

# REVELATIONS

*A COMPENDIUM OF RESEARCH  
FROM MULTI RADIANCE MEDICAL*



# Revelations

A compendium of research  
from Multi Radiance Medical

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English Edition:  
Solon, OH USA

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6521 Davis Industrial Parkway  
Solon, OH 44139 USA  
440-542-0761  
[www.multiradiance.com](http://www.multiradiance.com)

# Multi Radiance Medical Super Pulsed Laser Therapy

## INTRODUCTION

This book presents a collection of summaries of scientific papers on safety and effectiveness of Multi Radiance Medical's (MRM) Super Pulsed Laser Therapy in different fields of application. The papers report the outcomes of research coordinated by MRM's Research Division and carried out in numerous clinical and research centers, both public and private.

Multi Radiance Medical's Super Pulsed Laser Technology is in the safest classification of lasers and its efficacy has been validated in vitro, in vivo, in controlled laboratory experiments and in clinical practice. A Scientific Monograph, written in conjunction with Laser Therapy University entitled The Pillars Paper, has been recently published and confirms this to be not only statistically significant, but clinically significant technology. It also raises the bar in the industry from evidence-based research to translational research.

Multi Radiance Medical is also currently involved with over 30 Clinical Studies Worldwide. It is our mission to investigate, validate and educate our practitioners with the knowledge and clinical skills necessary to achieve the best possible outcomes. Join hundreds of professionals each month and thousands per year who choose Multi Radiance because our Super Pulsed Lasers are safe for both patients and clinicians and are more cost effective than Class IV Lasers (surgical and rebranded "therapeutic").

## CASCADING ENERGY EFFECT™

Multi Radiance Medical uses three clinically proven wavelengths: 660 nm, 875 nm and 905 nm to cover the entire spectrum of the therapeutic window of light for deeper penetration and enhanced absorption of light.

Our sophisticated software algorithm synergizes multiple wavelengths, creating a cascading effect: 660 nm absorbed by superficial tissue clears the way for infrared 875 nm to penetrate deeper and eliminate cellular interference, which allows infrared 905 nm super pulsed laser to go even deeper.

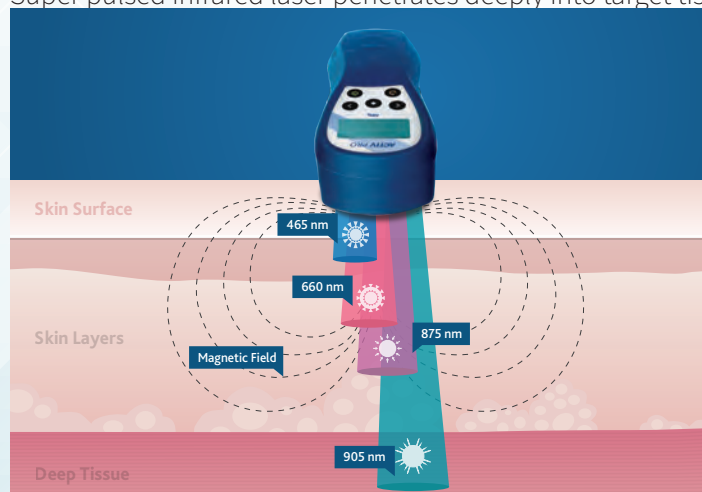
Multi Radiance Medical's proprietary multi-source technology successfully manipulates the interaction between light, laser and magnetic energy fields to achieve the desired penetration in the target tissue area.

## SUPER PULSING IS KEY TO MRM TECHNOLOGY

Super pulsed infrared laser (905 nm) GaAS is the essential component of Multi Radiance Medical technology. Multi Radiance Medical super pulsed lasers deliver billionths-of-a-second pulses, combined with up to 50,000 mW of peak power for a higher concentration of light energy, or photons, driven deeper into the target tissue without any risk of overheating.

Super pulsing allows for deeper penetration than a laser of the same wavelength that is not super pulsed but has the same average output power. This is because short pulses allow for quick absorption. In addition, the period between pulses promotes a better environment for optimal pain relief.

Super pulsed infrared laser penetrates deeply into target tis-



ues and exerts powerful stimulating influences upon blood microcirculation. In general, laser diodes are either continuous wave or pulsed. The continuous wave diodes emit laser energy for the entire time they are electrically driven, hence the name. They provide a fixed level of power during emission. Super pulsed diodes emit a series (frequency) of radiation impulses with high amplitude in an extremely short duration (typically 100 to 200 nanoseconds). The mean output of power of a Multi Radiance Medical super pulsed laser will increase as the pulse repetition is increased.

Each impulse of the super pulsed laser produces high peak power delivered for a very brief duration. It is the high-power level during each pulse that creates the energy density nec-

essary to deliver adequate doses to the target tissue. Even though the pulse peaks at a high-power level, there are no thermal effects in the tissue. Therefore, the peak power of a pulsed laser is high compared to its average output power. By using super pulsed lasers, one is able to more effectively deliver higher densities of light energy into the tissue without the associated deleterious thermal effects.

#### ADVANTAGES OF SUPER PULSED LASER:

- More photonic energy.
- Super pulsed laser technology provides more energy and penetrates deeper than comparable non-super pulsed lasers but does not generate excessive damaging heat.
- The advanced semi-conductor laser diode delivers higher power pulses of photonic energy in thousands of milliwatts without any deleterious heating of tissue.
- Maximum Photonic Density: the power density during these very high pulses yields an extremely high photon flux and saturation, delivering a stronger effect.
- Increases in peak power improve energy penetration into tissue.
- Safety

#### OUR STORY

Multi Radiance Medical is a global leader in Laser Therapy. The Super Pulsed Laser technology developed by Multi Radiance traces back to quantum research laboratories 30 years ago. More of a “mission” than a “business plan,” hundreds of researchers with million-dollar budgets developed an extraordinary and groundbreaking synergy of laser, light and magnetic field that revolutionized healthcare for space travelers.

Four generations later, Multi Radiance Medical, based in Solon, Ohio, has continued that inspiration and innovation and has recently introduced the MR5 ACTIV PRO and MR5 ACTIV PRO with LaserStim™. These products are the most validated, optimized and unrivaled therapy lasers in the world.

Ten years and millions of research dollars ago, Multi Radiance set out to validate its technology in vitro, in vivo, in controlled laboratory trials and in clinical trials. World-Renowned Researcher Ernesto Leal Junior, PhD, PT, and Multi Radiance Senior Vice President, Clinical and Scientific Affairs Douglas Johnson, ATC, EES, CLS, systematically validated the Multi Radiance Super Pulsed Laser’s dosimetry curve, depth of penetration time profile, thermal time profile, and cytochrome c oxidase peak activation time profile. In doing so, they have not only raised the bar for other laser manufacturers, but have actually set the Gold Standard by which all other laser validation should occur.

Dr. Leal Junior is the pioneer who changed the paradigm for

using therapeutic laser after injury to accelerate recovery. He proved that using laser prophylactically before exercise or competition increased performance, stamina and strength, thereby reducing fatigue and preventing injury. This work was largely carried out by Dr. Leal Junior and his dedicated team of researchers at the Laboratory of Phototherapy in Sports and Exercise in Sao Paulo, Brazil. This facility is historically one of the first of its kind in the world to be dedicated solely to conducting research in laser therapy.

Their combined determination and tireless energy to document and conduct human clinical trials on the combined energy device led to Multi Radiance technology receiving NHN clearance for neck and shoulder pain from the US Food & Drug Administration (FDA). Of the hundreds of laser companies in the world, only a special few have both ILY and NHN clearances from the FDA. ILY clearance means the product just heats tissue to produce beneficial results, while NHN means that the technology is non-heating and produces beneficial results by bio-modulation at the cellular level.

The original laser pre-application was proven with athletic performance, but the ramifications and clinical translation of this research has led to exciting new opportunities for cyto-protection in the fields of ophthalmology, neurology, cardiology, pulmonary and aesthetics. Multi Radiance is leading the charge by being involved in over 30 clinical trials around the world in its effort to advance the field of laser therapy.

Please review the enclosed and unprecedented 30+ peer-reviewed and published studies. However, please know that as of this printing, another 8 studies have either been submitted, are being prepared, or are in data collection. Multi Radiance has not only validated and optimized its technology; it has developed a treatment methodology called the Priority Principle. The Priority Principle was developed as a result of technology validation and promotes successful and reproducible patient outcomes.

Combined with a commitment to education featuring monthly webinars, newsletters and live clinical support, Multi Radiance and the MR5 ACTIV PRO technology are truly unrivaled. We look forward to serving you soon.



# Table of Contents

<b>Pg.</b>	<b><u>RESEARCH ABSTRACTS</u></b>
7	Adjunctive use of combination of super-pulsed laser and light-emitting diodes phototherapy on nonspecific knee pain
8	Phototherapy in skeletal muscle performance and recovery after exercise: effect of combination of super-pulsed laser and light-emitting diodes
9	Phototherapy with combination of super-pulsed laser and LEDs is beneficial in improvement of muscular performance (strength and muscular endurance), dyspnea, and fatigue sensation in patients with chronic obstructive pulmonary disease
10	Clinical Parameters Response to Low-Level Laser versus Monochromatic Near-Infrared Photo Energy in Diabetic Patients with Peripheral Neuropathy
11	The thermal impact of phototherapy with concurrent super-pulsed lasers and red and infrared LEDs on human skin
12	Using Pre-Exercise PBM Therapy Combining Super-Pulsed Lasers and LEDs to Improve Performance in Progressive Cardio-pulmonary Exercise Tests
13	What is the best moment to apply phototherapy when associated to a strength training program?
14	Photobiomodulation Therapy Improves Performance and Accelerates Recovery of High-Level Rugby Players in Field Test
15	Photobiomodulation therapy (PBMT) and/or cryotherapy in skeletal muscle restitution, what is better?
16	Photobiomodulation therapy (PBMT) on acute pain and inflammation in patients who underwent total hip arthroplasty
17	Immediate and short-term effects of phototherapy on pain, muscle activity, and joint mobility in women with temporomandibular disorder
18	In vitro bactericidal activity of blue light (465 nm) phototherapy on meticillin-susceptible and meticillin-resistant Staphylococcus pseudintermedius
19	Phototherapy for Improvement of Performance and Exercise Recovery: Comparison of 3 Commercially Available Devices
20	Photobiomodulation therapy for the improvement of muscular performance and reduction of muscular fatigue associated with exercise in healthy people
21	When is the best moment to apply photobiomodulation therapy (PBMT) when associated to a treadmill endurance-training program?
22	PBM therapy protects skeletal muscle and improves muscular function of mdx mice in a dose-dependent manner through modulation of dystrophin
23	Randomized, blinded, controlled trial on effectiveness of photobiomodulation therapy and exercise training in the fibromyalgia treatment
24	Incorporation of photobiomodulation therapy into a therapeutic exercise program for knee osteoarthritis
25	Low level laser therapy: an untapped resource in dentistry
26	Combined magnetic and pulsed laser fields produce synergistic acceleration of cellular electron transfer
27	Photobiomodulation therapy before futsal matches improves the staying time in athletes on the court and accelerates post-exercise recovery
28	Acute effects of PBMT combining laser diodes, light-emitting diodes, and magnetic field in exercise assessed by 6MST in patients with COPD

- 29 Topical hyperbaric oxygen and low-energy laser for the treatment of chronic ulcers
- 30 Clinical and scientific recommendations for the use of photobiomodulation therapy in exercise performance enhancement, and post-exercise recovery: current evidence and future directions
- 31 Effects of photobiomodulation therapy in aerobic endurance training and detraining in humans.
- 32 Effects of photobiomodulation therapy on inflammatory mediators in patients with chronic non-specific low back pain.
- 33 Effects of photobiomodulation therapy in patients with chronic non-specific low back pain
- 34 Intraoral photobiomodulation diminishes pain and improves functioning in women with temporomandibular disorder
- 35 Acute effects of photobiomodulation therapy and magnetic field on functional mobility in stroke survivors
- 36 Penetration Profiles of a Class IV Therapeutic Laser and a Photobiomodulation Therapy Device in Equine Skin
- 37 Effect of Laser Acupuncture on Mitigating Anxiety in Acute Stressed Horses

### **CASE STUDY ABSTRACTS**

- 39 Effectiveness of Take Home Low-Level Laser Therapy in Treating Fibromyalgia Syndrome: A Case Study
- 40 Effects of Low Level Laser Therapy (LLLT) as a Treatment for Plantar Fasciitis in Two Female Cross Country Runners: A Case Study
- 40 Effects of Low Level Laser Therapy on Pain Levels in a Patient with Fibromyalgia: A Case Study
- 41 A Case of Adhesive Capsulitis Shoulder Relieved With Therapeutic Low Level Laser
- 41 The Use of Laser Therapy for Treatment of a Damaged Bicep Due to Weight Training of the Non-Dominant Arm
- 42 LLLT accelerated healing and improved symptoms and outcome for second degree scalding burns on human skin for the subject patient
- 43 Subscapularis Syndrome: A case report
- 43 Effects of Low Level Laser Therapy as a Treatment for Post-Surgical Tarsal Coalition in a Collegiate Women's Basketball Player
- 44 Conclusion





# RESEARCH

## Abstracts



# Adjunctive use of combination of super-pulsed laser and light-emitting diodes phototherapy on nonspecific knee pain: double-blinded randomized placebo-controlled trial

**ABSTRACT:** Phototherapy with low-level laser therapy (LLLT) and light-emitting diode therapy (LEDT) has arisen as an interesting alternative to drugs in treatments of musculo-skeletal disorders. However, there is a lack of studies investigating the effects of combined use of different wavelengths from different light sources like lasers and light-emitting diodes (LEDs) in skeletal muscle disorders. With this perspective in mind, this study aimed to investigate the effects of phototherapy with combination of different light sources on nonspecific knee pain. It was performed a randomized, placebo-controlled, double-blinded clinical trial. Eighty-six patients rated 30 or greater on the pain visual analogue scale (VAS) were recruited and included in study. Patients of LLLT group received 12 treatments with active phototherapy (with 905 nm super-pulsed laser and 875 and 640 nm LEDs, Manufactured by Multi Radiance Medical, Solon, OH, USA) and conventional treatment (physical therapy or chiropractic care), and patients of placebo group were treated at same way but with placebo phototherapy device. Pain assessments (VAS) were performed at baseline, 4th, 7th, and 10th treatments, after the completion of treatments and at 1-month follow-up visit. Quality of life assessments (SF-36<sup>®</sup>) were performed at baseline, after the completion of treatments and at 1-month follow-up visit. Our results demonstrate that phototherapy significantly decreased pain ( $p < 0.05$ ) from 10th treatment to follow-up assessments and significantly improved ( $p < 0.05$ ) SF-36<sup>®</sup> physical component summary at posttreatments and follow-up assessments compared to placebo. We conclude that combination of super-pulsed laser, red and infrared LEDs is effective to decrease pain and improve quality of life in patients with knee pain.

## AUTHORS:

Ernesto Cesar Pinto Leal-Junior, Douglas Scott Johnson, Anita Saltmarche, Timothy Demchak

## INSTITUTIONS:

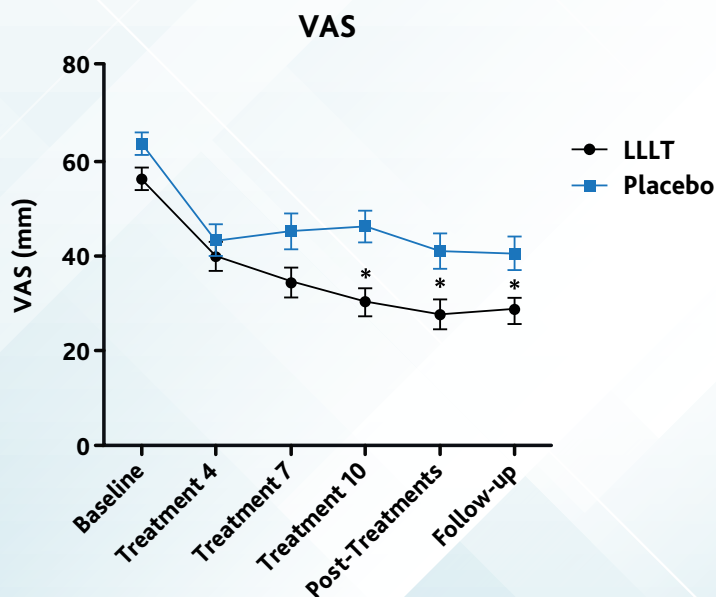
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil, Multi Radiance Medical, Solon, USA, Laser Therapy U, Atlanta, USA, Department Applied Medicine and Rehabilitation, Indiana State University, Terre Haute, USA

## YEAR:

2014

## JOURNAL:

Lasers in Medical Science  
November 2014, Volume 29, Issue 6, pp 1839–1847



The active group resulted in a 50% improvement (15% greater than the placebo group) or one standard deviation improvement over the placebo group which is statistically significant.

