Physiother Res Int. 2015 Jun;20(2):108-25. doi: 10.1002/pri.1606. Epub 2014 Dec 2.

The efficacy of low-level laser therapy for shoulder tendinopathy: a systematic review and meta-analysis of randomized controlled trials.

Haslerud S[1,2], Magnussen LH[2,3], Joensen J[2,3], Lopes-Martins RA[4], Bjordal JM[1,2].
Author information

- [1]Centre for Evidence Based Practice, Faculty of Health and Social Sciences, NorPhyPain Research Group, Bergen University College, Bergen, Norway.
- [2]Department of Global Public Health and Primary Care, Physiotherapy Research Group, University of Bergen, Bergen, Norway.
- [3]Department of Occupational Therapy, Physiotherapy and Radiography, Faculty of Health and Social Sciences, Bergen University College, Bergen, Norway.
- [4]Department of Biomedical Engineering, University of Mogi das Cruzes, SP, Brazil.

Abstract

BACKGROUND AND PURPOSE:

Low-level laser therapy (LLLT) is proposed as a treatment for tendinopathies. This is the first systematic review focusing solely on LLLT treatment effects in shoulder tendinopathy.

METHODS:

A systematic review with meta-analysis and primary outcome measures pain relief on 100-mm visual analogue scale (VAS) and relative risk for global improvement. Two independent assessors rated the included studies according to the PEDro scale. Intervention quality assessments were performed of LLLT dosage and treatment procedures according to World Association for Laser Therapy guidelines. The included trials were sub-grouped by intervention quality and use of other physiotherapy interventions.

RESULTS:

Seventeen randomized controlled trials (RCTs) met the inclusion criteria, and 13 RCTs were of high and 4 RCTs of moderate methodological quality. Significant and clinically important pain relief was found with weighted mean differences (WMD) over placebo, for LLLT as monotherapy at 20.41 mm (95% CI: 12.38 to 28.44) and as adjunct to exercise therapy at 16.00 mm (95% CI: 11.88 to 20.12). The WMD when LLLT was used in a multimodal physiotherapy treatment regime reached statistical significance over placebo at 12.80 (95% CI: 1.67-23.94) mm pain reduction on VAS. Relative risks for global improvement were statistically significant at 1.96 (95% CI: 1.25-3.08) and 1.51 (95% CI: 1.12-2.03), for laser as monotherapy or adjunctive in a physiotherapy regime, respectively. Secondary outcome measures of shoulder function were only significantly in

favour of LLLT when used as monotherapy. Trials performed with inadequate laser doses were ineffective across all outcome measures.

CONCLUSION:

This review shows that optimal LLLT can offer clinically relevant pain relief and initiate a more rapid course of improvement, both alone and in combination with physiotherapy interventions. Our findings challenge the conclusions in previous multimodal shoulder reviews of physiotherapy and their lack of intervention quality assessments.

Lasers Med Sci. 2016 May;31(4):759-66. doi: 10.1007/s10103-016-1918-7. Epub 2016 Mar 16.

Low-level laser therapy modulates pro-inflammatory cytokines after partial tenotomy.

Da Ré Guerra F[1], Vieira CP[2], Oliveira LP[2], Marques PP[3], dos Santos Almeida M[4], Pimentel ER[2].
Author information

- [1]Department of Anatomy, Institute of Biomedical Science, Federal University of Alfenas - UNIFAL-MG, 37130-000, Alfenas, MG, Brazil. dgflavia@yahoo.com.br.
- [2]Department of Structural and Functional Biology, Institute of Biology, CP 6109, University of Campinas - UNICAMP, 13083-970, Campinas, SP, Brazil.
- [3]Department of Biochemistry, Institute of Biomedical Science, Federal University of Alfenas - UNIFAL-MG, 37130-000, Alfenas, MG, Brazil.
- [4]Department of Anatomy, Institute of Biomedical Science, Federal University of Alfenas - UNIFAL-MG, 37130-000, Alfenas, MG, Brazil.

