

Published in final edited form as:

Photonics Lasers Med. 2012 November 1; 1(4): 267–286. doi:10.1515/plm-2012-0032.

Low-level laser (light) therapy (LLLT) on muscle tissue: performance, fatigue and repair benefited by the power of light

Cleber Ferraresi,

Laboratory of Electro-thermo-phototherapy, Department of Physical Therapy, Federal University of São Carlos, São Carlos, São Paulo 13565-905, Brazil; and Department of Biotechnology, Federal University of São Carlos, São Carlos, São Paulo 13565-905, Brazil

Michael R. Hamblin*, and

Harvard-MIT Division of Health Science and Technology, Cambridge, MA 02139, USA; and Department of Dermatology, Harvard Medical School, Boston, MA 02115, USA

Nivaldo A. Parizotto

Laboratory of Electro-thermo-phototherapy, Department of Physical Therapy, Federal University of São Carlos, São Carlos, São Paulo 13565-905, Brazil; Department of Biotechnology, Federal University of São Carlos, São Carlos, São Paulo 13565-905, Brazil; and Wellman Center for Photomedicine, Massachusetts General Hospital, Boston, MA 02114, USA

Abstract

The use of low level laser (light) therapy (LLLT) has recently expanded to cover areas of medicine that were not previously thought of as the usual applications such as wound healing and inflammatory orthopedic conditions. One of these novel application areas is LLLT for muscle fatigue and muscle injury. Since it is becoming agreed that mitochondria are the principal photoacceptors present inside cells, and it is known that muscle cells are exceptionally rich in mitochondria, this suggests that LLLT should be highly beneficial in muscle injuries. The ability of LLLT to stimulate stem cells and progenitor cells means that muscle satellite cells may respond well to LLLT and help muscle repair. Furthermore the ability of LLLT to reduce inflammation and lessen oxidative stress is also beneficial in cases of muscle fatigue and injury. This review covers the literature relating to LLLT and muscles in both preclinical animal experiments and human clinical studies. Athletes, people with injured muscles, and patients with Duchenne muscular dystrophy may all benefit.

Keywords

low level laser therapy; muscle fatigue; muscle injury; mitochondria; ATP; reactive oxygen species; satellite cells

1 Introduction to muscle fatigue

The intense use of muscles during high intensity exercise or during repeated muscle contractions leads to a decrease in muscle performance and appearance of peripheral muscle fatigue [1, 2]. Muscle fatigue is a complex phenomenon with many theories and scientific evidence to explain its process of appearance. Among the scientific evidence, we highlight the depletion of energy sources such as phosphocreatine, glycogen; increased amounts of

*Corresponding author: Michael R. Hamblin, BAR414, Wellman Center for Photomedicine, Massachusetts General Hospital, 40 Blossom Street, Boston, MA 02114, USA, mhamblin@partners.org.
All authors have contributed equally to this work.