Photomedicine and Laser Surgery
Volume 35, Number 1, 2017

Pp. 32–42
DOI: 10.1089/pho.2016.4150

Low-Level Laser Therapy and Cryotherapy as Mono- and Adjunctive Therapies for Achilles Tendinopathy in Rats

Sturla Haslerud, MSc, PT,[1,2] Rodrigo Alvaro Brandão Lopes-Martins,[3] Lúcio Frigo,[4] Jan Magnus Bjordal,[1,2] Rodrigo Labat Marcos, PhD,[5] Ingvill Fjell Naterstad, MSc, PT,[2] Liv Heide Magnussen,[2,6] and Jon Joensen, PhD[2,6]

Abstract

Background and objective: Low-level laser therapy (LLLT) and cryotherapy are widely used treatments in the acute phase of tendon injury. The aim of this study was to investigate the interaction of these two treatments on tendon inflammation and mechanical properties. ***Materials and methods:*** Six groups of six Wistar rats were used in this study. The Achilles tendons of the healthy control group were not subjected to injury or treatment. The tendons of the injured nontreated group (ING) were injured, but not treated. The remaining four groups were injured and subjected to LLLT, cryotherapy, LLLT first/cryotherapy, or cryotherapy first/LLLT. All treatments were performed at 1 h post-trauma. Inflammatory mediators, tendon histology, and biomechanical properties were assessed at 24 h post-trauma by comparing the treatment groups with the ING. ***Results:*** In all treatment groups, the inflammatory process shifted in an anti-inflammatory direction compared with the ING. Significant alterations in cytokine expression were found in only the LLLT group ($\downarrow$IL-1β) and the combined intervention groups ($\downarrow$IL-1β, $\downarrow$TNF-α, $\uparrow$IL-6). It was also found that cryotherapy followed by LLLT was the only treatment that significantly ($p < 0.05$) improved the biomechanical parameters of force (N) and displacement (mm) at the tendon rupture and corresponded with the best histological scores of all of the treatment groups. ***Conclusions:*** Our results demonstrate that cryotherapy in combination with LLLT can produce an anti-inflammatory ''add-on'' effect. The order of therapy administration seems essential, as superior histology and biomechanical results were found in the cryotherapy first/LLLT group.

Keywords: low-level laser therapy, tendinopathies and tendinitis, animal, photobiomodulation

Introduction

Tendons have a critical role in body mechanics, predominantly by transferring force from muscle contractions to bone, thus allowing movement and joint stability. The complex structure and viscoelastic properties of tendon material protect the muscle and bone from injury, and the tendon stores and distributes energy during motional activities.[1] Tendons also respond to mechanical loading by altering their structure through mechanotransduction, whereby cells transform loads into biochemical signals.[2] As such, strenuous activities or manual work may induce favorable adaptive physiological changes, ultimately strengthening the tendon. Conversely, overuse may start a cascade of pathological events, leading to inflammation and degeneration of tendon tissue,[3] collectively referred to as tendinopathy.[4]

Photobiomodulation (PBM) is a description of interventions with light therapy that modulate biological processes. Low-level laser therapy (LLLT) is a subtype of PBM where red and infrared light is generated by lasers.[5] LLLT is primarily offered as an ''add-on'' therapy to exercise in tendinopathy treatment, due to the proposed anti-inflammatory and stimulatory effect of laser irradiation on tendon healing.[6] Evidence of a positive interaction between LLLT and

[1]NorPhyPain Research Group, Faculty of Health and Social Sciences, Centre for Evidence Based Practice, Bergen University College, Bergen, Norway.
[2]Physiotherapy Research Group, Department of Global Public Health and Primary Care, University of Bergen, Bergen, Norway.
[3]Nucleus of Technological Research–NPT, Post-Graduate Program in Biomedical Engeneering, University of Mogi das Cruzes (UMC), São Paulo, Brazil.
[4]Centro de Ciências da Saúde, Universidade Cruzeiro do Sul, São Paulo, Brazil.
[5]Programa de Pós-Graduação em Biofotônica Aplicada as Ciências da Saúde, Universidade Nove de Julho, São Paulo, Brazil.
[6]Department of Occupational Therapy, Physiotherapy and Radiography, Faculty of Health and Social Sciences, Bergen University College, Bergen, Norway.