Abstract

Tendon injuries give rise to substantial morbidity, and current understanding of the mechanisms involved in tendon injury and repair is limited. This lesion remains a clinical issue because the injury site becomes a region with a high incidence of recurrent rupture and has drawn the attention of researchers. We already demonstrated that low-level laser therapy (LLLT) stimulates the synthesis and organization of collagen I, MMP-9, and MMP-2 and improved the gait recovery of the treated animals. The aim of this study was to evaluate the effects of LLLT in the nitric oxide and cytokines profile during the inflammatory and remodeling phases. Adult male rats were divided into the following groups: G1--intact, G2-- injured, G3--injured + LLLT (4 J/cm(2) continuous), G4--injured + LLLT (4 J/cm(2)-20 Hz--pulsed laser). According to the analysis, the animals were euthanized on different dates (1, 4, 8, or 15 days after injury). ELISA assay of TNF-α, IL-1β, IL-10, and TGF-β was performed. Western blotting of isoform of nitric oxide synthase (i-NOS) and nitric oxide dosage experiments was conducted. Our results showed that the pulsed LLLT seems to exert an anti-inflammatory effect over injured tendons, with reduction of the release of proinflammatory cytokines, such as TNF-α and the decrease in the i-NOS activity. Thanks to the pain reduction and the facilitation of movement, there was a stimulation in the TGF-β and IL-1β release. In conclusion, we believe that pulsed LLLT worked effectively as a therapy to reestablish the tendon integrity after rupture.

Lasers Surg Med. 2009 Apr;41(4):271-6. doi: 10.1002/lsm.20760.

Effect of low level laser therapy (830 nm) with different therapy regimes on the process of tissue repair in partial lesion calcaneous tendon.

Oliveira FS[1], Pinfildi CE, Parizoto NA, Liebano RE, Bossini PS, Garcia EB, Ferreira LM.
Author information

- [1]Department of Plastic Surgery, São Paulo Federal University-UNIFESP, São Paulo, SP 04024-900, Brazil.

Abstract

BACKGROUND AND OBJECTIVE:

Calcaneous tendon is one of the most damaged tendons, and its healing may last from weeks to months to be completed. In the search after speeding tendon repair, low intensity laser therapy has shown favorable effect. To assess the effect of low intensity laser therapy on the process of tissue repair in calcaneous tendon after undergoing a partial lesion.

STUDY DESIGN/MATERIALS AND METHODS:

Experimentally controlled randomized single blind study. Sixty male rats were used randomly and were assigned to five groups containing 12 animals each one; 42 out of 60 underwent lesion caused by dropping a 186 g weight over their Achilles tendon from a 20 cm height. In Group 1 (standard control), animals did not suffer the lesion nor underwent laser therapy; in Group 2 (control), animals suffered the lesion but did not undergo laser therapy; in Groups 3, 4, and 5, animals suffered lesion and underwent laser therapy for 3, 5, and 7 days, respectively. Animals which suffered lesion were sacrificed on the 8th day after the lesion and assessed by polarization microscopy to analyze the degree of collagen fibers organization.

RESULTS:

Both experimental and standard control Groups presented significant values when compared with the control Groups, and there was no significant difference when Groups 1 and 4 were compared; the same occurred between Groups 3 and 5.

CONCLUSION:

Low intensity laser therapy was effective in the improvement of collagen fibers organization of the calcaneous tendon after undergoing a partial lesion.

Lasers Surg Med. 2005 Oct;37(4):293-300.

Low-level laser therapy (LLLT) prevents oxidative stress and reduces fibrosis in rat traumatized Achilles tendon.

Fillipin LI[1], Mauriz JL, Vedovelli K, Moreira AJ, Zettler CG, Lech O, Marroni NP, González-Gallego J.
Author information

- [1]Department of Physiology, Universidade Federal de Rio Grande do Sul, Brazil.

Abstract

BACKGROUND AND OBJECTIVES:

The present study investigated the effects of low-level laser therapy (LLLT) on oxidative stress and fibrosis in an experimental model of Achilles tendon injury induced by a single impact trauma.

STUDY DESIGN/MATERIALS AND METHODS:

Male Wistar rats were randomly divided into four groups (n = 8): control, trauma, trauma+LLLT for 14 days, and trauma+LLLT for 21 days. Achilles tendon traumatism was produced by dropping down a load with an impact kinetic energy of 0.544 J. A low level Ga-As laser was applied with a 904 nm wavelength, 45 mW average power, 5 J/cm(2) dosage, for 35 seconds duration, continuously. Studies were carried out at day 21.