# Phototherapy in skeletal muscle performance and recovery after exercise: effect of combination of super-pulsed laser and light-emitting diodes

**ABSTRACT:** Recent studies with phototherapy have shown positive results in enhancement of performance and improvement of recovery when applied before exercise. However, several factors still remain unknown such as therapeutic windows, optimal treatment parameters, and effects of combination of different light sources (laser and LEDs). The aim of this study was to evaluate the effects of phototherapy with the combination of different light sources on skeletal muscle performance and post-exercise recovery, and to establish the optimal energy dose. A randomized, double-blinded, placebo-controlled trial with participation of 40 male healthy untrained volunteers was performed. A single phototherapy intervention was performed immediately after pre-exercise (baseline) maximum voluntary contraction (MVC) with a cluster of 12 diodes (4 of 905 nm lasers—0.3125 mW each, 4 of 875 nm LEDs—17.5 mW each, and 4 of 670 nm LEDs—15 mW each— manufactured by Multi Radiance Medical™) and dose of 10, 30, and 50 J or placebo in six sites of quadriceps. MVC, delayed onset muscle soreness (DOMS), and creatine kinase (CK) activity were analyzed. Assessments were performed before, 1 min, 1, 24, 48, 72, and 96 h after eccentric exercise protocol employed to induce fatigue. Phototherapy increased ( $p < 0.05$ ) MVC was compared to placebo from immediately after to 96 h after exercise with 10 or 30 J doses (better results with 30 J dose). DOMS was significantly decreased compared to placebo ( $p < 0.05$ ) with 30 J dose from 24 to 96 h after exercise, and with 50 J dose from immediately after to 96 h after exercise. CK activity was significantly decreased ( $p < 0.05$ ) compared to placebo with all phototherapy doses from 1 to 96 h after exercise (except for 50 J dose at 96 h). Pre-exercise phototherapy with combination of low-level laser and LEDs, mainly with 30 J dose, significantly increases performance, decreases DOMS, and improves biochemical marker related to skeletal muscle damage.

## AUTHORS:

Fernanda Colella Antonialli, Thiago De Marchi, Shaiane Silva Tomazoni, Adriane Aver Vanin, Vanessa dos Santos Grandinetti, Paulo Roberto Vicente de Paiva, Henrique Dantas Pinto, Eduardo Foschini Miranda, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

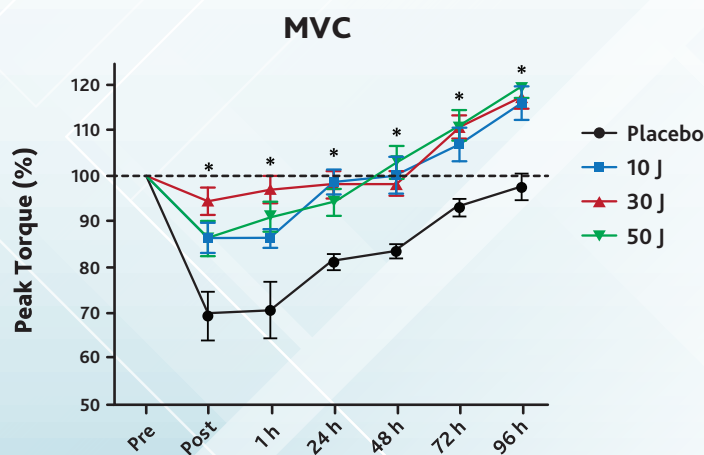
Universidade Nove de Julho (UNINOVE), São Paulo, SP, Brazil

## YEAR:

2014

## JOURNAL:

Lasers in Medical Science  
November 2014, Volume 29, Issue 6, pp 1967–1976



This represents at 300% increase in recovery rate.

# Phototherapy with combination of super-pulsed laser and light-emitting diodes is beneficial in improvement of muscular performance (strength and muscular endurance), dyspnea, and fatigue sensation in patients with chronic obstructive pulmonary disease

**ABSTRACT:** Phototherapy is an electrophysical intervention being considered for the retardation of peripheral muscular fatigue usually observed in chronic obstructive pulmonary disease (COPD). The objective of this study was to evaluate the acute effects of combination of super-pulsed laser and light-emitting diodes phototherapy on isokinetic performance in patients with COPD. Thirteen patients performed muscular endurance tests in an isokinetic dynamometer. The maximum voluntary isometric contraction (MVIC), peak torque (PT), and total work (TW) of the non-dominant lower limb were measured in two visits. The application of phototherapy or placebo (PL) was conducted randomly in six locations of femoral quadriceps muscle by using a cluster of 12 diodes (4 of 905 nm super-pulsed lasers, 0.3125 mW each; 4 of 875 nm LEDs, 17.5 mW each; and 4 of 640 nm LEDs, 15 mW each, manufactured by Multi Radiance Medical™). We found statistically significant increases for PT ( $174.7 \pm 35.7 \text{ N} \cdot \text{m}$  vs.  $155.8 \pm 23.3 \text{ N} \cdot \text{m}$ ,  $p=0.003$ ) and TW after application of phototherapy when compared to placebo ( $778.0 \pm 221.1 \text{ J}$  vs.  $696.3 \pm 146.8 \text{ J}$ ,  $p=0.005$ ). Significant differences were also found for MVIC ( $104.8 \pm 26.0 \text{ N} \cdot \text{m}$  vs.  $87.2 \pm 24.0 \text{ N} \cdot \text{m}$ ,  $p=0.000$ ), sensation of dyspnea (1 [0–4] vs. 3 [0–6],  $p=0.003$ ), and fatigue in the lower limbs (2 [0–5] vs. 5 [0.5–9],  $p=0.002$ ) in favor of phototherapy. We conclude that the combination of super-pulsed lasers and LEDs administered to the femoral quadriceps muscle of patients with COPD increased the PT by 20.2 % and the TW by 12 %. Phototherapy with a combination of super-pulsed lasers and LEDs prior to exercise also led to decreased sensation of dyspnea and fatigue in the lower limbs in patients with COPD.

## AUTHORS:

Eduardo Foschini Miranda, Luís Vicente Franco de Oliveira, Fernanda Colella Antonialli, Adriane Aver Vanin, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

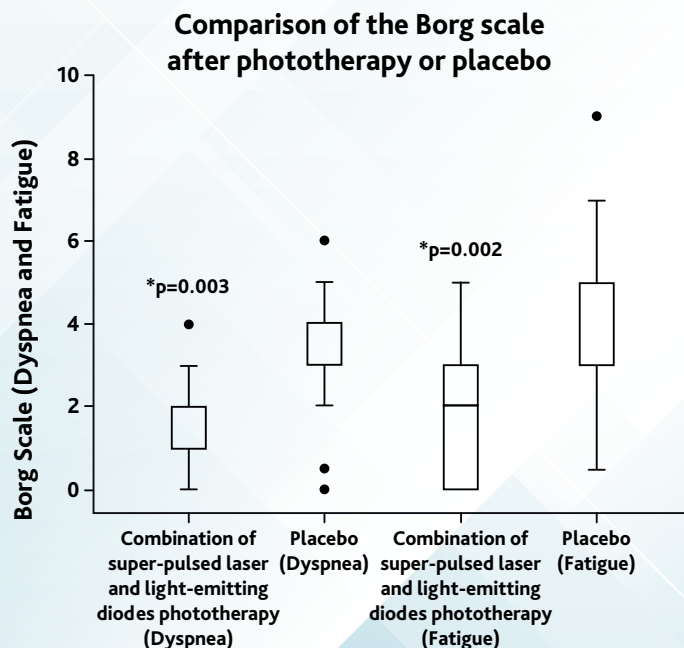
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil

## YEAR:

2015

## JOURNAL:

Lasers in Medical Science  
January 2015, Volume 30, Issue 1, pp 437–443



# Clinical Parameters Response to Low-Level Laser versus Monochromatic Near-Infrared Photo Energy in Diabetic Patients with Peripheral Neuropathy

**ABSTRACT:** Background: Diabetic sensorimotor polyneuropathy (DSP) is one of the most common microvascular complications of type 2 diabetes. Loss of sensation is thought to contribute to a lack of static and dynamic stability and increased risk of falling. Purpose: The purpose of this study was to compare the effects of low-level laser (LLL) and monochromatic near-infrared photo energy (MIRE) on pain, cutaneous sensation, static stability, and index of lower limb blood flow in diabetic patients with peripheral neuropathy. Methods: Forty diabetic patients with peripheral neuropathy were recruited for participation in this study. They were divided into two groups: The MIRE group, which contained 20 patients, and the LLL group, which contained 20 patients. All patients who participated in the study had been subjected to various physical assessment procedures, including pain, cutaneous sensation, Doppler flow meter, and static stability assessments. The baseline measurements were followed by treatment sessions that were conducted twice a week for six successive weeks. Results: The statistical analysis of the data revealed significant improvement of pain in both groups, with significant improvement in cutaneous sensation and static balance in the MIRE group compared to the LLL group; on the other hand, the results showed no significant differences in lower limb blood flow between the groups. Conclusion: LLL and MIRE can improve painful symptoms in patients with diabetic neuropathy. On the other hand, MIRE is also useful in improving cutaneous sensation and static stability in patients with diabetic neuropathy.

**AUTHORS:**

Abeer A. Abdelhamed

**INSTITUTIONS:**

**YEAR:**

2015

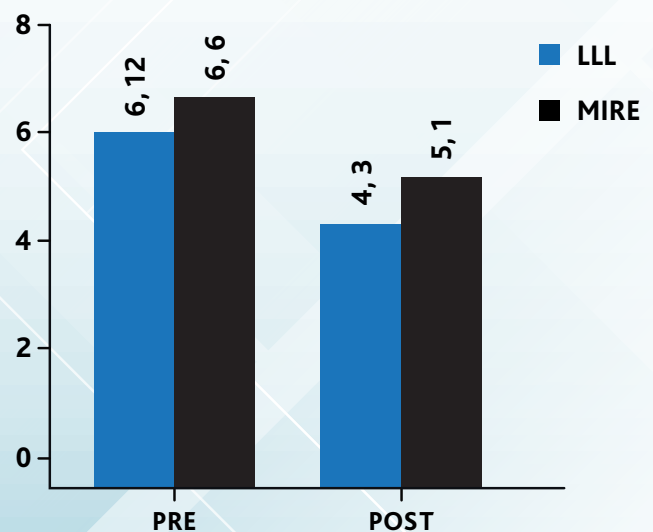
**JOURNAL:**

World Academy of Science, Engineering and Technology

International Journal of Medical and Health Sciences

Vol:9, No:7, 2015

The mean values of VAS Pre and Post 6 Weeks in Both Groups



# The thermal impact of phototherapy with concurrent super-pulsed lasers and red and infrared LEDs on human skin

**ABSTRACT:** From the very first reports describing the method of action of phototherapy, the effects have been considered to be the result of photochemical and photophysical interactions between the absorbed photons and tissue and not related to secondary changes in tissue or skin temperature. However, thermal effects have been recently reported in dark pigmented skin when irradiated with single wavelengths of 810 and 904 nm of low-level laser therapy (LLLT) devices even with doses that do not exceed those recommended by the World Association of Laser Therapy (WALT). The aim of this study was to evaluate the thermal impact during the concurrent use of pulsed red and infrared LEDs and super-pulsed lasers when applied to light, medium, and dark pigmented human skin with doses typically seen in clinical practice. The study evaluated the skin temperature of 42 healthy volunteers (males and females 18 years or older, who presented different pigmentations, stratified according to Von Luschan's chromatic scale) via the use of a thermographic camera. Active irradiation was performed with using the multi-diode phototherapy cluster containing four 905-nm super-pulsed laser diodes (frequency set to 250 Hz), four 875-nm infrared-emitting diodes, and four 640-nm LEDs (manufactured by Multi Radiance Medical™, Solon, OH, USA). Each of the four doses were tested on each subject: placebo, 0 J (60 s); 10 J (76 s); 30 J (228 s); and 50 J (380 s). Data were collected during the last 5 s of each dose of irradiation and continued for 1 min after the end of each irradiation. No significant skin temperature increases were observed among the different skin color groups ( $p > 0.05$ ), age groups ( $p > 0.05$ ), or gender groups ( $p > 0.05$ ). Our results indicate that the concurrent use of super-pulsed lasers and pulsed red and infrared LEDs can be utilized in patients with all types of skin pigmentation without concern over safety or excessive tissue heating. Additionally, the doses and device utilized in present study have demonstrated positive outcomes in prior clinical trials. Therefore, it can be concluded that the effects seen by the concurrent use of multiple wavelengths and light sources were the result of desirable photobiomodulation effect and not related to thermal influence.

## **AUTHORS:**

Vanessa dos Santos Grandinetti, Eduardo Foschini Miranda, Douglas Scott Johnson, Paulo Roberto Vicente de Paiva, Shaiane Silva Tomazoni, Adriane Aver Vanin, Gianna Mões Albuquerque-Pontes, Lucio Frigo, Rodrigo Labat Marcos, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## **INSTITUTIONS:**

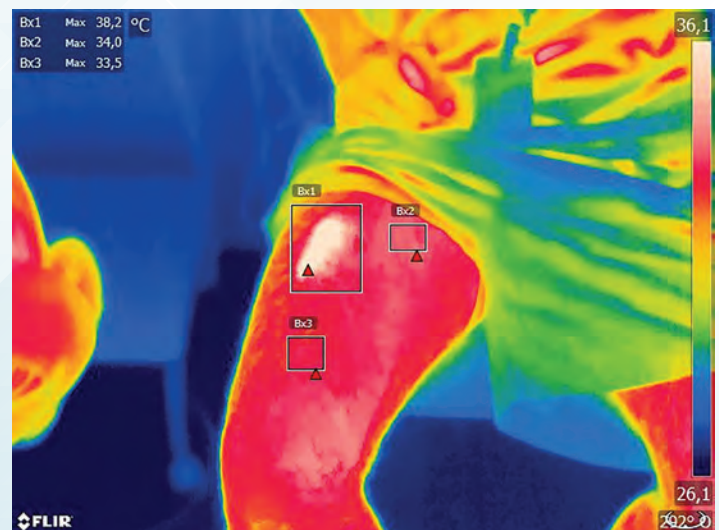
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil

## **YEAR:**

2015

## **JOURNAL:**

Lasers in Medical Science  
July 2015, Volume 30, Issue 5, pp 1575–1581



**Our results indicate that the concurrent use of super-pulsed lasers and pulsed red and infrared LEDs can be utilized in patients with all types of skin pigmentation without concern over safety or excessive tissue heating.**

# Using Pre-Exercise Photobiomodulation Therapy Combining Super-Pulsed Lasers and Light-Emitting Diodes to Improve Performance in Progressive Cardiopulmonary Exercise Tests

**ABSTRACT:** Context: Skeletal muscle fatigue and exercise performance are novel areas of research and clinical application in the photobiomodulation field, and positive outcomes have been reported in several studies; however, the optimal measures have not been fully established. Objective: To assess the acute effect of photobiomodulation therapy (PBMT) combining superpulsed lasers (low-level laser therapy) and light-emitting diodes (LEDs) on muscle performance during a progressive cardiopulmonary treadmill exercise test. Design: Crossover study. Setting: Laboratory. Patients or Other Participants: Twenty untrained male volunteers (age =  $26.0 \pm 6.0$  years, height =  $175.0 \pm 10.0$  cm, mass =  $74.8 \pm 10.9$  kg). Intervention(s): Participants received PBMT with either combined superpulsed lasers and LED (active PBMT) or placebo at session 1 and the other treatment at session 2. All participants completed a cardiopulmonary test on a treadmill after each treatment. For active PBMT, we performed the irradiation at 17 sites on each lower limb (9 on the quadriceps, 6 on the hamstrings, and 2 on the gastrocnemius muscles), using a cluster with 12 diodes (four 905-nm superpulsed laser diodes with an average power of 0.3125 mW, peak power of 12.5 W for each diode, and frequency of 250 Hz; four 875-nm infrared LED diodes with an average power of 17.5 mW; and four 640-nm red LED diodes with an average power of 15 mW) and delivering a dose of 30 J per site. Main Outcome Measure(s): Distance covered, time until exhaustion, pulmonary ventilation, and dyspnea score. Results: The distance covered ( $1.96 \pm 0.30$  versus  $1.84 \pm 0.40$  km,  $t_{19} = 2.119$ ,  $P < .001$ ) and time until exhaustion on the cardiopulmonary test ( $780.2 \pm 91.0$  versus  $742.1 \pm 94.0$  seconds,  $t_{19} = 3.028$ ,  $P < .001$ ) was greater after active PBMT than after placebo. Pulmonary ventilation was greater ( $76.4 \pm 21.9$  versus  $74.3 \pm 19.8$  L/min,  $t_{19} = 0.180$ ,  $P = .004$ ) and the score for dyspnea was lower ( $3.0$  [interquartile range =  $0.5-9.0$ ] versus  $4.0$  [ $0.0-9.0$ ],  $U = 184.000$ ,  $P < .001$ ) after active PBMT than after placebo. Conclusions: The combination of lasers and LEDs increased the time, distance, and pulmonary ventilation and decreased the score of dyspnea during a cardiopulmonary test.

