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Original Research

Achilles Tendon Vascularization of Proximal, Medial, and Distal Portion Before and After Partial Lesion in Rats Treated with Phototherapy

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Abstract

Background: The Achilles tendon is one of the tendons most commonly injured by microtraumas and overuse during sports practice. This tendon is especially fragile because of the low blood supply in its central part. Nevertheless, the literature does not offer enough scientific support to explain the composition and vascular dynamic of animal tendons, despite the relevance of being able to observe if the animal tendon undergoes the same processes of vascularization in different regions, as occurs in humans. ***Methods:*** We used 28 rats weighing 280 ± 20 g, which were divided into four groups with seven animals each (control, sham, 830 nm, 660 nm). The laser parameters were: power output 60 mW for both lasers, 40 J/cm^2 of energy density, total energy 1.1 J, power density 2.14 W/cm^2, and application time 18.6 sec. This study evaluated the vascular constitution of healthy and injured calcaneous tendons. The tendons of each animal were processed to be embedded in Paraplast and, after that, they were divided into three parts: proximal, medial, and distal. Afterwards, they were cut in slices of 6 μm were made, then they were stained with hematoxylin and eosin. Using an ocular lens reticulated with magnification $\times 400$, we analyzed the number and the area density of the blood vessels using morphometric methods. Data were analyzed with the Shapiro–Wilk test, followed by Tukey, considering p as <0.05. ***Results:*** The area density and the number of blood vessels in the proximal part were 36% and 42%, respectively, of the values found in the medial part. The distal part had 64% more vessels and 52.8% more area density ($p < 0.05$) than the medial part. ***Conclusions:*** Low-level laser therapy (LLLT) had no effect on the studied parameters. The vascularization of rat tendon is similar to that of humans, which contributes to the studies of therapies that have been applied in humans.

Introduction

The calcaneal tendon is the largest and most resistant tendon of the human body,[1] being indispensable to the functioning of the articular mechanism of the ankles, and has, as its main functions, the transmission of the strength produced by the muscle to the bone and the resistance of significant loads of tensile strength.[2–4] This is one of the most commonly injured tendons, and the possible causes of these injuries are the repetitive microtraumas, overuse, overtraining, and the increasing participation in sport activities by society.[3,5–8]

The disruption of this tendon is considered a serious injury, because of its scarce blood supply, and it may take weeks or even months before complete cicatrization.[9] This injury generally occurs between 2 and 6 cm from its insertion in the calcaneus bone,[1] and some important alterations may occur, such as: functional complications[6] and ultrastructural,[10,11] biochemical,[5,12,13] and biomechanical[14] changes.

Many studies have been developed to better understand the processes of tissue repair and the shortening of cicatrization time for the calcaneal tendon.[3,15,16] In the rehabilitation scenario, the use of some physical agents, such as electrical stimulation,[17] therapeutic ultrasound,[3,18,19] and

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All the experiments were approved by the Ethics Committee of the university ''Universidade Metodista de Piracicaba – UNIMEP – CONSEPE 4209''.