RESULTS:

Histology showed a loss of normal architecture, with inflammatory reaction, angiogenesis, vasodilatation, and extracellular matrix formation after trauma. This was accompanied by a significant increase in collagen concentration when compared the control group. Oxidative stress, measured by the concentration of thiobarbituric acid reactive substances and hydroperoxyde-initiated chemiluminiscence, was also significantly increased in the trauma group. Administration of LLLT for 14 or 21 days markedly alleviated histological abnormalities reduced collagen concentration and prevented oxidative stress. Superoxide dismutase activity was significantly increased by LLLT treatment over control values.

CONCLUSION:

LLLT by Ga-As laser reduces histological abnormalities, collagen concentration, and oxidative stress in an experimental model of Achilles tendon injury. Reduction of fibrosis could be mediated by the beneficial effects on the oxidant/antioxidant balance.

Photomed Laser Surg. 2014 Jun;32(6):345-50. doi: 10.1089/pho.2013.3694. Epub 2014 May 15.

Low-level laser therapy on tissue repair of partially injured achilles tendon in rats.

de Jesus JF[1], Spadacci-Morena DD, Rabelo ND, Pinfildi CE, Fukuda TY, Plapler H.
Author information

- [1]1 Interdisciplinary Surgical Science Program, Universidade Federal de São Paulo-UNIFESP , São Paulo, Brazil .

Abstract

OBJECTIVE:

The aim of this study was to assess the alignment and type of collagen (I and III) in partially injured Achilles tendons of rats treated with low-level laser therapy (LLLT).

BACKGROUND:

Achilles tendons present high indices of injury and their regeneration process may take a long time. LLLT has been used to accelerate and enhance injured Achilles tendon repair.

METHODS:

Sixty-five male Wistar rats were distributed into seven groups: LASER 1, 3, and 7 (the rat's Achilles tendons were partially injured and submitted to treatment for 1, 3, or 7 days, respectively); a Sham group 1, 3, and 7 for each of LASER group (same injury, but the LLLT was only simulated), and five remaining animals were allocated to the control group (no procedures were performed). The 780 nm LLLT was applied once a day, with 70 mW of mean power, fluence of 17.5 J/cm(2) for 10 sec. After the rats were euthanized, the tendons were surgically removed and assessed by birefringence technique (collagen alignment) and picrosirius red (collagen I and III).

RESULTS:

Sham versus LASER analysis did not show differences ($p>0.05$) for collagen alignment. The collagen composition (median) was significantly different ($p<0.05$) for LASER 3 (I: 16.5; III: 83.5) versus Sham 3 (I: 12.5; III: 87.5) and LASER 7 (I: 20.2; III: 79.8) versus Sham 7 (I: 10.2; III: 89.8). LASER groups exhibited a higher percentage of type I collagen and a lower percentage of type III collagen.

CONCLUSIONS:

LLLT stimulated collagen I proliferation, improving the injured Achilles tendons' healing process.

Lasers Med Sci. 2014 Jul;29(4):1377-84. doi: 10.1007/s10103-014-1528-1. Epub 2014 Feb 9.

Low-level laser irradiation stimulates tenocyte proliferation in association with increased NO synthesis and upregulation of PCNA and cyclins.

Tsai WC[1], Cheng JW, Chen JL, Chen CY, Chang HN, Liao YH, Lin MS, Pang JH.
Author information

- [1]Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital, Gueishan Township, Taoyuan County, Taiwan.

Abstract

Low-level laser therapy is commonly used to treat tendinopathy or tendon injury. Tendon healing requires tenocyte migration to the repair site, followed by proliferation and synthesis of the extracellular matrix. There are few evidence to elucidate that low-level laser promote tenocyte proliferation. This study was designed to determine the effect of laser on tenocyte proliferation. Furthermore, the association of this effect with secretion of nitric oxide (NO) and the expressions of proliferating cell nuclear antigen (PCNA) and cyclins D1, E, A, and B1 was investigated. Tenocytes intrinsic to rat Achilles tendon were treated with low-level laser (660 nm). Tenocyte proliferation was evaluated by MTT assay and immunocytochemistry with Ki-67 stain. NO in the conditioned medium was measured by ELISA. Western blot analysis was used to evaluate the protein expressions of PCNA and cyclins D1, E, A, and B1. The results revealed that tenocytes proliferation was enhanced dose dependently by laser. NO secretion was increased after laser treatment. PCNA and cyclins E, A, and B1 were upregulated by laser. In conclusion, low-level laser irradiation stimulates tenocyte proliferation in a process that is mediated by upregulation of NO, PCNA, and cyclins E, A, and B1.