## AUTHORS:

Eduardo Foschini Miranda, PhD, PT; Adriane Aver Vanin, MSc, PT; Shaiane Silva Tomazoni, PhD, PT; Vanessa dos Santos Grandinetti, MSc, PT; Paulo Roberto Vicente de Paiva, MSc, PE; Caroline dos Santos Monteiro Machado, PT; Kadma Karênina, PT; Heliodora Leão Casalechi, PhD, PT; Paulo de Tarso; Camillo de Carvalho, PhD, PT; Ernesto Cesar Pinto Leal-Junior, PhD, PT

## INSTITUTIONS:

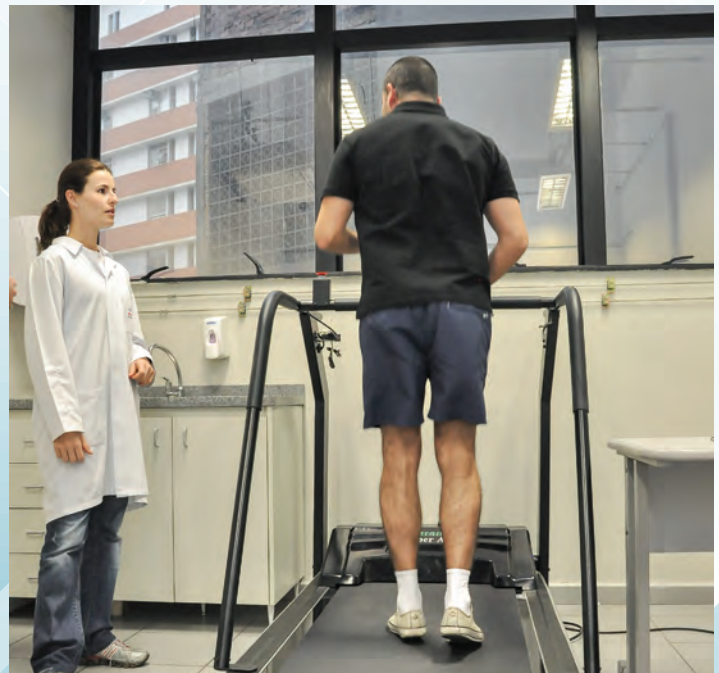
University of São Paulo, Brazil

## YEAR:

2016

## JOURNAL:

Journal of Athletic Training  
Volume 51, Issue 2 (February 2016)



# What is the best moment to apply phototherapy when associated to a strength training program? A randomized, double-blinded, placebo-controlled trial

**ABSTRACT:** The effects of phototherapy (or photobiomodulation therapy) with low-level laser therapy (LLLT) and/or light-emitting diodes (LEDs) on human performance improvement have been widely studied. Few studies have examined its effect on muscular training and no studies have explored the necessary moment of phototherapy irradiations (i.e., before and/or after training sessions). The aim of this study was to determine the optimal moment to apply phototherapy irradiation when used in association with strength training. Forty-eight male volunteers (age between 18 to 35 years old) completed all procedures in this study. Volunteers performed the strength training protocol where either a phototherapy and/or placebo before and/or after each training session was performed using cluster probes with four laser diodes of 905 nm, four LEDs of 875 nm, and four LEDs of 640 nm—manufactured by Multi Radiance Medical™. The training protocol duration was 12 weeks with assessments of peak torque reached in maximum voluntary contraction test (MVC), load in 1-repetition maximum test (1-RM) and thigh circumference (perimetry) at larger cross-sectional area (CSA) at baseline, 4 weeks, 8 weeks, and 12 weeks. Volunteers from group treated with phototherapy before and placebo after training sessions showed significant ( $p < 0.05$ ) changes in MVC and 1-RM tests for both exercises (leg extension and leg press) when compared to other groups. With an apparent lack of side effects and safety due to no thermal damage to the tissue, we conclude that the application of phototherapy yields enhanced strength gains when it is applied before exercise. The application may have additional beneficial value in post-injury rehabilitation where strength improvements are needed.

## **AUTHORS:**

Adriane Aver Vanin, Eduardo Foschini Miranda, Caroline Santos Monteiro Machado, Paulo Roberto Vicente de Paiva, Gianna Mões Albuquerque-Pontes, Heliadora Leão Casalechi, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## **INSTITUTIONS:**

Universidade Nove de Julho (UNINOVE), São Paulo, Brazil

## **YEAR:**

2016

## **JOURNAL:**

Lasers in Medical Science  
November 2016, Volume 31, Issue 8, pp 1555–1564



# Photobiomodulation Therapy Improves Performance and Accelerates Recovery of High-Level Rugby Players in Field Test: A Randomized, Crossover, Double-Blind, Placebo-Controlled Clinical Study

**ABSTRACT:** Photobiomodulation therapy improves performance and accelerates recovery of high-level rugby players in field test: A randomized, crossover, double-blind, placebo-controlled clinical study. Although growing evidence supports the use of photobiomodulation therapy (PBMT) for performance and recovery enhancement, there have only been laboratory-controlled studies. Therefore, the aim of this study was to analyze the effects of PBMT in performance and recovery of high-level rugby players during an anaerobic field test. Twelve male high-level rugby athletes were recruited in this randomized, crossover, double-blinded, placebo-controlled trial. No interventions were performed before the Bangsbo sprint test (BST) at familiarization phase (week 1); at weeks 2 and 3, pre-exercise PBMT or placebo were randomly applied to each athlete. Photobiomodulation therapy irradiation was performed at 17 sites of each lower limb, employing a cluster with 12 diodes (4 laser diodes of 905 nm, 4 light emitting diodes [LEDs] of 875 nm, and 4 LEDs of 640 nm, 30 J per site, manufactured by Multi Radiance Medical). Average time of sprints, best time of sprints, and fatigue index were obtained from BST. Blood lactate levels were assessed at baseline, and at 3, 10, 30, and 60 minutes after BST. Athletes' perceived fatigue was also assessed through a questionnaire. Photobiomodulation therapy significantly ( $p \leq 0.05$ ) improved the average time of sprints and fatigue index in BST. Photobiomodulation therapy significantly decreased percentage of change in blood lactate levels ( $p \leq 0.05$ ) and perceived fatigue ( $p \leq 0.05$ ). Pre-exercise PBMT with the combination of super-pulsed laser (low-level laser), red LEDs, and infrared LEDs can enhance performance and accelerate recovery of high-level rugby players in field test. This opens a new avenue for wide use of PBMT in real clinical practice in sports settings.

## **AUTHORS:**

Henrique D. Pinto, Adriane A. Vanin, Eduardo F. Miranda, Shaiane S. Tomazoni, Douglas S. Johnson, Gianna M. Albuquerque-Pontes, Ivo de O. Aleixo, Vanessa dos S. Grandinetti, Heliadora L. Casalechi, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar P. Leal Junior

## **INSTITUTIONS:**

University of São Paulo, São Paulo, Brazil  
Multi Radiance Medical, Solon, Ohio

## **YEAR:**

2016

## **JOURNAL:**

The Journal of Strength & Conditioning Research  
December 2016 - Volume 30 - Issue 12 - p 3329–3338



**Photobiomodulation therapy significantly improved the average time of sprints and fatigue index in BST (Bangsbo Sprint Test).**





# Photobiomodulation therapy (PBMT) and/or cryotherapy in skeletal muscle restitution, what is better? A randomized, double-blinded, placebo-controlled clinical trial

**ABSTRACT:** Cryotherapy for post-exercise recovery remains widely used despite the lack of quality evidence. Photobiomodulation therapy (PBMT) studies (with both low-level laser therapy and light-emitting diode therapy) have demonstrated positive scientific evidence to suggest its use. The study aims to evaluate PBMT and cryotherapy as a single or combined treatment on skeletal muscle recovery after eccentric contractions of knee extensors. Fifty healthy male volunteers were recruited and randomized into five groups (PBMT, cryotherapy, cryotherapy + PBMT, PBMT + cryotherapy, or placebo) for a randomized, double-blinded, placebo-controlled trial that evaluated exercise performance (maximum voluntary contraction (MVC)), delayed onset muscle soreness (DOMS), and muscle damage (creatinase kinase (CK)). Assessments were performed at baseline; immediately after; and at 1, 24, 48, 72, and 96 h. Comparator treatments was performed 3 min after exercise and repeated at 24, 48, and 72 h. PBMT was applied employing a cordless, portable GameDay™ device (combination of 905 nm super-pulsed laser and 875- and 640-nm light-emitting diodes (LEDs); manufactured by Multi Radiance Medical™, Solon - OH, USA), and cryotherapy by flexible rubber ice packs. PBMT alone was optimal for post-exercise recovery with improved MVC, decreased DOMS, and CK activity ( $p < 0.05$ ) from 24 to 96 h compared to placebo, cryotherapy, and cryotherapy + PBMT. In the PBMT + cryotherapy group, the effect of PBMT was decreased ( $p > 0.05$ ) but demonstrated significant improvement in MVC, decreased DOMS, and CK activity ( $p < 0.05$ ). Cryotherapy as single treatment and cryotherapy + PBMT were similar to placebo ( $p > 0.05$ ). We conclude that PBMT used as single treatment is the best modality for enhancement of post-exercise restitution, leading to complete recovery to baseline levels from 24 h after high-intensity eccentric contractions.

## AUTHORS:

Paulo Roberto Vicente de Paiva, Shaiane Silva Tomazoni, Douglas Scott Johnson, Adriane Aver Vanin, Gianna Mões Albuquerque-Pontes, Caroline dos Santos Monteiro Machado, Heliodora Leão Casalechi, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

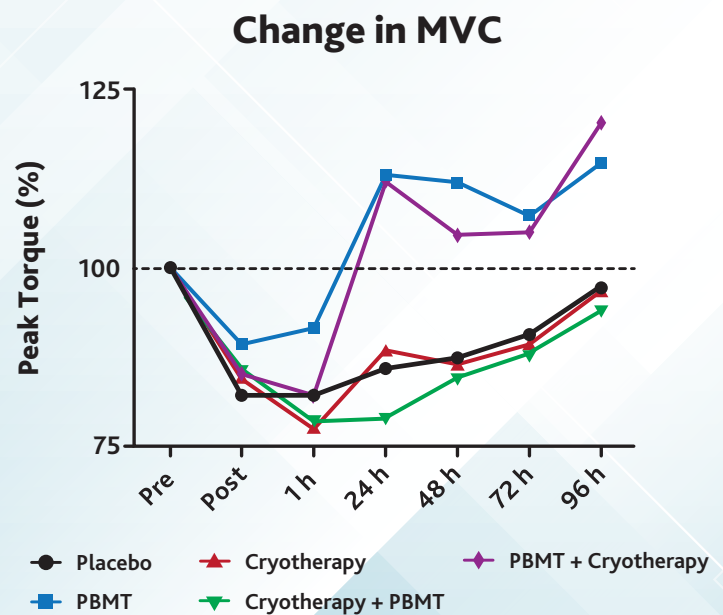
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil  
University of São Paulo, São Paulo, Brazil  
Multi Radiance Medical, Solon, USA

## YEAR:

2016

## JOURNAL:

Lasers in Medical Science  
November 2016, Volume 31, Issue 8, pp 1555–1564



# Photobiomodulation therapy (PBMT) on acute pain and inflammation in patients who underwent total hip arthroplasty - A randomized, triple-blinded, placebo-controlled trial

**ABSTRACT:** When conservative treatments fail, hip osteoarthritis (OA), a chronic degenerative disease characterized by cartilage wear, progressive joint deformity and loss of function, can result in the need for a total hip arthroplasty (THA). Surgical procedures induced tissue trauma and incite an immune response. Photobiomodulation therapy (PBMT) using low-level laser therapy (LLLT) and/or light emitting diode therapy (LEDT) has proven effective in tissue repair by modulating the inflammatory process and promoting pain relief. Therefore, the aim of this study was to analyze the immediate effect of PBMT on inflammation and pain of patients undergoing total hip arthroplasty. The study consisted of eighteen post-surgical hip arthroplasty patients divided into two groups (n=9 each) placebo and active PBMT who received one of the treatments in a period from 8 to 12 hours following THA surgery. PBMT (active or placebo) was applied using a device consisting of 9 diodes (1 super-pulsed laser of 905nm, 4 infrared LEDs of 875nm and 4 red LEDs 640nm, 40.3J per point) applied to 5 points along the incision. Visual analogue scale (VAS) and blood samples for analysis of the levels of the cytokines TNF- $\alpha$ , IL-6 and IL-8 were recorded before and after PBMT application. The values for the visual analogue scale as well as those in the analysis of TNF- $\alpha$  and IL-8 serum levels, decreased in the active PBMT group compared to placebo-control group ( $p < 0.05$ ). No decrease was observed for IL-6 levels. We conclude that PBMT is effective in decreasing pain intensity and post-surgery inflammation in patients receiving total hip arthroplasty.

## AUTHORS:

Luciana Gonçalves Langella, Heliodora Leão Casalechi, Shaiane Silva Tomazoni, Douglas Scott Johnson, Regiane Albertini, Rodney Capp Pallotta, Rodrigo Labat Marcos, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

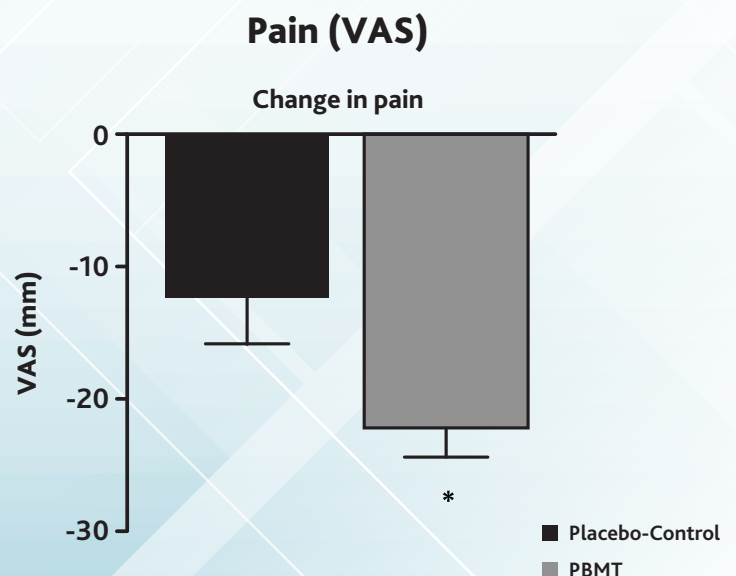
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil, Multi Radiance Medical, Solon, USA

## YEAR:

2018

## JOURNAL:

Lasers in Medical Science



Statistically significant ( $p > 0.03$ ) reduction in VAS. This change resulted in an immediate reduction of pain experienced by the patients following THA.

