group, whereas there was no significant intra-group difference in the LLLT group at the same evaluation times. In the LLLT group there were 66.3 +/- 13.2 apoptotic cells after 24 h and 39.0 +/- 6.8 apoptotic cells after 48 h. The results suggest that LLLT influences the metabolic profile of animals subjected to fatigue by lowering serum levels of CK. This demonstrates that LLLT can act as a preventive tool against cell apoptosis experienced during high-intensity physical exercise.

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Low-level laser irradiation promotes the recovery of atrophied gastrocnemius skeletal muscle in rat.

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Low-level laser (LLL) irradiation promotes proliferation of muscle satellite cells, angiogenesis and expression of growth factors. Satellite cells, angiogenesis and growth factors play important roles in the regeneration of muscle. The objective of this study was to examine the effect of LLL irradiation on rat gastrocnemius muscle recovering from disuse muscle atrophy. Eight-week-old rats were subjected to hindlimb suspension for 2 weeks, after which they were released and recovered. During the recovery period, rats underwent daily LLL irradiation (Ga-Al-As; 830 nm; 60 mW; total, 180 sec) to the right gastrocnemius muscle through the skin. The untreated left gastrocnemius muscle served as the control. In conjunction with LLL irradiation, 5-bromo-2.deoxyuridine (BrdU) was injected subcutaneously for labeling of nuclei of proliferating cells. After 2 weeks, myofiber diameters of irradiated muscle increased in comparison with those of untreated muscle, but did't recover back to normal levels. Additionally, in the superficial region of muscle, the number of capillaries and fibroblast growth factor levels in irradiated muscle exhibited meaningful elevation relative to those of untreated muscle. In the deep region of muscle, BrdU-positive nuclei of satellite cells and / or myofibers of irradiated muscle increased significantly relative to that of the untreated muscle. The results of this study suggested that LLL irradiation can promote recovery from disuse muscle atrophy in association with proliferation of satellite cells and angiogenesis.

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Effect of 655-nm low-level laser therapy on exercise-induced skeletal muscle fatigue in humans.

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OBJECTIVE: To investigate if development of skeletal muscle fatigue during repeated voluntary biceps contractions could be attenuated by low-level laser therapy (LLLT). BACKGROUND DATA: Previous animal studies have indicated that LLLT can reduce oxidative stress and delay the onset of skeletal muscle fatigue. MATERIALS AND METHODS: Twelve male professional volleyball players were entered into a randomized double-blind placebo-controlled trial, for two sessions (on day 1 and day 8) at a 1-wk interval, with both groups performing as many voluntary biceps contractions as possible, with a load of 75% of the maximal voluntary contraction force (MVC). At the second session on day 8, the groups were either given LLLT (655 nm) of 5 J at an energy density of 500 J/cm2 administered at each of four points along the middle of the biceps muscle belly, or placebo LLLT in the same manner immediately before the exercise session. The number of muscle contractions with 75% of MVC was counted by a blinded observer and blood lactate concentration was measured. RESULTS: Compared to the first session (on day 1), the mean number of repetitions increased significantly by 8.5 repetitions (+/- 1.9) in the active LLLT group at the second session (on day 8), while in the placebo LLLT group the increase was only 2.7 repetitions (+/- 2.9) (p = 0.0001). At the second session, blood lactate levels increased from a pre-exercise mean of 2.4 mmol/L (+/- 0.5 mmol/L), to 3.6 mmol/L (+/- 0.5 mmol/L) in the placebo group, and to 3.8 mmol/L (+/-

0.4 mmol/L) in the active LLLT group after exercise, but this difference between groups was not statistically significant. CONCLUSION: We conclude that LLLT appears to delay the onset of muscle fatigue and exhaustion by a local mechanism in spite of increased blood lactate levels.

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Effect of 830 nm low-level laser therapy applied before high-intensity exercises on skeletal muscle recovery in athletes.

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Our aim was to investigate the immediate effects of bilateral, 830 nm, low-level laser therapy (LLLT) on high-intensity exercise and biochemical markers of skeletal muscle recovery, in a randomised, double-blind, placebo-controlled, crossover trial set in a sports physiotherapy clinic. Twenty male athletes (nine professional volleyball players and eleven adolescent soccer players) participated. Active LLLT (830 nm wavelength, 100 mW, spot size 0.0028 cm(2), 3-4 J per point) or an identical placebo LLLT was delivered to five points in the rectus femoris muscle (bilaterally). The main outcome measures were the work performed in the Wingate test: 30 s of maximum cycling with a load of 7.5% of body weight, and the measurement of blood lactate (BL) and creatine kinase (CK) levels before and after exercise. There was no significant difference in the work performed during the Wingate test ($P > 0.05$) between subjects given active LLLT and those given placebo LLLT. For volleyball athletes, the change in CK levels from before to after the exercise test was significantly lower ($P = 0.0133$) for those given active LLLT (2.52 U l(-1) +/- 7.04 U l(-1)) than for those given placebo LLLT (28.49 U l(-1) +/- 22.62 U l(-1)). For the soccer athletes, the change in blood lactate levels from before exercise to 15 min after exercise was significantly lower ($P < 0.01$) in the group subjected to active LLLT (8.55 mmol l(-1) +/- 2.14 mmol l(-1)) than in the group subjected to placebo LLLT (10.52 mmol l(-1) +/- 1.82 mmol l(-1)). LLLT irradiation before the Wingate test seemed to inhibit an expected post-exercise increase in CK level and to accelerate post-exercise lactate removal without affecting test performance. These findings suggest that LLLT may be of benefit in accelerating post-exercise recovery.