PLoS One. 2012;7(5):e38235. doi: 10.1371/journal.pone.0038235. Epub 2012 May 30.

Low-level laser irradiation stimulates tenocyte migration with up-regulation of dynamin II expression.

Tsai WC[1], Hsu CC, Pang JH, Lin MS, Chen YH, Liang FC.

Author information

- [1]Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital, Taoyuan County, Taiwan.

Abstract

Low-level laser therapy (LLLT) is commonly used to treat sports-related tendinopathy or tendon injury. Tendon healing requires tenocyte migration to the repair site, followed by proliferation and synthesis of the extracellular matrix. This study was designed to determine the effect of laser on tenocyte migration. Furthermore, the correlation between this effect and expression of dynamin 2, a positive regulator of cell motility, was also investigated. Tenocytes intrinsic to rat Achilles tendon were treated with low-level laser (660 nm with energy density at 1.0, 1.5, and 2.0 J/cm(2)). Tenocyte migration was evaluated by an in vitro wound healing model and by transwell filter migration assay. The messenger RNA (mRNA) and protein expressions of dynamin 2 were determined by reverse transcription/real-time polymerase chain reaction (real-time PCR) and Western blot analysis respectively. Immunofluorescence staining was used to evaluate the dynamin 2 expression in tenocytes. Tenocytes with or without laser irradiation was treated with dynasore, a dynamin competitor and then underwent transwell filter migration assay. In vitro wound model revealed that more tenocytes with laser irradiation migrated across the wound border to the cell-free zone. Transwell filter migration assay confirmed that tenocyte migration was enhanced dose-dependently by laser. Real-time PCR and Western-blot analysis demonstrated that mRNA and protein expressions of dynamin 2 were up-regulated by laser irradiation dose-dependently. Confocal microscopy showed that laser enhanced the expression of dynamin 2 in cytoplasm of tenocytes. The stimulation effect of laser on tenocytes migration was suppressed by dynasore. In conclusion, low-level laser irradiation stimulates tenocyte migration in a process that is mediated by up-regulation of dynamin 2, which can be suppressed by dynasore.

Lasers Med Sci. 2013 Sep;28(5):1281-8. doi: 10.1007/s10103-012-1236-7. Epub 2012 Nov 21.

LLLT improves tendon healing through increase of MMP activity and collagen synthesis.

Guerra Fda R[1], Vieira CP, Almeida MS, Oliveira LP, de Aro AA, Pimentel ER.

Author information

- [1]Department of Anatomy, Cell Biology and Physiology and Biophysics, Institute of Biology, University of Campinas-UNICAMP, CP 6109, Campinas, São Paulo, 13083-970, Brazil. dgflavia@yahoo.com.br

Abstract

The Achilles tendon has a high incidence of rupture, and the healing process leads to a disorganized extracellular matrix (ECM) with a high rate of injury recurrence. To evaluate the effects of different conditions of low-level laser (LLL) application on partially tenotomized tendons, adult male rats were divided into the following groups: G1, intact; G2, injured; G3, injured + LLL therapy (LLLT; 4 J/cm(2) continuous); G4, injured + LLLT (4 J/cm(2), 20 Hz); G5, injured; G6, injured + LLLT (4 J/cm(2) continuous); and G7, injured + LLLT (4 J/cm(2), 20 Hz until the 7th day and 2 kHz from 8 to 14 days). G2, G3, and G4 were euthanized 8 days after injury, and G5, G6, and G7 were euthanized on the 15th day. The quantification of hydroxyproline (HOPro) and non-collagenous protein (NCP), zymography for matrix metalloproteinase (MMP)-2 and MMP-9, and Western blotting (WB) for collagen types I and III were performed. HOPro levels showed a significant decrease in all groups (except G7) when compared with G1. The NCP level increased in all transected groups. WB for collagen type I showed an increase in G4 and G7. For collagen type III, G4 presented a higher value than G2. Zymography for MMP-2 indicated high values in G4 and G7. MMP-9 increased in both treatment groups euthanized at 8 days, especially in G4. Our results indicate that the pulsed LLLT improved the remodeling of the ECM during the healing process in tendons through activation of MMP-2 and stimulation of collagen synthesis.