# Immediate and short-term effects of phototherapy on pain, muscle activity, and joint mobility in women with temporomandibular disorder: a randomized, double-blind, placebo-controlled, clinical trial

**ABSTRACT:** The aim of the present study was to evaluate the immediate and short-term effects of phototherapy on pain intensity, the pressure pain threshold (PPT), maximum vertical mandibular movement, and the electrical activity of the masseter and temporal muscles in women with temporomandibular disorder (TMD). Methods: Sixty women were randomly allocated to four different groups and submitted to phototherapy with a combination of super-pulsed laser (905 nm), red (640 nm), and infrared (875 nm) light emitting diodes in the same equipment on the masseter (three points) and temporal (two points) muscles bilaterally in a single session. The following doses were used in each point of application: Group 1 – 2.62 J; Group 2 – 5.24 J; Group 3 – 7.86 J; placebo group. Pain intensity was determined using the visual analog scale. The PPT was analyzed using a digital algometer. Vertical mandibular movement was measured using digital calipers. Myoelectrical activity of the masseter and temporal muscles was measured using electromyography. Four evaluations were performed: pre-intervention, immediately after, 24 and 48 hours after phototherapy. Outcomes: A significant reduction in pain intensity during the post-treatment evaluations in comparison to the pretreatment evaluation was observed in group 1 (Median difference=2.60 [95% CI=1.35–3.85]) and group 2 (Median difference=2.2 [95% CI=0.98–3.42]) especially after 48 hours and group 3 (Median difference=2.50 [95% CI: 0.56–4.46]) especially after 24 hours, with a moderate effect size, but no effect was found regarding the other variables. Conclusions: A single session of combined phototherapy was capable of reducing pain intensity in individuals patients with TMD.

## **AUTHORS:**

Carolina Marciela Herpich, Ernesto Cesar Pinto Leal-Junior, Cid Andre Fidelis de Paula Gomes, Igor Phillip dos Santos Gloria, Ana Paula Amaral, Maitê de Freitas de Rocha Souza Amaral, Fabiano Politti & Daniela Aparecida Biasotto-Gonzalez

## **INSTITUTIONS:**

Universidade Nove de Julho (UNINOVE), São Paulo, Brazil

## **YEAR:**

2017

## **JOURNAL:**

Disability and Rehabilitation

June 2017, pp 1-7 doi.org/10.1080/09638288.2017.1336648



**A single session of combined phototherapy was capable of reducing pain intensity in individual patients with TMD.**



# In vitro bactericidal activity of blue light (465 nm) phototherapy on meticillin-susceptible and meticillin-resistant *Staphylococcus pseudintermedius*

**ABSTRACT:** Background: *Staphylococcus pseudintermedius* is the most common cause of bacterial skin infections in dogs. Meticillin-resistant infections have become more common and are challenging to treat. Blue light phototherapy may be an option for treating these infections. Hypothesis/Objectives –The objective of this study was to measure the in vitro bactericidal activity of 465 nm blue light on meticillin-susceptible *Staphylococcus pseudintermedius* (MSSP) and meticillin-resistant *Staphylococcus pseudintermedius* (MRSP). We hypothesized that irradiation with blue light would kill MSSP and MRSP in a dose-dependent fashion in vitro as previously reported for meticillin-resistant *Staphylococcus aureus* (MRSA). Methods –In six replicate experiments, each strain [MSSP, n=1; MRSP ST-71 (KM1381) n=1; and MRSA (BAA-1680) n=1] were cultivated on semisolid media, irradiated using a 465 nm blue light phototherapeutic device at the cumulative doses of 56.25, 112.5 and 225 J/cm<sup>2</sup> and incubated overnight at 35°C. Controls were not irradiated. Colony counts (CC) were performed manually. Descriptive statistics were performed and treatment effects assessed using the Wilcoxon–Mann–Whitney rank-sum test. Bonferroni-corrected rank-sum tests were performed for post hoc analysis when significant differences were identified. Results: There was a significant decrease in CC with blue light irradiation at all doses for MRSA (P=0.0006) but not for MSSP (P=0.131) or MRSP (P=0.589). Conclusions –Blue light phototherapy significantly reduced CC of MRSA, but not of MSSP or MRSP. The mechanism for the relative photosensitivity of the MRSA isolate is unknown, but is hypothesized to be due to an increased concentration of porphyrin in *S. aureus* relative to *S. pseudintermedius*, which would modulate blue light absorption.

**AUTHORS:**

Amy H. Schnedeker, Lynette K. Cole, Gwendolen Lorch, Sandra F. Diaz, John Bonagura and Joshua B. Daniels

**INSTITUTIONS:**

Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University Veterinary Medical Center, 601 Vernon L. Tharp St., Columbus, OH 43210, USA

**YEAR:**

2017

**JOURNAL:**

Veterinary Dermatology  
DOI: 10.1111/vde.12451

Blue Light Dose	MSSP			MRSP			MRSA		
	NC	TG	%Red	NC	TG	%Red	NC	TG	%Red
56.25 J cm <sup>-2</sup>	29	27	6.9	23	25	-8.7	67	4.5	93.3
112.5 J cm <sup>-2</sup>	31	28	9.7	29.5	29.5	0	72.5	0	100
225 J cm <sup>-2</sup>	38.5	34	11.7	26	20.5	21.2	90.5	0	100

**There was a significant decrease in CC with blue light irradiation at all doses for MRSA**

# Phototherapy for Improvement of Performance and Exercise Recovery: Comparison of 3 Commercially Available Devices

**ABSTRACT:** Recent studies suggest the prophylactic use of low-powered laser/light has ergogenic effects on athletic performance and post activity recovery. Manufacturers of high-powered lasers/light devices claim that these can produce the same clinical benefits with increased power and decreased irradiation time; however, research with high-powered lasers is lacking. Objective: To evaluate the magnitude of observed photo-therapeutic effects with 3 commercially available devices. Design: Randomized double-blind placebo-controlled study. Setting: Laboratory. Patients or Other Participants: Forty healthy untrained male participants. Intervention(s): Participants were randomized into 4 groups: placebo, high-powered continuous laser/light, low-powered continuous laser/light, or low-powered pulsed laser/light (comprising both lasers and light-emitting diodes). A single dose of 180 J or placebo was applied to the quadriceps. Main Outcome Measure(s): Maximum voluntary contraction, delayed-onset muscle soreness (DOMS), and creatine kinase (CK) activity from baseline to 96 hours after the eccentric exercise protocol. Results: Maximum voluntary contraction was maintained in the low-powered pulsed laser/light group compared with placebo and high-powered continuous laser/light groups in all time points (P,.05). Low-powered pulsed laser/light demonstrated less DOMS than all groups at all time points (P,.05). High-powered continuous laser/light did not demonstrate any positive effects on maximum voluntary contraction, CK activity, or DOMS compared with any group at any time point. Creatine kinase activity was decreased in low-powered pulsed laser/light compared with placebo (P,.05) and high-powered continuous laser/light (P,.05) at all time points. High-powered continuous laser/light resulted in increased CK activity compared with placebo from 1 to 24 hours (P,.05). Conclusions: Low-powered pulsed laser/light demonstrated better results than either low-powered continuous laser/light or high-powered continuous laser/light in all outcome measures when compared with placebo. The increase in CK activity using the high-powered continuous laser/light compared with placebo warrants further research to investigate its effect on other factors related to muscle damage.

## AUTHORS:

Thiago De Marchi, Vinicius Mazzochi Schmitt, Carla Danúbia da Silva Fabro, Larissa Lopes da Silva, Juliane Sene, Olga Tairova, Mirian Salvador

## INSTITUTIONS:

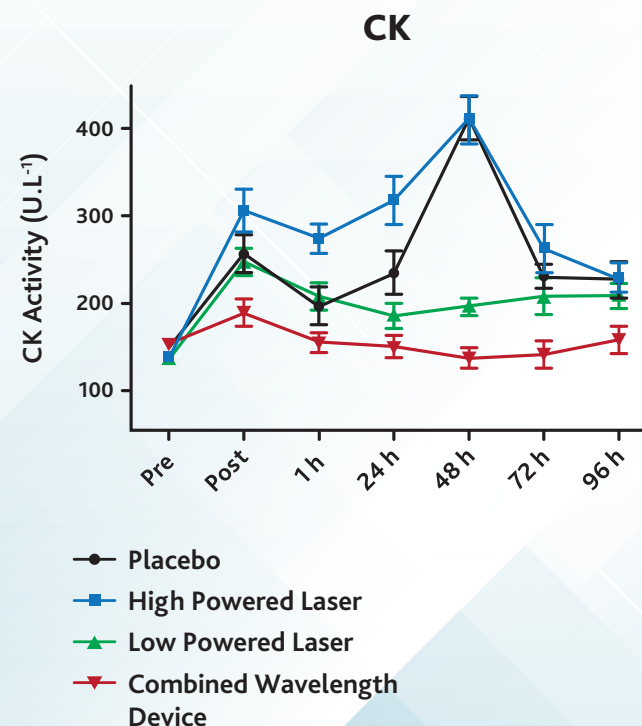
University of Caxias do Sul, Brazil.

## YEAR:

2017

## JOURNAL:

Journal of Athletic Training  
2017 May;52(5):429-438



High-powered continuous laser/light resulted in increased CK activity compared with placebo from 1 to 24 hours

# Photobiomodulation therapy for the improvement of muscular performance and reduction of muscular fatigue associated with exercise in healthy people: a systematic review and meta-analysis

**ABSTRACT:** Researches have been performed to investigate the effects of phototherapy on improving performance and reduction of muscular fatigue. However, a great variability in the light parameters and protocols of the trials are a concern to establish the efficacy of this therapy to be used in sports or clinic. The aim of this study is to investigate the effectiveness, moment of application of phototherapy within an exercise protocol, and which are the parameters optimally effective for the improvement of muscular performance and the reduction of muscular fatigue in healthy people. Systematic searches of PubMed, PEDro, Cochrane Library, EMBASE, and Web of Science databases were conducted for randomized clinical trials to March 2017. Analyses of risk of bias and quality of evidence of the included trials were performed, and authors were contacted to obtain any missing or unclear information. We included 39 trials (861 participants). Data were reported descriptively through tables, and 28 trials were included in meta-analysis comparing outcomes to placebo. Meta-analysis was performed for the variables: time until reach exhaustion, number of repetitions, isometric peak torque, and blood lactate levels showing a very low to moderate quality of evidence and some effect in favor to phototherapy. Further investigation is required due the lack of methodological quality, small sample size, great variability of exercise protocols, and phototherapy parameters. In general, positive results were found using both low-level laser therapy and light-emitting diode therapy or combination of both in a wavelength range from 655 to 950 nm. Most of positive results were observed with an energy dose range from 20 to 60 J for small muscular groups and 60 to 300 J for large muscular groups and maximal power output of 200 mW per diode.

## **AUTHORS:**

Adriane Aver Vanin,  
Evert Verhagen,  
Saulo Delfino Barboza,  
Leonardo Oliveira Pena Costa,  
Ernesto Cesar Pinto Leal-Junior

## **INSTITUTIONS:**

Universidade Nove de Julho (UNINOVE), São Paulo, Brazil  
Research Centre for Prevention of Injury and Protection of Athlete Health, Amsterdam, The Netherlands  
VU University Medical Center, Amsterdam, The Netherlands  
Universidade Cidade de São Paulo, São Paulo, Brazil

## **YEAR:**

2018

## **JOURNAL:**

Lasers in Medical Science  
January 2018, Volume 33, Issue 1, pp 181–214



**...positive results were found using both low-level laser therapy and light-emitting diode therapy or combination of both in a wavelength range from 655 to 950 nm.**



# When is the best moment to apply photobiomodulation therapy (PBMT) when associated to a treadmill endurance-training program? A randomized, triple-blinded, placebo-controlled clinical trial

**ABSTRACT:** Photobiomodulation therapy (PBMT) employing low-level laser therapy (LLLT) and/or light emitting diode therapy (LEDT) has emerged as an electrophysical intervention that could be associated with aerobic training to enhance beneficial effects of aerobic exercise. However, the best moment to perform irradiation with PBMT in aerobic training has not been elucidated. The aim of this study was to assess the effects of PBMT applied before and/or after each training session and to evaluate outcomes of the endurance-training program associated with PBMT. Seventy-seven healthy volunteers completed the treadmill-training protocol for 12 weeks, with 3 sessions per week. PBMT was performed before and/or after each training session (17 sites on each lower limb, using a cluster of 12 diodes: 4×905 nm super-pulsed laser diodes, 4×875 nm infrared LEDs, and 4×640 nm red LEDs, dose of 30 J per site). Volunteers were randomized in four groups according to the treatment they would receive before and after each training session: PBMT before + PBMT after, PBMT before + placebo after, placebo before + PBMT after, and placebo before + placebo after. Assessments were performed before the start of the protocol and after 4, 8, and 12 weeks of training. Primary outcome was time until exhaustion; secondary outcome measures were oxygen uptake and body fat. PBMT applied before and after aerobic exercise training sessions (PBMT before + PBMT after group) significantly increased ( $p < 0.05$ ) the percentage of change of time until exhaustion and oxygen uptake compared to the group treated with placebo before and after aerobic exercise training sessions (placebo before + placebo after group) at 4th, 8th, and 12th week. PBMT applied before and after aerobic exercise training sessions (PBMT before + PBMT after group) also significantly improved ( $p < 0.05$ ) the percentage of change of body fat compared to the group treated with placebo before and after aerobic exercise training sessions (placebo before + placebo after group) at 8th and 12th week. PBMT applied before and after sessions of aerobic training during 12 weeks can increase the time-to-exhaustion and oxygen uptake and also decrease the body fat in healthy volunteers when compared to placebo irradiation before and after exercise sessions. Our outcomes show that PBMT applied before and after endurance-training exercise sessions lead to improvement of endurance three times faster than exercise only.

## AUTHORS:

Eduardo Foschini Miranda, Shaiane Silva Tomazoni, Paulo Roberto Vicente de Paiva, Henrique Dantas Pinto, Denis Smith Larissa Aline Santos, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

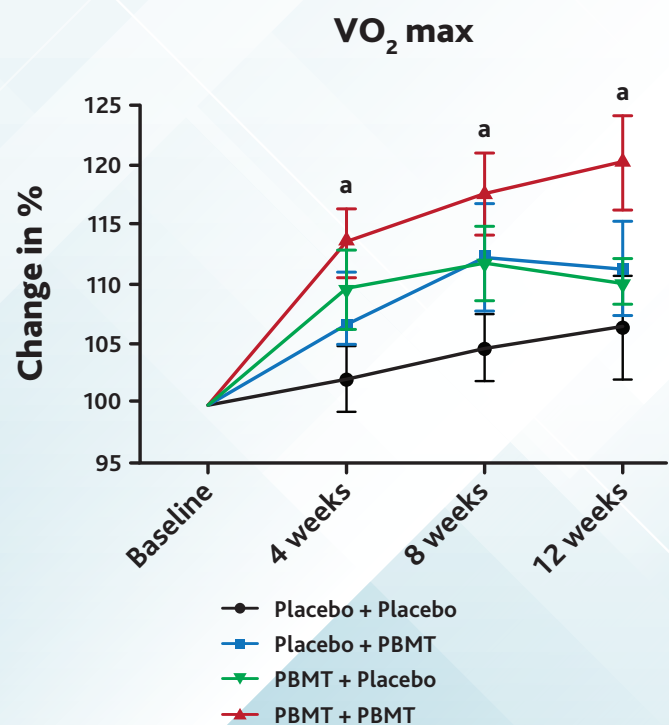
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil  
Universidade Cidade de São Paulo (UNICID) Sao Paulo, Brazil

## YEAR:

2018

## JOURNAL:

Lasers in Medical Science  
May 2018, Volume 33, Issue 4, pp 719–727



**PBMT applied before and after each aerobic exercise training session significantly increased ( $p < 0.05$ ) the percentage change of oxygen consumption and time-to-exhaustion compared to the group treated with placebo before and after each aerobic exercise training session.**

# Photobiomodulation therapy protects skeletal muscle and improves muscular function of mdx mice in a dose-dependent manner through modulation of dystrophin

**ABSTRACT:** This study aimed to analyze the protective effects of photobiomodulation therapy (PBMT) with combination of low-level laser therapy (LLLT) and light emitting diode therapy (LEDT) on skeletal muscle tissue to delay dystrophy progression in mdx mice (DMD<sup>mdx</sup>). To this aim, mice were randomly divided into five different experimental groups: wild type (WT), placebo-control (DMD<sup>mdx</sup>), PBMT with doses of 1 J (DMD<sup>mdx</sup>), 3 J (DMD<sup>mdx</sup>), and 10 J (DMD<sup>mdx</sup>). PBMT was performed employing a cluster probe with 9 diodes (1 x 905nm super-pulsed laser diode; 4 x 875nm infrared LEDs; and 4 x 640nm red LEDs, manufactured by Multi Radiance Medical®, Solon - OH, USA), 3 times a week for 14 weeks. PBMT was applied on a single point (tibialis anterior muscle—bilaterally). We analyzed functional performance, muscle morphology, and gene and protein expression of dystrophin. PBMT with a 10 J dose significantly improved ( $p < 0.001$ ) functional performance compared to all other experimental groups. Muscle morphology was improved by all PBMT doses, with better outcomes with the 3 and 10 J doses. Gene expression of dystrophin was significantly increased with 3 J ( $p < 0.01$ ) and 10 J ( $p < 0.01$ ) doses when compared to placebo-control group. Regarding protein expression of dystrophin, 3 J ( $p < 0.001$ ) and 10 J ( $p < 0.05$ ) doses also significantly showed increase compared to placebo-control group. We conclude that PBMT can mainly preserve muscle morphology and improve muscular function of mdx mice through modulation of gene and protein expression of dystrophin. Furthermore, since PBMT is a non-pharmacological treatment which does not present side effects and is easy to handle, it can be seen as a promising tool for treating Duchenne's muscular dystrophy.

