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Original Research

Infrared Laser Improves Collagen Organization in Muscle and Tendon Tissue During the Process of Compensatory Overload

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Abstract

Background: The photobiomodulation using the low-level laser therapy (LLLT) exerts a positive modulating effect on the synthesis of collagen in skeletal muscles and tendons. However, few studies have addressed this effect during the compensatory overload. ***Objective:*** Evaluate the effect of infrared laser on the deposition and organization of collagen fibers in muscle and tendon tissue during compensatory overload of the plantar muscle in rats. ***Materials and methods:*** Wistar rats were submitted to bilateral ablation of the synergist muscles of the hind paws and divided in groups: Control, Hypertrophy, and Hypertrophy (H)+LLLT (780 nm, 40 mW, 9.6 J/cm^2 and 10 s/point, 8 points, total energy 3.2 J, daily), evaluated at 7 and 14 days. Muscle cuts were stained with Picrosirius-Red and hematoxylin-eosin and tendon cuts were submitted to birefringence for determination of collagen distribution and organization. ***Results:*** After 7 days an increase was observed in the area between beam muscles in H+LLLT (25.45% ± 2.56) in comparison to H (20.3% ± 3.31), in mature fibers and fibrilis in H+LLLT (29346.88 μm^2 ± 2182.56; 47602.8 μm^2 ± 2201.86 respectively) in comparison to H (26656.5 μm^2 ± 1880.46; 45630.34 μm^2 ± 2805.82 respectively) and in the collagen area in H+LLLT (2.25% ± 0.19) in comparison to H (2.0% ± 0.15). However, after 14 days a reduction was observed in the area between beam muscles in H+LLLT (13.88% ± 2.54) in comparison to H (19.1% ± 2.61), in fibrils and mature fibers in H+LLLT (17174.1 μm^2 ± 2563.82; 32634.04 μm^2 ± 1689.38 respectively) in comparison to H (55249.86 μm^2 ± 1992.65; 44318.36 μm^2 ± 1759.57) and in the collagen area in H+LLLT (1.76% ± 0.16) in comparison to H (2.09 ± 0.27). A greater organization of collagen fibers in the tendon was observed after 7 and 14 days in H+LLLT groups. ***Conclusions:*** Infrared laser irradiation induces an improvement in collagen organization in tendons and a reduction in the total area of collagen in muscles during compensatory atrophy following the ablation of synergist muscles.

Keywords: skeletal muscle, collagen, low-level laser therapy, hypertrophy, photobiomodulation

Introduction

Skeletal muscle tissue has considerable plastic (metabolic and regenerative) capacity and can adapt to functional demands and sport activities through changes in the muscle fibers and the components of the connective tissue. Macromolecules of the extracellular matrix are produce and secreted by fibroblasts and collagen is the main constituent protein of this matrix.[1]

Collagen fibers are structural proteins that confer strength in muscle and tendon tissue to the mechanical deformations imposed on the muscle.[2] According to Kannus,[3] the organization of these fibers differs throughout their trajectory, which initiates in the muscle tissue and extends to the tendon-to-bone insertion. The fibers may be arranged either in parallel or in a cross pattern. Changes in the direction, organization, and deposition of collagen fibers seem to be related to the load imposed by the muscle and remodeling

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