Photomed Laser Surg. 2011 Oct;29(10):663-8. doi: 10.1089/pho.2010.2919. Epub 2011 Jun 13.

Different power settings of LLLT on the repair of the calcaneal tendon.

Neves MA[1], Pinfildi CE, Wood VT, Gobbato RC, da Silva FM, Parizotto NA, Hochman B, Ferreira LM.
Author information

- [1]Department of Plastic Surgery, Universidade Federal de São Paulo, Rua Napoleão de Barros 715, São Paulo, Brazil. marcoain@gmail.com

Abstract

OBJECTIVE:

The purpose of this study was to evaluate the effect of an 830-nm GaAlAs diode laser operating at output powers of 40, 60, 80, and 100 mW and energy density of 30 J/cm(2) on the repair of partial calcaneal tendon ruptures in rats.

METHODS:

A partial tendon rupture was induced in all animals, which were treated with laser irradiation for 5 consecutive days. Six days after injury, the injured tendons were removed and examined by polarized light microscopy. Collagen fiber organization was evaluated by birefringence measurements, and collagen content was determined by Picrosirius Red staining.

RESULTS:

It was observed that the higher the output power (60-100 mW) the greater the amount of type III collagen ($p<0.01$). The amount of type I collagen was significantly greater ($p=0.05$) in the 80 mW group than in the control group (sham stimulation). A non-statistically significant improvement in the realignment of collagen fibers was observed in the irradiated groups.

CONCLUSIONS:

Low-level laser therapy resulted in significantly greater amounts of type III collagen (output powers of 60 mW or more) and type I collagen (output power of 80 mW), however, no significant differences between groups were found in the realignment of collagen fibers.

Lasers Med Sci. 2014 Mar;29(2):805-11. doi: 10.1007/s10103-013-1406-2. Epub 2013 Aug 28.

Pulsed LLLT improves tendon healing in rats: a biochemical, organizational, and functional evaluation.

Guerra Fda R[1], Vieira CP, dos Santos de Almeida M, Oliveira LP, Claro AC, Simões GF, de Oliveira AL, Pimentel ER.

Author information

- [1]Department of Structural and Functional Biology, Institute of Biology, University of Campinas-UNICAMP, CP 6109, 13083-970, Campinas, SP, Brazil, dgflavia@yahoo.com.br.

Abstract

In the last decades, the tendon injuries have increased substantially. Previous results suggested that low-level laser treatment (LLLT) promotes synthesis of extracellular matrix and improves the functional properties of the tendon. The aim of this study was to evaluate the effects of different protocols of LLLT on partially tenotomized tendons. Adult male rats were divided into the following: G1-intact, G2-injured, G3-injured + LLLT (4 J/cm(2) continuous), G4-injured + LLLT (4 J/cm(2) at 20 Hz). G2, G3, and G4 were euthanized 8 days after injury. G5-injured, G6-injured + LLLT (4 J/cm(2) continuous), and G7-injured + LLL (4 J/cm(2) at 20 Hz until the seventh day and 2 kHz from 8 to 14 days). G5, G6, and G7 were euthanized on the 15th day. Glycosaminoglycan (GAG) level was quantified by dimethylmethylene blue method and analyzed on agarose gel. Toluidine blue (TB) stain was used to observe metachromasy. CatWalk system was used to evaluate gait recovery. Collagen organization was analyzed by polarization microscopy. The GAG level increased in all transected groups, except G5. In G6 and G7, there was a significant increase in GAG in relation to G5. In G3 and G4, the presence of dermatan sulfate band was more prominent than G2. TB stains showed intense metachromasy in the treated groups. Birefringence analysis showed improvement in collagen organization in G7. The gait was significantly improved in G7. In conclusion, pulsed LLLT leads to increased organization of collagen bundles and improved gait recovery.

Lasers Med Sci. 2014 May;29(3):1075-81. doi: 10.1007/s10103-013-1468-1. Epub 2013 Nov 2.

Analysis of the effect of phototherapy in model with traumatic Achilles tendon injury in rats.

Casalechi HL[1], de Farias Marques AC, da Silva EA, Aimbire F, Marcos RL, Lopes-Martins RA, de Carvalho Pde T, Albertini R.

Author information

- [1]Post Graduate Program in Rehabilitation Sciences, Universidade Nove de Julho (UNINOVE), Rua Vergueiro, 235, São Paulo, SP, 01504-001, Brazil.