## **AUTHORS:**

Gianna Mões Albuquerque-Pontes, Heliodora Leão Casalechi, Shaiane Silva Tomazoni, Andrey Jorge Serra, Cheila de Sousa Bacelar Ferreira, Rodrigo Barbosa de Oliveira Brito, Brunno Lemes de Melo, Adriane Aver Vanin, Kadma Karênina Damasceno Soares Monteiro, Humberto Dellê, Lucio Frigo, Rodrigo Labat Marcos, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior

## **INSTITUTIONS:**

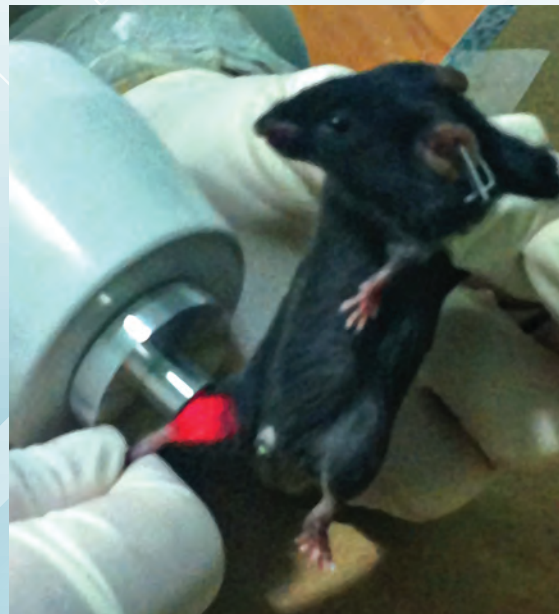
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil  
Universidade Cidade de São Paulo (UNICID) São Paulo, Brazil  
Universidade Federal de São Paulo (UNIFESP) São Paulo, Brazil  
Cruzeiro do Sul University, São Paulo, Brazil

## **YEAR:**

2018

## **JOURNAL:**

Lasers in Medical Science  
May 2018, Volume 33, Issue 4, pp 755–764





# Randomized, blinded, controlled trial on effectiveness of photobiomodulation therapy and exercise training in the fibromyalgia treatment

**ABSTRACT:** This study evaluated the role of the phototherapy and exercise training (EXT) as well as the combined treatment in general symptoms, pain, and quality of life in women suffering from fibromyalgia (FM). A total of 160 women were enrolled and measures were carried out in two sets: it was sought to identify the acute effect for a single phototherapy and EXT session (Set 1); long-term effect (10 weeks) of the interventions (Set 2). Phototherapy irradiation was performed at 11 locations in their bodies, employing a cluster with nine diodes (one super-pulsed infrared 905 nm, four light-emitting diodes [LEDs] of 640 nm, and four LEDs of 875 nm, 39.3 J per location). Algometry and VAS instrument were applied to evaluate pain. The FM symptoms were evaluated with Fibromyalgia Impact Questionnaire (FIQ) and Research Diagnostic Criteria (RDC) instruments. Quality of life was assessed through SF-36 survey. Set 1: pain threshold was improved with the phototherapy, and EXT improved the pain threshold for temporomandibular joint (right and left body side) and occipital site (right body side). Set 2: there was improved pain threshold in several tender points with the phototherapy and EXT. There was an overlap of therapies to reduce the tender point numbers, anxiety, depression, fatigue, sleep, and difficulty sleeping on FIQ/RDC scores. Moreover, quality of life was improved with both therapies. The phototherapy and EXT improved the pain threshold in FM women. A more substantial effect was noticed for the combined therapy, in which pain relief was accomplished by improving VAS and FIQ scores as well as quality of life.

## AUTHORS:

Mariana Moreira da Silva, Regiane Albertini, Paulo de Tarso Camillo de Carvalho, Ernesto Cesar Pinto Leal-Junior, Sandra Kalil Bussadori, Stella Sousa Vieira, Danilo Sales Bocalini, Luis Vicente Franco de Oliveira, Vanessa Grandinetti, José Antonio Silva Jr, Andrey Jorge Serra

## INSTITUTIONS:

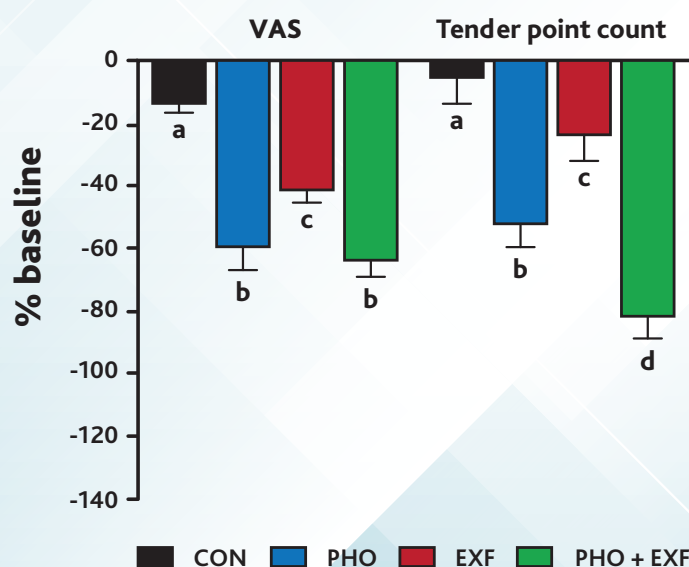
Universidade Nove de Julho (UNINOVE), São Paulo, Brazil  
Federal University of São Paulo, São Paulo, Brazil  
São Judas Tadeu University, São Paulo, Brazil  
Centro Universitário de Anápolis, Goiânia, Brazil

## YEAR:

2018

## JOURNAL:

Lasers in Medical Science  
February 2018, Volume 33, Issue 2, pp 343–351



Long-term effect of phototherapy and exercise training on VAS scores and tender point numbers. Kruskal-Wallis test (post hoc Dunn) was applied in analysis. Different letters show significant differences among groups. Similar letters show no significant differences. Data are expressed as  $\Delta\%$

# Incorporation of photobiomodulation therapy into a therapeutic exercise program for knee osteoarthritis: A placebo-controlled, randomized, clinical trial

**ABSTRACT:** **OBJECTIVE:** To investigate the clinical effects of incorporation of phototherapy in a therapeutic exercise program for individuals with knee osteoarthritis (OA) when compared to a group that received exercise alone and to a group that received exercise+ placebo phototherapy.

**MATERIALS AND METHODS:** This is a randomized, blinded and placebo-controlled trial. Thus, sixty male and female individuals aged 40-80 years with knee pain in the previous 6 months participated of the study, with diagnosis of unilateral knee OA based on the criteria established by the American College of Rheumatology and radiographic confirmation and Grades 2 or 3 of the Kellgren-Lawrence Classification. The individuals were equally divided in the groups exercise alone, exercise+ active phototherapy (nine-diode cluster device: one 905 nm super-pulsed diode laser, four 875 nm LED and four 640 nm LED; energy per quadrant: 7.85 J; total energy: 23.55 J per session), or exercise+ placebo phototherapy. Treatments were performed twice a week for 5 consecutive weeks. Patients were evaluated before and after the sessions of treatment. The outcome measures were: Western Ontario and McMaster University Osteoarthritis Index (WOMAC), Lower Extremity Functional Scale (LEFS), Numerical Rating Pain Scale (NRPS), pressure pain threshold (PPT) in two points of knee, muscle strength, and the Functional Reach Test (FRT).

**RESULTS:** Exercise+ active phototherapy was significantly more effective than exercise alone (mean difference [MD]=2.75, 95% confidence interval [CI]=3.17 to 2.32) and exercise+ placebo phototherapy (MD=2.38, 95% CI=2.79 to 1.96) only with regard to the NRPS, considering minimal clinically important difference. No clinical significant results were found for function, the pressure pain threshold, muscle strength or balance.

**CONCLUSIONS:** The combination of phototherapy and an exercise program is effective at reducing pain intensity among individuals with knee osteoarthritis than exercise alone or exercise+ placebo phototherapy in a short-term protocol.

## **AUTHORS:**

Cid A. F. de Paula Gomes, Ernesto C. P. Leal-Junior, Almir V. Dibai-Filho, Adriano R. de Oliveira, André S. Bley, Daniela A. Biasotto-Gonzalez, Paulo de Tarso Camillo de Carvalho

## **INSTITUTIONS:**

Nove de Julho University, São Paulo, SP, Brazil, Federal University of Maranhão, São Luís, MA, Brazil, City of São Paulo University, São Paulo, SP, Brazil

## **YEAR:**

2018

## **JOURNAL:**

Lasers in Surgery and Medicine  
May 7. doi: 10.1002/lsm.22939



## Low level laser therapy: an untapped resource in dentistry

**ABSTRACT:** Imagine a tool that could reduce pain, improve wound healing, relieve muscle tension and regenerate nerves without the use of pharmaceuticals and the associated side effects. Although it may sound like magic, it's actually a therapeutic technology that has been used clinically for decades: low level laser therapy (LLLT). One of the first people to demonstrate the use of light as a therapeutic tool was Dr. Andre Mester in 1966. During an experiment investigating whether a low level laser could cause cancer, he shaved the bellies of two groups of rats and irradiated the skin. These were some of the first indications of the benefits of photobiomodulation. Low level laser therapy (LLLT), also referred to as phototherapy or photobiomodulation, uses light energy from lasers or light emitting diodes to elicit cellular and biological responses in the body. Low Level Lasers are another subset of laser therapy that is a virtually untapped commodity in dentistry, yet which would be a huge asset to a dental practice and its patients. This review presents benefits of LLLT in the dental industry and a paradigm shift; instead of using drugs to treat the pain after it has started, a dentist now has the opportunity to treat the pain immediately in the dental office.

### **AUTHORS:**

Vinisha Pandey, Vipin Kumar, Subhra Dey, Maneesha Das

### **INSTITUTIONS:**

Institute of Dental Studies and Technologies, Delhi, India, Saraswati-Dhanwantari Dental College and Hospital, Maharashtra, Rama Dental college, Index Dental college, Indore

### **YEAR:**

2015

### **JOURNAL:**

International Journal of Dental and Health Sciences  
Volume 01, Issue 04



**Low Level Lasers are another subset of laser therapy that is a virtually untapped commodity in dentistry, yet which would be a huge asset to a dental practice and its patients.**



## Combined magnetic and pulsed laser fields produce synergistic acceleration of cellular electron transfer

**ABSTRACT:** We have studied the acceleration of cellular electron transfer by the combined magnetic and pulsed laser field at high peak power, but very low average intensity. To monitor the acceleration of electron transfer, the reduction of 2,2,6,6-tetramethyl piperidine-N-oxyl (TEMPO) was followed using the EPR technique. It was shown that the electromagnetic field alone, or the magnetic field alone, produced no reduction of the TEMPO EPR signal. Only a combination between a laser of very low average intensity, but high peak power and a low-intensity magnetic field, reduced the TEMPO signal. The experiment was performed in a medium containing 10<sup>7</sup> Escherichia coli (E. coli) bacteria per cc. It was verified that at high average intensity the obtained reduction of the TEMPO by electromagnetic radiation was unaffected by the addition of a magnetic field. A possible mechanism underlying the photo-magnetic synergy is proposed.

### **AUTHORS:**

Harry Friedmann, Anat Lipovsky, Yeshayahu Nitzan, Rachel Lubart

### **INSTITUTIONS:**

Departments of Chemistry and Physics, Bar-Ilan University, Ramat-Gan 52900, Israel; The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan 52900, Israel

### **YEAR:**

2009

### **JOURNAL:**

Laser Therapy  
18.3: 137-141

“

**Only a combination between a laser of very low average intensity, but high peak power and a low-intensity magnetic field, reduced the TEMPO signal.**

”

# Photobiomodulation therapy before futsal matches improves the staying time of athletes on the court and accelerates post-exercise recovery.

**ABSTRACT:** This study aimed to analyze PBMT effects on futsal player's performance and recovery in a non-controlled field environment. It is a randomized, triple-blinded, placebo-controlled, crossover clinical trial. The research included six professional athletes and in each match phototherapy treatments were performed before matches (40 minutes), blood samples were collected before treatments, and samples immediately after the end of the matches and 48 h after. Furthermore, videos were analyzed to quantify the time athletes spent on the pitch and the distance they covered. PBMT was performed at 17 sites of each lower limb (40 mins before matches), employing a cluster with 12 diodes (4 laser diodes of 905 nm, 4 LEDs of 875 nm, and 4 LEDs of 640 nm, 30 J per site). The performance of the athlete could be quantified considering the time on the pitch and the distance covered; the biochemical markers evaluated were creatine kinase, lactate dehydrogenase, blood lactate, and oxidative damage to lipids and proteins. PBMT significantly increased the time of staying in the pitch and a significant improvement in all the biochemical markers evaluated. No statistically significant difference was found for the distance covered. Pre-exercise PBMT can enhance performance and accelerate recovery of high-level futsal players.

## AUTHORS:

De Marchi T, Leal-Junior ECP, Lando KC, Cimadon F, Vanin AA, da Rosa DP, Salvador M

## INSTITUTIONS:

University of Caxias do Sul, Caxias do Sul, RS, Brazil  
Faculty Cenequista of Bento Gonçalves (CNEC), Bento Gonçalves, RS, Brazil, Nove de Julho University (UNINOVE), São Paulo, SP, Brazil

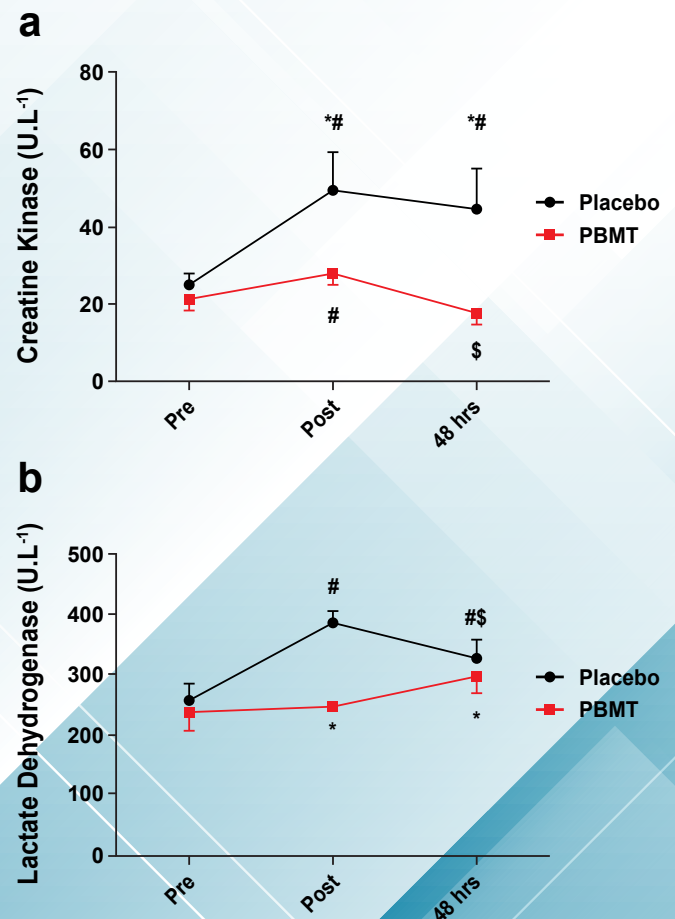
## YEAR:

2018

## JOURNAL:

Lasers Med Sci. 2018 Sep 27. doi:  
10.1007/s10103-018-2643-1.

**Fig. 4 a,b** #Statistically significant difference in comparison with the pre ( $p < 0.05$ ), \$ statistically significant difference in comparison with the post and 48 h ( $p < 0.05$ ), \*statistically significant difference in comparison between the placebo and photobiomodulation groups.



