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Low-Level Laser Therapy on Tissue Repair of Partially Injured Achilles Tendon in Rats

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Abstract

Objective: The aim of this study was to assess the alignment and type of collagen (I and III) in partially injured Achilles tendons of rats treated with low-level laser therapy (LLLT). ***Background:*** Achilles tendons present high indices of injury and their regeneration process may take a long time. LLLT has been used to accelerate and enhance injured Achilles tendon repair. ***Methods:*** Sixty-five male Wistar rats were distributed into seven groups: LASER 1, 3, and 7 (the rat's Achilles tendons were partially injured and submitted to treatment for 1, 3, or 7 days, respectively); a Sham group 1, 3, and 7 for each of LASER group (same injury, but the LLLT was only simulated), and five remaining animals were allocated to the control group (no procedures were performed). The 780 nm LLLT was applied once a day, with 70 mW of mean power, fluence of 17.5 J/cm^2 for 10 sec. After the rats were euthanized, the tendons were surgically removed and assessed by birefringence technique (collagen alignment) and picrosirius red (collagen I and III). ***Results:*** Sham versus LASER analysis did not show differences ($p > 0.05$) for collagen alignment. The collagen composition (median) was significantly different ($p < 0.05$) for LASER 3 (I: 16.5; III: 83.5) versus Sham 3 (I: 12.5; III: 87.5) and LASER 7 (I: 20.2; III: 79.8) versus Sham 7 (I: 10.2; III: 89.8). LASER groups exhibited a higher percentage of type I collagen and a lower percentage of type III collagen. ***Conclusions:*** LLLT stimulated collagen I proliferation, improving the injured Achilles tendons' healing process.

Introduction

The Achilles tendon is mainly formed by parallel bundles of collagen I and III and contains elastin embedded in an extracellular matrix. Furthermore, it is extremely exposed to overloading during sports and daily living activities and presents high indices of injury. Its regeneration process can take weeks or even months, given the morphological changes that occur.[1–7]

These morphological changes promote a reduction of collagen type I (thick fibers) and a change of aggregation and collagen alignment in the injured tendons, slowing the repair process and also making injured Achilles tendon susceptible to total ruptures.[5–7]

Low-level laser therapy (LLLT) has been used to accelerate the repair of Achilles injuries and tendinopathies, once LLLT generates synthesis of nucleic acid and cellular divisions in fibroblasts, while also increasing the quantity of mRNA pro-collagen types I and III, and improving the alignment of collagen fibers, facilitating and optimizing the Achilles tendon repair process.[7–10]

The widespread use of different types of LLLT is associated with a variability of effects. There are some studies reporting accelerated tendon repair;[11] modulation in pain, strength, and function;[12] increases in the organization of collagen fibers; and consequent improvements in tendon regeneration[10] as a result of LLLT application to Achilles tendon injuries.

Although there are numerous studies reporting promising results with near-infrared LLLT in relation to the proliferation and alignment of collagen,[10–12] there are also a wide variety of parameters used (mean power and fluence), and there is still a lack of data determining how to achieve the best results with LLLT. Therefore, the aim of the present study was to assess the effects of LLLT, with a wavelength of 780 nm (near infrared), a mean power of 70 mW, and fluence (ΔE) of 17.5 J/cm^2, on the repair process of partially injured Achilles tendons in rats.

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