Abstract

The aim of this study was to investigate the effect of low-intensity laser (LILT) infrared (830 nm) therapy in tendon inflammation, tendinitis induced by mechanical trauma in rat Achilles tendon. For this, we used 65 young male Wistar rats, weighing ± 300 g divided into different groups: C = control (n = 5) and experimental (n = 10/group), with two different times of sacrifice such as treated with L = laser, D = treated with diclofenac, and T = untreated injured. The tendon inflammation was induced by controlled contusion in the medial region of the Achilles tendon of the animals. The treated groups received some kind of intervention every 24 h, all groups were sacrificed on the 7th or 14th day after the trauma. The tendons were dissected, extracted, and sent for analysis. Histological analysis of the L group showed a decrease in the number of inflammatory cells in relation to other groups in both periods studied. The comparative results between the number of inflammatory cells in the control and treated groups at 7 and 14 days showed statistically significant differences. Qualitative analysis findings obtained by the picrosirius red technique under polarized light showed that in 7 days, the T group presented collagen types I and III in the same proportion; group D presented a predominance of type III fibers, while in group L, type I collagen predominated. The 14-day group D showed collagen types I and III in the same proportion, while in group L, there was a predominance of type I fibers. Biomechanical analysis showed that 7-day groups L and C showed similar stiffness and increased breaking strength. The 14-day groups L and C showed greater rupturing strength as well as increased stiffness angle. Group D showed a decrease of maximum traction strength and degree of rigidity. It was concluded that treatment with LIL in the parameters used and the times studied reduces migration of inflammatory cells and improves the quality of repair while reducing the functional limitations.

Keio J Med. 1993 Dec;42(4):191-5.

Laser applications in plastic and reconstructive surgery.

Ohshiro T[1], Fujino T.
Author information

- [1]Department of Plastic and Reconstructive Surgery, School of Medicine, Keio University, Tokyo, Japan.

Abstract

Very shortly after the laser's first successful firing in 1960, applications were found in the medical field in the specialities of ophthalmology and dermatology and have since expanded to include indications in plastic and reconstructive surgery. In the photodestructive mode, laser energy is used selectively to vaporize, incise, excise, ablade and coagulate target tissue; the surgical laser can also degrade or denature protein in the target tissue, and the latter photoreaction now forms the basis for laser tissue welding in a variety of tissue types. The author refers to these photodestructive applications as high reactive-level laser treatment, or HLLT. In laser therapeutic applications, the temperature of the cells may rise only very slightly or not at all, and there is no immediate irreversible change in the target tissue architecture. The level of reaction is thus lower than the cell survival threshold, giving a direct photoactivative effect. The author refers to this as low reactive-level laser therapy, or LLLT: LLLT applications include pain attenuation, wound healing acceleration; enhanced remodeling in accelerated bone and tendon repair; restoration of normal neural function; normalization of abnormal hormonal function; modulation of the autoimmune system; control of hyper- and hypotension and so on. HLLT and LLLT are contrasted and compared, and applications of both HLLT and LLLT in PRS are discussed in brief.

Wound healing of animal and human body sport and traffic accident injuries using low-level laser therapy treatment: a randomized clinical study of seventy-four patients with control group.

Simunovic Z[1], Ivankovich AD, Depolo A.
Author information

- [1]Department of Anesthesiology, La Caritá Medical Center, Laser Center, Locarno, Switzerland. info@lasermedico.ch

Abstract

BACKGROUND AND OBJECTIVE:

The main objective of current animal and clinical studies was to assess the efficacy of low level laser therapy (LLLT) on wound healing in rabbits and humans.

STUDY DESIGN/MATERIALS AND METHODS:

In the initial part of our research we conducted a randomized controlled animal study, where we evaluated the effects of laser irradiation on the healing of surgical wounds on rabbits. The manner of the application of LLLT on the human body are analogous to those of similar physiologic structure in animal tissue, therefore, this study was continued on humans. Clinical study was performed on 74 patients with injuries to the following anatomic locations: ankle and knee, bilaterally, Achilles tendon; epicondylus; shoulder; wrist; interphalangeal joints of hands, unilaterally. All patients had had surgical procedure prior to LLLT. Two types of laser devices were used: infrared diode laser (GaAlAs) 830 nm continuous wave for treatment of trigger points (TPs) and HeNe 632.8 nm combined with diode laser 904-nm pulsed wave for scanning procedure. Both were applied as monotherapy during current clinical study. The results were observed and measured according to the following clinical parameters: redness, heat, pain, swelling and loss of function, and finally postponed to statistical analysis via chi2 test.