# Acute effects of PBMT combining laser diodes, light-emitting diodes, and magnetic field in exercise capacity assessed by 6MST in patients with COPD: a crossover, randomized, and triple-blinded clinical trial

**ABSTRACT:** Chronic obstructive pulmonary disease (COPD) is characterized by dyspnea, as well as musculoskeletal and systemic manifestations. Photobiomodulation therapy (PBMT) with use of low-level laser therapy (LLLT) and/or light-emitting diode therapy (LEDT) is an electrophysical intervention that has been found to minimize or delay muscle fatigue. The aim of this study was to evaluate the acute effect of PBMT with combined use of lasers diodes, light-emitting diodes (LEDs), magnetic field on muscle performance, exercise tolerance, and metabolic variables during the 6-minute stepper test (6MST) in patients with COPD. Twenty-one patients with COPD (FEV146.3% predicted) completed the 6MST protocol over 2 weeks, with one session per week. PBMT/magnetic field or placebo (PL) was performed before each 6MST (17 sites on each lower limb, with a dose of 30 J per site, using a cluster of 12 diodes 4 × 905 nm super-pulsed laser diodes, 4 × 875 nm infrared LEDs, and 4 × 640 nm red LEDs; Multi Radiance Medical™, Solon, OH, USA). Patients were randomized into two groups before the test according to the treatment they would receive. Assessments were performed before the start of each protocol. The primary outcomes were oxygen uptake and number of steps, and the secondary outcome was perceived exertion (dyspnea and fatigue in the lower limbs). PBMT/magnetic field applied before 6MST significantly increased the number of steps during the cardiopulmonary exercise test when compared to the results with placebo ( $129.8 \pm 10.6$  vs  $116.1 \pm 11.5$ ,  $p= 0.000$ ). PBMT/magnetic field treatment also led to a lower score for the perception of breathlessness ( $3.0 [1.0-7.0]$  vs  $4.0 [2.0-8.0]$ ,  $p= 0.000$ ) and lower limb fatigue ( $2.0 [0.0-5.0]$  vs  $4.0 [0.0-7.0]$ ,  $p= 0.001$ ) compared to that with placebo treatment. This study showed that the combined application of PBMT and magnetic field increased the number of steps during the 6MST and decreased the sensation of dyspnea and lower limb fatigue in patients with COPD.

## AUTHORS:

Eduardo Foschini Miranda  
Welton Alves Diniz  
Marcos Vinicius Nogueira Gomes  
Marcelo Ferreira Duarte de Oliveira  
Paulo de Tarso Camillo de Carvalho  
Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

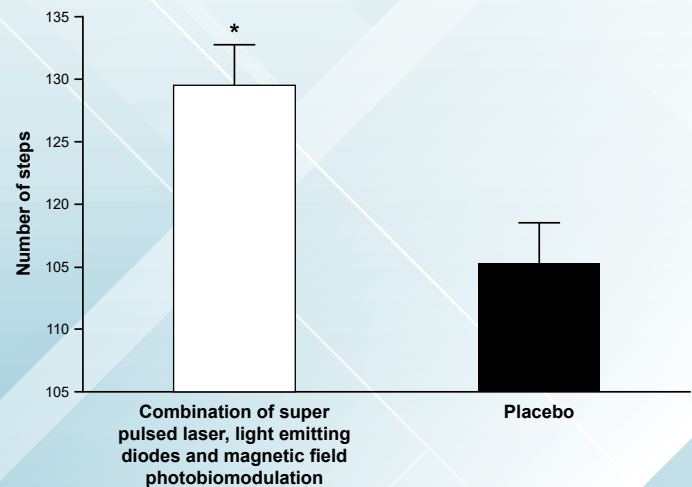
Nove de Julho University, São Paulo, SP, Brazil.

## YEAR:

2019

## JOURNAL:

Lasers in Medical Science



# Topical hyperbaric oxygen and low-energy laser for the treatment of chronic ulcers

**ABSTRACT:** Background: Diabetic foot ulcers (DFU) and chronic venous ulcers (CVU) are persistent cutaneous lesions that are difficult to treat and heal. Topical hyperbaric oxygen (THO) and low-energy laser (LEL) are therapies that have been employed separately for ulcer treatment, but their concomitant use has not been investigated.

Methods: In this unblinded, open-label non-randomized trial, we treated 374 consecutive patients with treatment-refractory chronic ulcers (218 patients with DFU and 156 individuals with CVU) with a combination of THO and LEL. THO was administered by pumping 100% oxygen into a disposable, sealed polyethylene chamber for 2 h, two to three times weekly. LEL was administered concurrently using a helium–neon laser at 4 J/cm<sup>2</sup> for 20 min.

Results: Complete ulcer closure was obtained in 78% of patients in each group (170 patients with DFU and 127 patients with CVU). Treatment failure resulting in amputation in DFU was seen in 48 patients (22%); non-closure of ulcers within 18 months in individuals with CVU was seen in 29 (22%). The length of therapy was also similar in the two groups (3.7±3 versus 4.1±3 months in DFU and CVU cohorts, respectively). However, the number of treatments required to affect healing was greater in the CVU group than among the DFU patients (40±25 versus 31.4±20 treatments).

Conclusion: THO and LEL therapies are safe, effective, simple and inexpensive therapies for DFU and CVU. Confirmation must await the performance of double-blind, randomized, controlled trials currently under way.

## **AUTHORS:**

Zvi Landau, Ahuva Sommer, Edward B. Miller

## **INSTITUTIONS:**

Kaplan Medical Center, POB 1, Rehovot, 76100, Israel

## **YEAR:**

2006

## **JOURNAL:**

European Journal of Internal Medicine  
July 2006, Volume 17, Issue 4, Pages 272–275



**Complete ulcer closure was obtained in 78% of patients in each group.**



# Clinical and scientific recommendations for the use of photobiomodulation therapy in exercise performance enhancement and post-exercise recovery

**ABSTRACT:** Background: It has been about ten years since the first randomized controlled trial looking for the effects of photobiomodulation therapy using low-level laser therapy and/or light emitting diodes therapy in athletic performance enhancement was published. Since then, the knowledge in this field has increased exponentially.

Objective: Given the fast advance in clinical interest, research and development in the use of photobiomodulation therapy for athletic performance enhancement and also to accelerate post-exercise recovery, as pioneers in this research field we felt the need to establish recommendations to ensure the correct use of the therapy, and also to guide the further studies in this area looking for the achievement of highest scientific evidence. It is important to highlight that the establishment of both clinical and scientific recommendations in this masterclass article were based on the most recent systematic reviews with meta-analysis and randomized controlled trials published in this field. It is important to stress that the recommendations of this masterclass article are based on most recent systematic reviews with meta-analysis and RCTs published in this research field. Future guidelines must follow the same direction and must be based only on the highest scientific evidence, avoiding overstatements and extrapolations based on animal experiments and case studies.

**AUTHORS:**

Ernesto Cesar Pinto Leal-Junior  
Rodrigo Álvaro Brandão Lopes-Martins  
Jan Magnus Bjordal

**INSTITUTIONS:**

Universidade Nove de Julho (UNINOVE), São Paulo, SP, Brazil

Universidade Valedo Paraíba, São José dos Campos, SP, Brazil

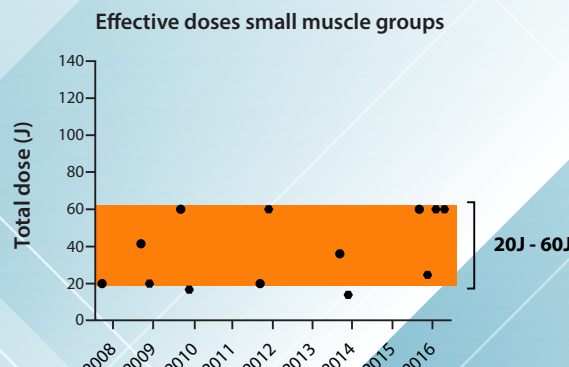
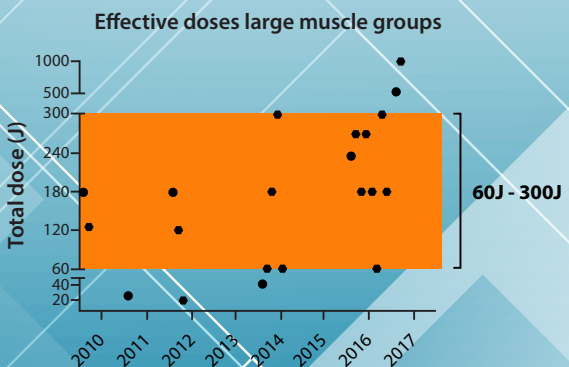
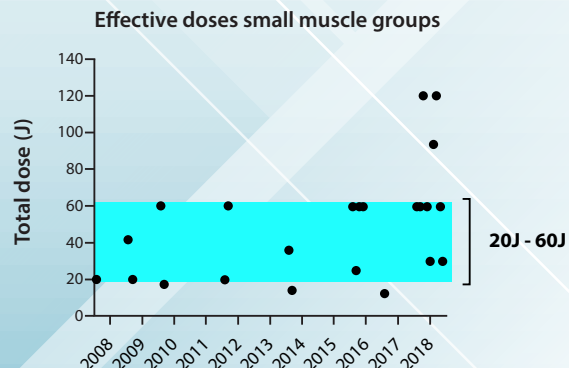
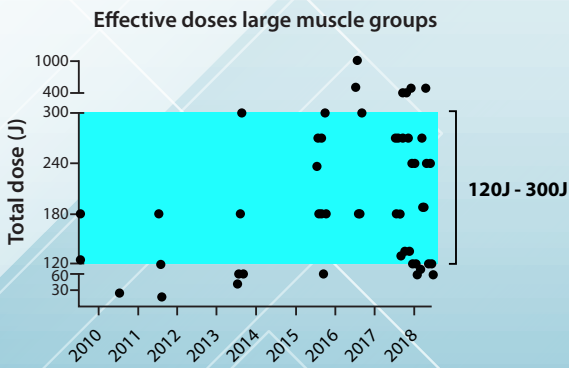
University of Bergen, Bergen, Norway

**YEAR:**

2018

**JOURNAL:**

Brazilian Journal of Physical Therapy





# Effects of photobiomodulation therapy in aerobic endurance training and detraining in humans: Protocol for a randomized placebo-controlled trial

**ABSTRACT:** Introduction: Over the last 10 years, it has been demonstrated that photobiomodulation therapy (PBMT), also known as phototherapy, using low-level laser therapy (LLLT) and/or light-emitting diode therapy (LEDT) has ergogenic effects, improving athletic performance and also accelerating post-exercise recovery. However, many aspects related to these effects and its clinical applicability remain unknown. Therefore, the aim of this project is to evaluate the ergogenic effects of PBMT in detraining after an aerobic endurance training protocol.

Methods and analyses: A randomized, triple-blind, placebo-controlled clinical trial will be carried out. Healthy male volunteers will be randomly distributed into 4 experimental groups: PBMT before and after training sessions + PBMT during detraining, PBMT before and after training sessions + placebo during detraining, placebo before and after training sessions + PBMT during detraining, and placebo before and after training sessions + placebo during detraining. The aerobic endurance training sessions will be carried out using motorized treadmills during 12 weeks, and the detraining period will continue in the next 4 weeks after that. We will analyze the time until exhaustion, maximal oxygen uptake (VO<sub>2</sub>max), and fat percentage of volunteers.

Discussion: Despite the increasing body of evidence for the use of PBMT as an ergogenic agent, several aspects remain unknown. The findings of this study will contribute to the advancement of knowledge in this field regarding clinical applications.

## **AUTHORS:**

Paulo Roberto Vicente de Paiva, PE, MSc  
Heliodora Leão Casalechi, PT, PhD,  
Shaiane Silva Tomazoni, PT, PhD,  
Caroline dos Santos Monteiro Machado, PT, MSc,  
Eduardo Foschini Miranda, PT, PhD,  
Neide Firmo Ribeiro, PT,  
Amanda Lima Pereira, PT,  
Amanda Sampaio da Costa, BSc,  
Luana Barbosa Dias, BSc,  
Bianca Cristina Gomes Souza, BSc,  
Matheus Marinho Aguiar Lino, BSc,  
Paulo de Tarso Camillo de Carvalho, PT, PhD,  
Ernesto Cesar Pinto Leal-Junior, PT, PhD

## **INSTITUTIONS:**

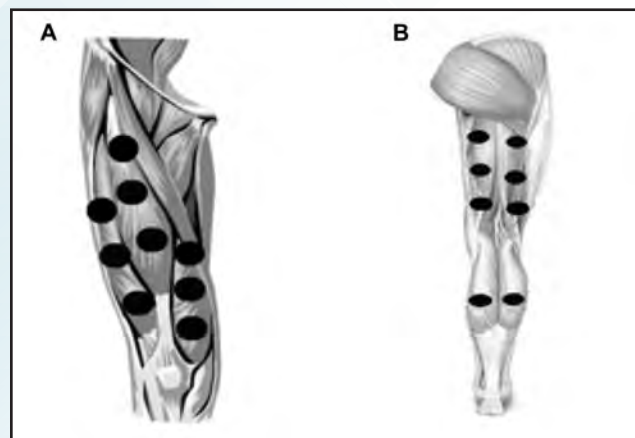
Laboratory of Phototherapy and Innovative Technologies in Health, Post Graduate Program in Rehabilitation Sciences, Nove de Julho University

## **YEAR:**

2019

## **JOURNAL:**

Medicine



# Effects of photobiomodulation therapy on inflammatory mediators in patients with chronic non-specific low back pain. Protocol for a randomized placebo-controlled trial

**ABSTRACT:** Introduction: Low back pain (LBP) is ranked as one of the most prevalent health conditions. It is likely that some inflammatory mediators could be associated with pain and disability in these patients. Photobiomodulation therapy (PBMT) is a nonpharmacological therapy often used in patients with LBP and one of the possible mechanisms of action of therapy is modulate inflammatory mediators. However, to date there are no studies that evaluated the effects of PBMT on the levels of inflammatory mediators in patients with LBP. The aim of this study is to evaluate the acute effects of PBMT on systemic levels of inflammatory mediators and pain intensity in patients with chronic non-specific low back pain.

Methods and analysis: This is a prospectively registered, two-arm randomized placebo-controlled trial with blinded patients, assessors and therapists. Eighteen patients with chronic non-specific LBP will be randomized into 2 groups: placebo or active PBMT. The treatment will be provided in a single session. The primary outcome will be levels of prostaglandin E2 (PGE2). The secondary outcomes will be levels of necrosis factor alpha (TNF- $\alpha$ ), interleukin 6 (IL-6) and pain intensity. Biochemical and clinical outcomes will be measured at baseline and 15 minutes after the single treatment session.

Discussion: Despite PBMT being used in musculoskeletal disorders such as LBP, to the best of our knowledge this is the first study that will investigate a possible biological mechanism behind the positive clinical effects of PBMT on non-specific chronic low back pain.

## **AUTHORS:**

Shaiane Silva Tomazoni, PT, PhD,  
Leonardo Oliveira Pena Costa, PT, PhD,  
Jon Joensen, PT, PhD,  
Martin Bjørn Stausholm, PT, MSc,  
Ingvill Fjell Naterstad, PT, MSc,  
Ernesto Cesar Pinto Leal-Junior, PT, PhD,  
Jan Magnus Bjordal, PT, PhD

## **INSTITUTIONS:**

Universidade Cidade de São Paulo, São Paulo, Brazil

Physiotherapy Research Group, Department of Global Public Health and Primary Care, University of Bergen, Bergen, Norway

Laboratory of Phototherapy and Innovative Technologies in Health, Nove de Julho University

## **YEAR:**

December 2019

## **JOURNAL:**

Medicine

**Thus, if PBMT is able to modulate inflammatory mediators in non-specific low back pain, patients with increased levels of these mediators might be more responsive and consequently benefit more with the use of therapy**

# Effects of photobiomodulation therapy in patients with chronic non-specific low back pain: protocol for a randomized placebo-controlled trial

**ABSTRACT:** Introduction: Low back pain (LBP) is one of the largest and most frequent public health problems worldwide. Photobiomodulation therapy (PBMT) is a frequently used non-pharmacological therapy for the treatment of musculoskeletal disorders. However, there is little high-quality scientific evidence that demonstrates the effectiveness of PBMT in the treatment of patients with chronic LBP in the short, medium and long term. Therefore, the objective of this clinical trial is to evaluate the effects of PBMT in patients with chronic non-specific LBP in the short, medium and long term.

