

Stem Cells

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Primary myogenic cells see the light: improved survival of transplanted myogenic cells following low energy laser irradiation.

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BACKGROUND AND OBJECTIVES: There is a substantial need for finding new avenues to promote muscle recovery when acute skeletal muscle loss extends beyond the natural capacity of the muscle to recover. Maintenance and regeneration of skeletal muscles depend mainly on resident stem cells known as satellite cells. Nevertheless, there are situations in which a significant loss of muscle tissue exhausts the satellite cell pool. For such cases, cell therapy and tissue engineering are becoming promising alternatives. Thus far, attempts to supplement damaged host muscles with donor satellite cells by means of myoblast transplantation therapy were mostly unsuccessful due to massive and rapid loss of donor cells within few hours after transplantation. This study aims at following the effects of low-energy-laser irradiation on the fate of implanted myoblasts. **STUDY DESIGN:** Primary myogenic cells, harvested from male rat skeletal muscles, were irradiated with low energy laser, seeded on a biodegradable scaffold and expanded in vitro. The scaffold containing cells was transplanted into partially excised muscles of host female rats. Donor cells were identified in the host muscle tissue, using Y-chromosome in situ hybridization. **RESULTS:** In this study, we show that laser irradiated donor primary myogenic cells not only survive, but also fuse with host myoblasts to form a host-donor syncytium. **CONCLUSIONS:** Our data show that the use of low energy laser irradiation (LELI), a non-surgical tool, is a promising means to enhance both the survival and functionality of transplanted primary myogenic cells.

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The effect of low level laser irradiation on adult human adipose derived stem cells.

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This study investigated the effect of low level laser irradiation on primary cultures of adult human adipose derived stem cells (ADSC) using a 635-nm diode laser, at 5 J/cm² with a power output of 50.2 mW and a power density of 5.5 mW/cm². Cellular morphology did not appear to change after irradiation. Using the trypan blue exclusion test, the cellular viability of irradiated cells increased by 1% at 24 h and 1.6% at 48 h but was not statistically significant. However, the increase of cellular viability as measured by ATP luminescence was statistically significant at 48 h ($p < 0.05$). Proliferation of irradiated cells, measured by optical density, resulted in statistically significant increases in values compared to nonirradiated cells ($p < 0.05$) at both time points. Western blot analysis and immunocytochemical labeling indicated an increase in the expression of stem cell marker beta1-integrin after irradiation. These results indicate that 5 J/cm² of laser irradiation can positively affect human adipose stem cells by increasing cellular viability, proliferation, and expression of beta1-integrin.

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Low-energy laser irradiation promotes the survival and cell cycle entry of skeletal muscle satellite cells.

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Low energy laser irradiation (LELI) has been shown to promote skeletal muscle cell activation and proliferation in primary cultures of satellite cells as well as in myogenic cell lines. Here, we have extended these studies to isolated myofibers. These constitute the minimum viable functional unit of the skeletal muscle, thus providing a close model of in vivo regeneration of muscle tissue. We show that LELI stimulates cell cycle entry and the accumulation of satellite cells around isolated single fibers grown under serum-free conditions and that these effects act synergistically with the addition of serum. Moreover, for the first time we show that LELI promotes the survival of fibers and their adjacent cells, as well as cultured myogenic cells, under serum-free conditions that normally lead to apoptosis. In both systems, expression of the anti-apoptotic protein Bcl-2 was markedly increased, whereas expression of the pro-apoptotic protein BAX was reduced. In culture, these changes were accompanied by a reduction in the expression of p53 and the cyclin-dependent kinase inhibitor p21, reflecting the small decrease in viable cells 24 hours after irradiation. These findings implicate regulation of these factors as part of the protective role of LELI against apoptosis. Taken together, our findings are of critical importance in attempts to improve muscle regeneration following injury.

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Erratum in:

[Biochim Biophys Acta](#) 1999 May 6;1450(1):108. Irintchev A [corrected to Irintchev A].

Low-energy laser irradiation affects satellite cell proliferation and differentiation in vitro.

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Low-energy laser (He-Ne) irradiation was found to promote skeletal muscle regeneration in vivo. In this study, its effect on the proliferation and differentiation of satellite cells in vitro was evaluated. Primary rat satellite cells were irradiated for various time periods immediately after preparation, and thymidine incorporation was determined after 2 days in culture. Laser irradiation affected thymidine incorporation in a bell-shaped manner, with a peak at 3 s of irradiation. Three seconds of irradiation caused an induction of cell-cycle regulatory proteins: cyclin D1, cyclin E and cyclin A in an established line of mouse satellite cells, pmi28, and proliferating cell nuclear antigen (PCNA) in primary rat satellite cells. The induction of cyclins by laser irradiation was compatible with their induction by serum refeeding of the cells. Laser irradiation effect on cell proliferation was dependent on the rat's age. At 3 weeks of age, thymidine incorporation in the irradiated cells was more than twofold higher than that in the controls, while at 6 weeks of age this difference had almost disappeared. Myosin heavy chain (MHC) protein levels were twofold lower in the irradiated than in the control cells, whereas the proliferation of the irradiated cells was twofold higher. Fusion percentage was lower in the irradiated compared to non-irradiated cells. In light of these data, the promoting effect of laser irradiation on skeletal muscle regeneration in vivo may be due to its effect on the activation of early cell-cycle regulatory genes in satellite cells, leading to increased proliferation and to a delay in cell differentiation.