RESULTS:

After comparing the healing process between two groups of patients, we obtained the following results: wound healing was significantly accelerated (25%-35%) in the group of patients treated with LLLT. Pain relief and functional recovery of patients treated with LLLT were significantly improved comparing to untreated patients.

CONCLUSION:

In addition to accelerated wound healing, the main advantages of LLLT for postoperative sport- and traffic-related injuries include prevention of side effects of drugs, significantly accelerated functional recovery, earlier return to work, training and sport competition compared to the control group of patients, and cost benefit.

J Clin Laser Med Surg. 1998 Jun;16(3):145-51.

Treatment of medial and lateral epicondylitis--tennis and golfer's elbow--with low level laser therapy: a multicenter double blind, placebo-controlled clinical study on 324 patients.

Simunovic Z[1], Trobonjaca T, Trobonjaca Z.
Author information

- [1]Laser Center, Locarno, Switzerland. tzlatko@mamed.medri.hr

Abstract

BACKGROUND AND OBJECTIVE:

Among the other treatment modalities of medial and lateral epicondylitis, low level laser therapy (LLLT) has been promoted as a highly successful method. The aim of this clinical study was to assess the efficacy of LLLT using trigger points (TPs) and scanner application techniques under placebo-controlled conditions.

STUDY DESIGN/MATERIAL AND METHODS:

The current clinical study was completed at two Laser Centers (Locarno, Switzerland and Opatija, Croatia) as a double-blind, placebo controlled, crossover clinical study. The patient population (n = 324), with either medial epicondylitis (Golfer's elbow; n = 50) or lateral epicondylitis (Tennis elbow; n = 274), was recruited. Unilateral cases of either type of epicondylitis (n = 283) were randomly allocated to one of three treatment groups according to the LLLT technique applied: (1) Trigger points; (2) Scanner; (3) Combination Treatment (i.e., TPs and scanner technique). Bilateral cases of either type of epicondylitis (n = 41) were subject to crossover, placebo-controlled conditions. Laser devices used to perform these treatments were infrared (IR) diode laser (GaAlAs) 830 nm continuous wave for treatment of TPs and HeNe 632.8 nm combined with IR diode laser 904 nm, pulsed wave for scanner technique. Energy doses were equally controlled and measured in Joules/cm2 either during TPs or scanner technique sessions in all groups of patients. The treatment outcome (pain relief and functional ability) was observed and measured according to the following methods: (1) short form of McGill's Pain Questionnaire (SF-MPQ); (2) visual analogue scales (VAS); (3) verbal rating scales (VRS); (4) patient's pain diary; and (5) hand dynamometer.

RESULTS:

Total relief of the pain with consequently improved functional ability was achieved in 82% of acute and 66% of chronic cases, all of which were treated by combination of TPs and scanner technique.

CONCLUSIONS:

This clinical study has demonstrated that the best results are obtained using combination treatment (i.e., TPs and scanner technique). Good results are obtained from adequate treatment technique correctly applied, individual energy doses, adequate medical education, clinical experience, and correct approach of laser therapists. We observed that under- and overirradiation dosage can result in the absence of positive therapy effects or even opposite, negative (e.g., inhibitory) effects. The current clinical study provides further evidence of the efficacy of LLLT in the management of lateral and medial epicondylitis.

Photomed Laser Surg. 2010 Feb;28(1):3-16. doi: 10.1089/pho.2008.2470.

Low level laser treatment of tendinopathy: a systematic review with meta-analysis.

Tumilty S[1], Munn J, McDonough S, Hurley DA, Basford JR, Baxter GD.
Author information

- [1]Centre for Physiotherapy Research, School of Physiotherapy, University of Otago, Dunedin, New Zealand. steve.tumilty@otago.ac.nz

Abstract

OBJECTIVES:

To assess the clinical effectiveness of Low Level Laser Therapy (LLLT) in the treatment of tendinopathy. Secondary objectives were to determine the relevance of irradiation parameters to outcomes, and the validity of current dosage recommendations for the treatment of tendinopathy.