Methods and analyses: This is a prospectively registered, two-arm randomized placebo-controlled trial with blinded patients, assessors and treatment providers. One hundred and forty-eight patients with chronic non-specific LBP will be recruited. Treatment sessions will be provided three times a week for 4 weeks (totaling 12 sessions) with patients receiving either placebo or active PBMT. For ethical reasons, all patients, regardless of treatment allocation, will also receive an information booklet based on 'The Back Book'. Clinical outcomes will be measured at baseline, at the end of treatment, as well as 3, 6 and 12 months after randomization. The primary outcomes will be pain intensity and disability measured after 12 sessions of treatment. The secondary outcomes will be pain intensity and disability measured at 3, 6 and 12 months after randomization, in addition to specific disability and global perceived effect in all time points.

Ethics and dissemination: The study was approved by the Research Ethics Committee of Universidade Cidade de São Paulo. The results will be disseminated through scientific publications and presentations at national and international scientific meetings.

Trial registration number: NCT03089424

## **AUTHORS:**

Shaiane Silva Tomazoni,  
Lucíola da Cunha Menezes Costa,  
Layana de Souza Guimarães,  
Amanda Costa Araujo,  
Dafne Port Nascimento,  
Flávia Cordeiro de Medeiros,  
Marina Athayde Avanzi,  
Leonardo Oliveira Pena Costa

## **INSTITUTIONS:**

Masters and Doctoral Programs in Physical Therapy,  
Universidade Cidade de São Paulo, Brazil

## **YEAR:**

May 2019

## **JOURNAL:**

BMJ Open



# Intraoral photobiomodulation diminishes pain and improves functioning in women with temporomandibular disorder: a randomized, sham-controlled, double-blind clinical trial

**ABSTRACT:** The aim of the present study was to evaluate the effect of intraoral photobiomodulation involving super-pulsed laser (905 nm) combined with red (640 nm) and infrared (875 nm) light-emitting diodes on pain, mandibular range of motion, and functioning in women with myogenous temporomandibular disorder. A randomized, sham-controlled, double-blind clinical trial was conducted involving 30 women with myogenous temporomandibular disorder diagnosed using the Research Diagnostic Criteria for Temporomandibular Disorders. The participants were randomly allocated to two groups (active and sham photobiomodulation). The evaluations involved use of the visual analog scale, digital calipers, and a functional scale. Photobiomodulation was administered intraorally in the region of the pterygoid muscles, bilaterally, in all participants for a total of six sessions. Evaluations were performed on five occasions: prior to the intervention, immediately after the first session, 24 h and 48 h after the first session, and after the six sessions. Significant differences between groups were found regarding pain ( $p \leq 0.01$ ) and functioning ( $p \leq 0.04$ ). However, no statistically significant difference was found regarding range of mandibular motion. The findings demonstrate that intraoral photobiomodulation involving super-pulsed laser (905 nm) combined with red (640 nm) and infrared (875 nm) light-emitting diodes diminishes pain and improves functioning but does not exert an influence on mandibular range of motion in women with temporomandibular disorder.

Trial registration: NCT02839967

## **AUTHORS:**

Carolina Marciela Herpich  
Ernesto Cesar Pinto Leal-Junior  
Fabiano Politti  
Cid André Fidelis de Paula Gomes  
Igor Phillip dos Santos Glória  
Maitê de Freitas Rocha de Souza Amaral  
Graciela Herpich  
Ludmila Menezes  
Alves de Azevedo  
Tabajara de Oliveira Gonzalez  
Daniela Aparecida Biasotto-Gonzalez

## **INSTITUTIONS:**

Department of Physical Therapy, University Nove de Julho, São Paulo, Brazil

## **YEAR:**

July 2019

## **JOURNAL:**

Lasers in Medical Science



# Acute effects of photobiomodulation therapy and magnetic field on functional mobility in stroke survivors: a randomized, sham-controlled, crossover, triple-blind clinical trial

**ABSTRACT:** Identify the optimal energy delivered with a single application of the combination of photobiomodulation therapy (PBMT) combining different light sources (low-level laser therapy—LLLT and light emitting diode therapy—LEDT) and static magnetic field (sMF) in order to determine the acute effects on functional mobility of stroke survivors. Was conducted a randomized, placebo-controlled, crossover, triple-blind, clinical trial (RCT). Twelve patients were recruited, however ten concluded the study, they were randomly treated with four PBMT/sMF energies (sham—0 J, 10 J, 30 J, and 50 J per site irradiated), with 1-week interval washout between treatments. PBMT/sMF were administered after the pre-intervention (baseline) evaluation and the total energy delivered per site at each treatment was determined based on the results of the randomization procedure. PBMT/sMF were administered in direct contact with the skin and applied with slight pressure to nine sites on the knee extensors, six sites on the knee flexors, and two sites on the plantar flexor muscles in both lower limbs (bilaterally). The primary outcome measure was the 6-min walk test (6MWT) and the secondary outcome was the Timed Up and Go (TUG) test. Significant improvements were found in the 6MWT test using a total energy of 30 J per site compared with sham (0 J) ( $p < 0.05$ ) and compared with the baseline evaluation ( $p < 0.01$ ). And in the TUG test significant improvements were also found using a total energy per site of 30 J per site compared to sham (0 J) and baseline ( $p < 0.05$ ). PBMT with different light sources (laser and LEDs) and wavelengths in combination with sMF with a total energy per site of 30 J has positive acute effects on functional mobility in stroke survivors.

## AUTHORS:

Heliadora Leão Casalechi  
Arislander Jonathan Lopes Dumont  
Luiz Alfredo Braun Ferreira  
Paulo Roberto Vicente de Paiva  
Caroline dos Santos Monteiro Machado  
Paulo de Tarso Camillo de Carvalho  
Claudia Santos Oliveira  
Ernesto Cesar Pinto Leal-Junior

## INSTITUTIONS:

Nove de Julho University (UNINOVE), Sao Paulo, Brazil  
Guairacá College and the Centro-Oeste State University (UNICENTRO), Guarapuava, Parana, Brazil  
Santa Casa School of Medical Sciences of São Paulo, Sao Paulo, Brazil  
University Center of Anapolis, Anapolis, Goias, Brazil

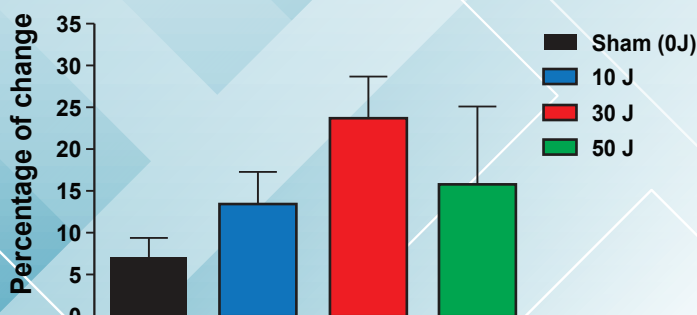
## YEAR:

2019

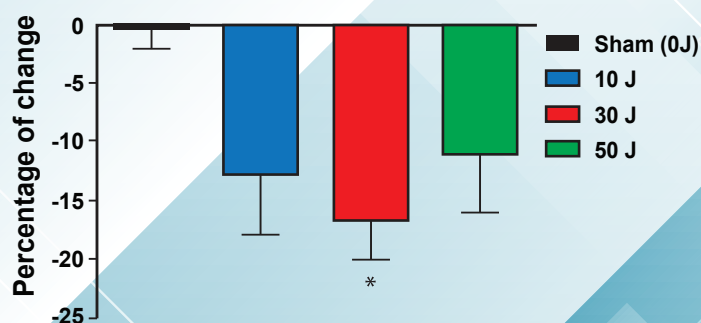
## JOURNAL:

Lasers in Medical Science

### Change in six-minutes walking test



### Change in TUG



\* Percentage of change in TUG test (data expressed as mean  $\pm$  SEM). Statistically significant difference in comparison to sham (0 J) ( $p < 0.05$ )

# Penetration Profiles of a Class IV Therapeutic Laser and a Photobiomodulation Therapy Device in Equine Skin

**ABSTRACT:** Photobiomodulation therapy (PBMT) effects depend on the energy settings and laser penetration. We investigated the penetration time profiles of two different light therapy devices, at the dark and light skin regions in horses. Six light skin and six dark skin adult clinically healthy Arab and Quarter horses were used. A cutometer was used to measure the width of the skin fold from both sides of the cervical area, followed by three measurements of the thickness of the same skin fold by transversal and longitudinal ultrasonography (US). The depth of light penetration was compared based on the percentage of penetration versus power, between a portable PBMT device versus a class IV laser device. The laser mean power output was measured with an optical power meter system for 120 seconds after penetrating the skin. Skin width and laser penetration were compared among equipment by paired “t” test. There was no difference in the width of the skin fold between measurements acquired by the cutometer against either longitudinal or transversal US or between the US measurements at cervical versus metacarpus area. Light penetration was greater in both kinds of skins in the PBMT ( $0.01303 \pm 0.00778$ ) versus class IV laser ( $0.00122 \pm SD 0.00070$ ) ( $P < .001$ ). The PBMT device provided a greater energy penetration than the class IV laser in unclipped light and dark skin, suggesting that the former may produce a better therapeutic effect. The color of the skin changes penetration profiles of PBMT. We conclude that the PBMT device provided a greater penetration than a class IV laser in unclipped light and dark skin, suggesting that the former may produce a better therapeutic clinical effect. The color of the skin changes penetration profiles of PBMT. Further investigation is warranted to compare the outcome after treatment of injuries by using these devices clinically.

## AUTHORS:

Stelio Pacca Loureiro Luna  
Allen Schoen  
Pedro Henrique Esteves Trindade  
Paula Barreto da Rocha

## INSTITUTIONS:

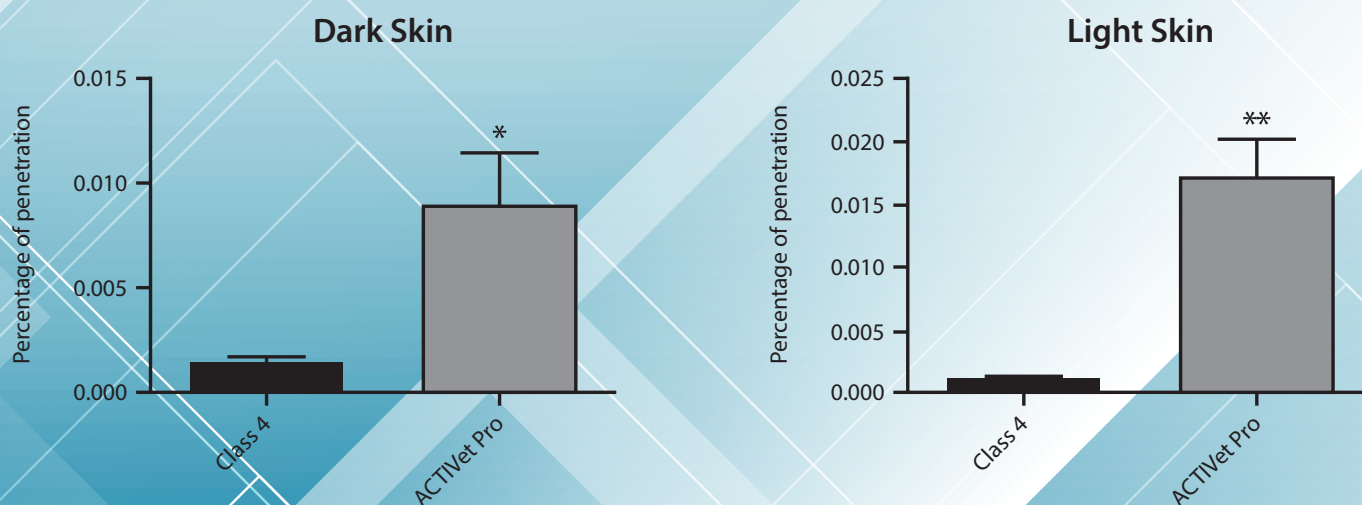
School of Veterinary Medicine and Animal Science (FMVZ), Sa~o Paulo State University (Unesp), Botucatu, Sa~o Paulo, Brazil  
Center for Integrative Animal Health, Salt Spring Island, British Columbia, Canada

## YEAR:

2020

## JOURNAL:

Journal of Equine Veterinary Science



# Effect of Laser Acupuncture on Mitigating Anxiety in Acute Stressed Horses: A Randomized, Controlled Study

**ABSTRACT:** Anxiety in sport horses affects their performance, health, and value, as well as the reputation of trainers and competitors. The objective of this study was to determine whether laser acupuncture (LAP), when given before stressful situations, can decrease anxiety and improve performance and health in horses. A 2x2 crossover study was conducted on 24 horses randomly assigned to one of the two groups: Group A - given LAP on Day 1; Group B - given sham LAP with the laser powered off on Day 1. The treatments were switched between the two groups after a 7-day wash-out period. All horses were fitted with a heart rate (HR) monitor before undergoing an acute startle test (AST). Each subject's HR was recorded continuously from 1 minute before to 10 minutes post the AST. The primary outcome data for assessing the treatment effect were HR increase from the baseline (peak HR – baseline HR) following the AST and the time duration needed for HR to return to baseline level (time between peak HR and baseline). The observed outcome data concluded: (1) horses treated with LAP had a smaller HR increase than those treated with sham LAP ( $p=0.036$ ), and (2) the time it took for the resulting peak HR to return to baseline was shorter in horses treated with LAP than those treated with sham LAP ( $p=0.045$ ). These findings indicate that laser acupuncture before a known stressful situation could help a horse accept the stressful situation and recover back to homeostasis more rapidly.

**AUTHORS:**

Wendy Ying  
Abhishek Bhattacharjee  
Samuel S. Wu

**INSTITUTIONS:**

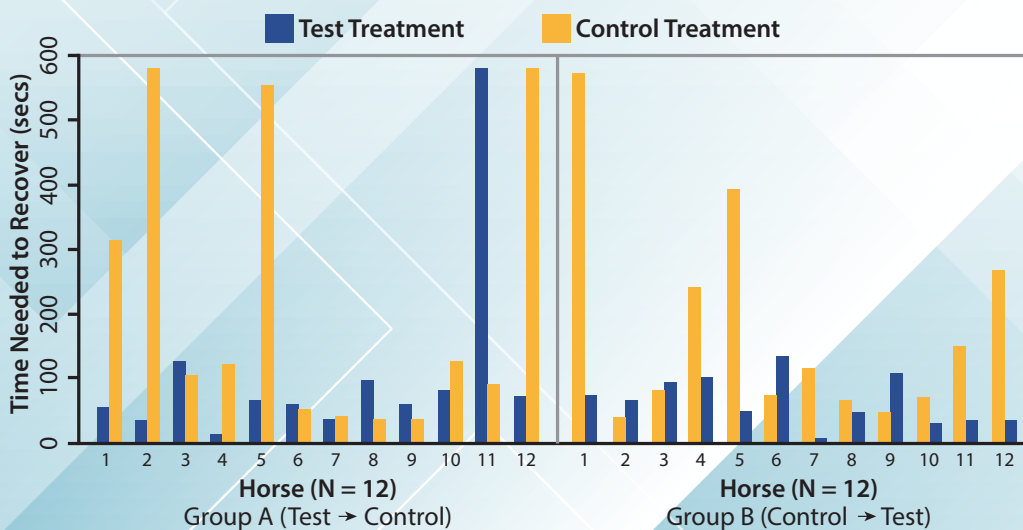
Five Elements for Animals, Sarasota, Florida;  
University of Northern Colorado, Greeley, Colorado;  
University of Florida, Gainesville, Florida

**YEAR:**

2019

**JOURNAL:**

The American Journal of Traditional Chinese Veterinary Medicine



**Figure 3:** Time needed for stress recovery (TSR), quantified as time length to recover from the peak HR to baseline HR during each of the two treatment periods (Day 1 and Day 8; Test or Control). The mean TSR in Group A test treatment was 107.3 seconds ± 151.8 (Day 1) compared to control treatment at 220.2 seconds ± 225.3 (Day 8). In Group B, the mean TSR test treatment was 65.0 seconds ± 37.9 (Day 8) while control treatment was 176.6 seconds ± 164.8 (Day 1). The mean TSR in horses receiving test treatment was shorter than those receiving the control treatment ( $p=0.045$ ).

# CASE STUDY

## Abstracts



# Effectiveness of Take Home Low-Level Laser Therapy in Treating Fibromyalgia Syndrome: A Case Study

**ABSTRACT:** Fibromyalgia affects an estimated 10 million people in the U.S. and an estimated 3-6% of the world population. While it is most prevalent in women (75-90 percent of the people who have FM are women), it also occurs in men and children of all ethnic groups. Fibromyalgia is a complex pain syndrome identified by symptoms of diffuse musculoskeletal pain. Possible Pathogenesis: unknown, however, recent research suggests that there may be small nerve fiber polyneuropathy or hyperactive nociceptors firing in the tender points.

Case Study Information: 46 y/o physically active Caucasian Female who was diagnosed with Fibromyalgia syndrome 14 years ago. Objective Findings: The patient had a Widespread Pain Index (WPI) of 13/19 and a Somatic Sensory (SS) Score of 9 and her symptoms had been present for greater than 3 months. The Fibromyalgia Impact Questionnaire (FIQ) asks a patient how fibromyalgia is affecting their daily living and the ability to complete specific tasks. These tasks include but are not limited to: the patient being able to shop, do laundry with a washer and dryer, prepare meals, wash dishes, vacuum, make beds, walk several blocks, visit friends or relatives, yard work, drive a car, or climb stairs.

Treatment: The patient had no contra-indications for laser (Pregnant, Cancer, infection). Low-Level Laser Therapy (LLLT) was used for three minutes on each painful site. Treatment was performed using a TQ Solo handheld super pulsed laser (Multi Radiance Medical, Solon, OH) Results: After 4 consecutive days of treatment her pain level was 0/10 and a WPI 0/19. Her FIQ decreased from score 75/100 to 31/100 and her activities of daily living increased. Patient reported her physical activity levels increased as her pain level decreased. She was able to pick vegetables, swim, and walk five blocks with her daughter. She was able to take a family vacation which included riding in a car for 8 hours each way, hiking for 2 hours and spending 4 hours in multi-level museum pain free. Clinical application: Low Level Laser Therapy reduced pain level to 0/10 with four consecutive days of treatment, after 14 years of Fibromyalgia Syndrome. Due to the decrease in pain the patient was able to increase her activities of daily living.

Conclusion: Take home LLLT is a viable non-pharmacological treatment to reduce pain and increase function in patients with fibromyalgia syndrome.

## AUTHORS:

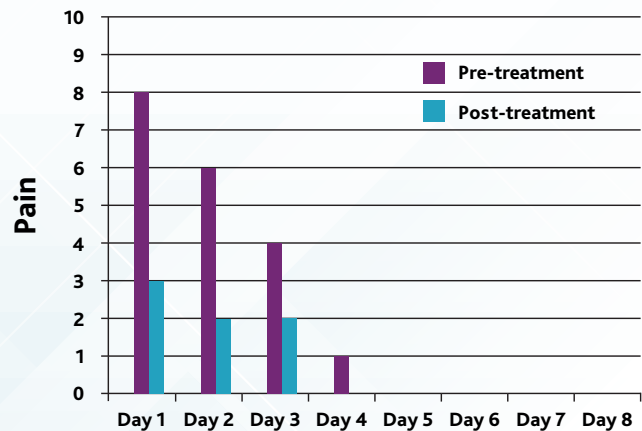
Spillman AC, Fagg B, Christopher M, Demchak TJ

## INSTITUTIONS:

Indiana State University

## PRESENTED:

NAALT / WALT 2014 and  
GLATA 2015



## Effects of Low Level Laser Therapy as a Treatment for Plantar Fasciitis in Two Female Cross Country Runners: A Case Study

**ABSTRACT:** Plantar fasciitis is the third most common injury among runners, following patellar-femoral pain and IT band friction. This injury occurs due to inflammation in the plantar aponeurosis located in the sole of the foot. The most common reported symptoms of this injury are pain when walking after getting out of bed in the morning or the first steps after sitting for a long period of time. In most cases, plantar fasciitis is treated by a combination of rehabilitation exercises including stretching and the use of anti-inflammatory drugs. This case study looks at the effects of low level laser therapy (LLLT) as an added modality to the treatment regimen in two collegiate female cross country runners. Throughout the two weeks of treatment, these athletes used laser to enhance healing of the plantar aponeurosis, increase microcirculation throughout the foot, and inhibit muscle tightness in the muscles affecting the inflamed tissues. Upon completion of the LLLT treatments and other rehabilitation protocols, these athletes were able to return to their competitions with no pain or discomfort.

### **AUTHORS:**

Charles, Benjamin, BS, ATS;  
Beer, Jeff MA, ATC, LAT

### **INSTITUTIONS:**

Manchester University, North Manchester, IN

### **YEAR:**



... these athletes used laser to enhance healing of the plantar aponeurosis, increase microcirculation throughout the foot, and inhibit muscle tightness



## Effects of Low Level Laser Therapy on Pain Levels in a Patient with Fibromyalgia: A Case Study

**ABSTRACT:** About 2% of the American population have been diagnosed with Fibromyalgia, a widespread pain syndrome<sup>1</sup>. Participant: The case study was completed on one individual from Manchester University whom has been diagnosed with fibromyalgia. She volunteered to complete this research and did not make any changes with her medications outside of the treatments. Purpose: In order to determine usefulness of laser therapy for treating patients with fibromyalgia, this research was completed on one participant to observe the changes in pain level with laser therapy treatments. Methods: This case study was completed using the Game Day super-pulsed low-level laser. Treatments were completed 2-3 times per week with a total of 14 treatments. The treatments included scanning with the pain inhibition setting up and down both sides of the spine from the neck to the sacrum. Scanning treatments lasted five minutes per side with additional treatments completed over trigger points. Because the patient seemed to have worse pain in the lower body and lower back, scanning treatments were completed twice on the lumbar spine in order to treat this region more specifically. Results: A matched pairs t-test was completed to analyze the resulting data of the research along with correlation.

### **AUTHORS:**

Ort, Kylee, BS, ATS;  
Beer Jeff, MA, ATC, LAT

### **INSTITUTIONS:**

Manchester University, North Manchester, IN

### **YEAR:**

2015



This case study was completed using the Game Day super-pulsed low-level laser. Treatments were completed 2-3 times per week with a total of 14 treatments.



## A Case of Adhesive Capsulitis Shoulder Relieved With Therapeutic Low Level Laser.

**ABSTRACT:** This study discusses the outcome of a patient with idiopathic adhesive capsulitis who was treated with therapeutic low level laser. Clinical Features: A 52 year old female patient who had a history of idiopathic adhesive capsulitis; also known as, frozen shoulder. She had decreased range of motion as measured with goniometer in flexion, extension, abduction, and external rotation. Methods: The patients shoulder range of motion was measured pre and post in the planes of flexion, extension, abduction, and external rotation using a goniometer. A therapeutic low level laser with stim/laser head was used, with the setting set to “sweep” mode for chronic conditions. The instrument was used for 6 minute sessions a total of 10 times. The stim was applied until areas of low impedance were normalized. After such areas were neutralized the laser was used for the remainder of the 6 minute session. Conclusion: Further testing is required, but the results showed a significant improvement and suggest that the therapeutic low level laser is successful in treating patients for adhesive capsulitis in the chiropractic setting.

### **AUTHORS:**

Beatrice Tapia, DC, DACBN

### **INSTITUTIONS:**

Life University

### **YEAR:**

2013



... results showed a significant improvement and suggest that the therapeutic low level laser is successful in treating patients for adhesive capsulitis



## The Use of Laser Therapy for Treatment of a Damaged Bicep Due to Weight Training of the Non-Dominant Arm

**ABSTRACT:** Numerous studies on lasers have reported the positive effects of laser therapy and the ability it has to effect tissue healing and fatigue resistance 2- 11. This is helpful in the rehabilitation process for athletic trainers to aid in the recovery of their athletes' injuries. The importance is to minimize time spent out of activity due to an injury and to provide the athletes quicker and healthier return to play. Participants: The participants were volunteers from the Manchester community. They had to be 18 or older and could be male or female. Participants were also required to complete a health screen questionnaire before participating in order to prevent increasing risk of injury due to previous health concerns. Purpose: The purpose of the research is to examine the effects of the low level laser on the treatment of muscle tissue damage in the bicep after induced fatigue and muscle breakdown due to weight lifting. Methods: Three days will be required for each participant to complete their treatment requirements for this research. The first day will be completion of baseline measures and acclimation to the weight training protocol. They will also be randomized into the treatment or placebo group at this time. The second day they will either receive a laser treatment or a placebo treatment followed by completion of bicep curls until failure.

### **AUTHORS:**

Ort, Kylee, BS, ATs;  
Beer Jeff, MA, ATC, LAT

### **INSTITUTIONS:**

Manchester University, North Manchester, IN

### **YEAR:**

2015



This is helpful in the rehabilitation process for athletic trainers to aid in the recovery of their athletes' injuries.



## Low-level laser therapy (LLLT) accelerated healing and improved symptoms and outcome for second degree scalding burns on human skin for the subject patient.

**ABSTRACT:** A 29-year-old Caucasian female, non-ambulatory with cerebral palsy suffered second degree scalding water burns to right, left thighs, abdomen and flank that responded to LLLT as the principle treatment for wound case management. Over 14 weeks, the sizing of each lesion diminished as healed tissues replaced the necrotic tissues. There was no visible evidence of opportunistic bacterial infection or invasion. The newly replaced skin has shown evidence of increased tensile elasticity. Scar formation changed from raised margins to flattened, smooth blending patterns. Inflammatory markers (edema, redness, heat and pain) were in concert with the levels of tissue healing per treatment with the laser. Waxy, white burned centers were replaced with healthier pink cutaneous tissues as granulation ensued. Increased lymphatic drainage allowed for cellular waste removal and reduction of inflammatory mitigators. Overall comfort level of the patient was improved each week as determined by demeanor and sleeping patterns. The clinical outcomes in this case represent the speed, efficiency, and efficacy of the use of LLLT in cases of skin conditions. Wound care management is well cited in the literature of LLLT as well as in the protocols from various manufacturers since the inception of phototherapy in the 1960s.<sup>6-8</sup> Because of the direct skin contact in this case, the visible outcomes of the effects of quantum medicine with second degree burns was seen rapidly at the cellular level—particularly due to the turnover rate at the epidermis.<sup>9</sup> Most notable was increased vascularity using the 1000-3000Hz program.<sup>10</sup> The rate of decreasing edema, increased lymphatic drainage, and increased phagocyte activity brought the reduction of central wound margins as the tissues were healing from the centers to the periphery. Increased fibroblastic activity was seen in the cellular proliferation rates between treatments. Increased collagen and epithelial production emerged new skin margins without overproduction of scarred in elastic tissues in the outer margins of the lesions. Photonic emissions of laser diodes target injured cellular tissue components, primarily the chromophores, flavoproteins, and porphyrins.<sup>11</sup> Light energy transforms into biochemical energy which begins a sequence of events to activate ATP production and synthesis, transportation of nutrients and oxygen to damaged cells, removal of cellular debris via lymphatic drainage, and increased synthesis of signaling proteins—all of which result in accelerated healing. In this study, a non-invasive approach to wound repair was efficacious and should encourage clinicians to utilize this modality of LLLT to accelerate healing, and improve symptoms and outcomes for patients with potential burn scarring.

### AUTHORS:

Stephanie A. Leonard, DC, CCFC

### SOURCE URL:

<https://www.practicalpainmanagement.com/treatments/complementary/lasers/clinical-case-study-low-level-laser-therapy>

### YEAR:

2012

**The clinical outcomes in this case represent the speed, efficiency, and efficacy of the use of LLLT in cases of skin conditions**

## Subscapularis Syndrome: A case report

**ABSTRACT:** Dysfunction of the subscapularis muscle is introduced in this case report as a potential factor for consideration in the etiology and/or consequential sequelae of subacromial impingement syndrome. Although dysfunction of the supraspinatus and infraspinatus are implicated as being most commonly involved with subacromial impingement pathology, the subscapularis is often overlooked and therefore undertreated. Identifying the subscapularis' potential involvement in patients with subacromial impingement pathology may offer insight into shoulder impingement dysfunction and injury treatment options available to specifically address subscapularis dysfunction. In this manuscript, a case report is presented to highlight the signs and symptoms of subscapularis pathology concordant with subacromial impingement syndrome and provide a clinical rationale for treatment. The purpose of this case report is not to suggest a new approach to shoulder rehabilitation, but rather to prompt the consideration of subscapularis dysfunction when evaluating and treating patients with subacromial impingement pathology.

### **AUTHORS:**

Michael S. Thurner, PT, DPT, CSCS  
Robert A. Donatelli, PhD, PT  
Randa Bascharon, DO, ATC

### **INSTITUTIONS:**

Physiotherapy Associates Orthopedic & Sports Center,  
Las Vegas, NV, USA  
Orthopedic & Sports Medicine Institute of Las Vegas,  
Las Vegas, NV, USA

### **YEAR:**

2012



**Identifying the subscapularis' potential involvement in patients with subacromial impingement pathology may offer insight into shoulder impingement dysfunction and injury treatment**



## Effects of Low Level Laser Therapy as a Treatment for Post-Surgical Tarsal Coalition in a Collegiate Women's Basketball Player: A Case Study

**ABSTRACT:** Tarsal coalition prevalence has been estimated to be problematic from 1%-13% of the population, approximately 50% of cases occurring bilaterally. This condition occurs when two or more bones develop an abnormal union, restricting unrestricted range of motion (ROM). The most common locations include the talocalcaneal and calcaneonavicular joints. The most common reported symptoms of tarsal coalition are vague rear-foot pain, stiffness in the foot, subtalar joint line tenderness, limited ROM, and a fallen longitudinal arch. There are two main treatment options: conservative treatment to address pain, however if that is unsuccessful the surgical option is then pursued. This case study looks at the effects of low level laser therapy (LLLT) as an added modality to the treatment process for post-surgical tarsal coalition in a collegiate women's basketball player. During the three weeks of treatment, the athlete used laser to aid in pain reduction of the talocalcaneal and calcaneonavicular joints, and inhibit muscle tightness affecting ROM. Upon completion of the LLLT treatments the athlete was able to continue with competition.

### **AUTHORS:**

Zook, Primmer, BS, ATS;  
Beer, Jeff MA, ATC, LAT

### **INSTITUTIONS:**

Manchester University North Manchester, IN

### **YEAR:**

2015



**This case study looks at the effects of low level laser therapy (LLLT) as an added modality to the treatment process for post-surgical**



## Conclusion:

Multi Radiance Medical continues to innovate light therapy technology and develop the most advanced therapeutic lasers for accelerating recovery and reducing pain. The latest advancement and the successor to the MR4 is the MR5 ACTIV PRO. Optimized by extensive scientific and laboratory studies from the Proof of Concept process (POC), the MR5 has a 300% increase in power over the original ; however, it remains first in class for industry safety.

The MR5 combines synchronous super pulsed laser along with ultra-bright infrared, red & blue LEDs all in a cordless, portable design, for in-clinic therapy or on-the-go treatment. With shorter treatment times and the unique ability to accelerate biological effects across the entire phototherapeutic window, the MR5 delivers consistent and reproducible outcomes. Not all light devices are equally effective; therefore it is always critically important for all devices to perform the POC process to validate the device's parameter selection. The optimal depth of penetration time profile (DPTP) and favorable thermal time profile (TTP) of the new MR5 results in a safer and superior alternative to all Class IV lasers for controlling pain and accelerating recovery.

Multi Radiance Medical remains dedicated to sound research, industry advancement and maintaining the utmost professional integrity. The company partners with the most respected researchers in the field to provide invaluable guidance with regard to the design of the devices with direction of clinical research. Multi Radiance Medical in three separate scientific monographs, has proven how and why its technology works, without limitations, and currently there are multiple clinical trials being conducted around the world funded by Multi Radiance Medical.

Multi Radiance is taking the responsibility to set new standards for the industry by setting the bar high on research and validation. Having proven its technology in vivo, in vitro, in controlled laboratory trials, and in clinical trials, we are now setting our sights on assuming Market Leadership by turning its current research into future treatment opportunities for those disease states and conditions that do not have an adequate current treatment, and in those cases where there is no current treatment at all. Multi Radiance remains committed to the on-going clinical and scientific studies of its devices, to push new industrial product designs, and become the innovative leader in the field.

This commitment will yield many new discoveries and move light-based medicine forward into the future and toward mainstream acceptance. More will be revealed.