BACKGROUND:

LLLT is proposed as a possible treatment for tendon injuries. However, the clinical effectiveness of this modality remains controversial, with limited agreement on the most efficacious dosage and parameter choices.

METHOD:

The following databases were searched from inception to 1(st) August 2008: MEDLINE, PubMed, CINAHL, AMED, EMBASE, All EBM reviews, PEDro (Physiotherapy Evidence Database), SCOPUS. Controlled clinical trials evaluating LLLT as a primary intervention for any tendinopathy were included in the review. Methodological quality was classified as: high (> or =6 out of 10 on the PEDro scale) or low (<6) to grade the strength of evidence. Accuracy and clinical appropriateness of treatment parameters were assessed using established recommendations and guidelines.

RESULTS:

Twenty-five controlled clinical trials met the inclusion criteria. There were conflicting findings from multiple trials: 12 showed positive effects and 13 were inconclusive or showed no effect. Dosages used in the 12 positive studies would support the existence of an effective dosage window that closely resembled current recommended guidelines. In two instances where pooling of data was possible, LLLT showed a positive effect size; in studies of lateral epicondylitis that scored > or =6 on the PEDro scale, participants' grip strength was 9.59 kg higher than that of the control group; for participants with Achilles tendinopathy, the effect was 13.6 mm less pain on a 100 mm visual analogue scale.

CONCLUSION:

LLLT can potentially be effective in treating tendinopathy when recommended dosages are used. The 12 positive studies provide strong evidence that positive outcomes are associated with the use of current dosage recommendations for the treatment of tendinopathy.

BMC Musculoskelet Disord. 2008 May 29;9:75. doi: 10.1186/1471-2474-9-75.

A systematic review with procedural assessments and meta-analysis of low level laser therapy in lateral elbow tendinopathy (tennis elbow).

Bjordal JM[1], Lopes-Martins RA, Joensen J, Couppe C, Ljunggren AE, Stergioulas A, Johnson MI.
Author information

- [1]Institute of Physiotherapy, Faculty of Health and Social Sciences, Bergen University College, Moellendalsvn, 6, 5009 Bergen, Norway. jmb@hib.no

Abstract

BACKGROUND:

Recent reviews have indicated that low level level laser therapy (LLLT) is ineffective in lateral elbow tendinopathy (LET) without assessing validity of treatment procedures and doses or the influence of prior steroid injections.

METHODS:

Systematic review with meta-analysis, with primary outcome measures of pain relief and/or global improvement and subgroup analyses of methodological quality, wavelengths and treatment procedures.

RESULTS:

18 randomised placebo-controlled trials (RCTs) were identified with 13 RCTs (730 patients) meeting the criteria for meta-analysis. 12 RCTs satisfied half or more of the methodological criteria. Publication bias was detected by Egger's graphical test, which showed a negative direction of bias. Ten of the trials included patients with poor prognosis caused by failed steroid injections or other treatment failures, or long symptom duration or severe baseline pain. The weighted mean difference (WMD) for pain relief was 10.2 mm [95% CI: 3.0 to 17.5] and the RR for global improvement was 1.36 [1.16 to 1.60]. Trials which targeted acupuncture points reported negative results, as did trials with wavelengths 820, 830 and 1064 nm. In a subgroup of five trials with 904 nm lasers and one trial with 632 nm wavelength where the lateral elbow tendon insertions were directly irradiated, WMD for pain relief was 17.2 mm [95% CI: 8.5 to 25.9] and 14.0 mm [95% CI: 7.4 to 20.6] respectively, while RR for global pain improvement was only reported for 904 nm at 1.53 [95% CI: 1.28 to 1.83]. LLLT doses in this subgroup ranged between 0.5 and 7.2 Joules. Secondary outcome measures of painfree grip strength, pain pressure threshold, sick leave and follow-up data from 3 to 8 weeks after the end of treatment, showed consistently significant results in favour of the same LLLT subgroup ($p < 0.02$). No serious side-effects were reported.

CONCLUSION:

LLLT administered with optimal doses of 904 nm and possibly 632 nm wavelengths directly to the lateral elbow tendon insertions, seem to offer short-term pain relief and less disability in LET, both alone and in conjunction with an exercise regimen. This finding contradicts the conclusions of previous reviews which failed to assess treatment procedures, wavelengths and optimal doses.