Low Level Laser Therapy (LLLT)

Scientific Studies Overview
Evidence based indications

- Achilles Tendinopathy
- Diabetic Foot
- Rotator cuff tendinitis / Impingement
- Carpal Tunnel Syndrome
- Epicondylitis
- Fracture Healing
- Raynaud’s Phenomenon
- Wound Healing
- Muscle Recovery
- Neck Pain
- Herpes Simplex
- Temporomandibular Disorder
- Peripheral Nerve Injury
- Knee OA
- Meniscal Pathology
- Achilles Tendinopathy
- Ankle Sprain
- Plantar Fasciitis
TEMPOROMANDIBULAR DISORDER

| EFFECTIVENESS OF OCCLUSAL SPLINTS AND LOW-LEVEL LASER THERAPY ON MYOFASCIAL PAIN. |
|---|---|
| **Authors** | Demirkol N, Sari F, Bulbul M, Demirkol M, Simsek I, Usumez A. |
| **Published** | Lasers Med Sci. 2014 Feb 7. [Epub ahead of print] |
| **Date** | Feb 2014 |
| **Place of origin** | Department of Prosthodontics, Faculty of Dentistry, Gaziantep University, Gaziantep, Turkey |
| **Objective** | To evaluate the effects of low-level laser therapy and occlusal splints in patients with signs and symptoms of temporomandibular disorders (TMD) characterized with myofascial pain (MP) and to compare the efficiency results of the two therapies. |
| **Study design & methods** | **Prospective placebo controlled study.** |
| | **Subjects:** 30 patients with myofascial pain according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TDM). |
| | **Methods:** the patients were divided into three groups. |
| | - **Occlusal splint (OS) group A (n = 10):** were instructed to wear occlusal splints 12 h/day for 3 weeks. |
| | - **Low-level laser therapy (LLLT) group B (n = 10):** LLLT (Nd:YAG laser, 1,064 nm, 8 J/cm², 250 mW) was applied to the patients in the study group once a day for 10 days, for a total of 10 sessions. |
| | - **Placebo group C (n = 10):** same parameters and application times were used for placebo group, but the patients were not irradiated. |
| **Outcomes:** | Functional examination was based on RDC/TDM |
| | Pressure pain values were obtained with the Visual Analog Scale. |
| | Comparisons were made between the groups before and after the treatment. |
| **Results** | The pain score values decreased significantly after both LLLT (p < 0.05) and occlusal splint therapy (p < 0.05) compared to placebo group (p < 0.05). |
| | There was no significant difference between LLLT and OS groups after treatment (p > 0.05). |
| **Conclusion** | Both occlusal Splint and LLLT are effective for decreasing MP. The LLLT treatment in this study is as effective as occlusal splint for pain relief. |
| **Key message** | 10 daily LLLT sessions were equally effective to 3 weeks 12h/day occlusal splint wear for decreasing pain in myofascial TMD. |
| **Pubmed ID** | 24504660 |
# EVALUATION OF LOW-LEVEL LASER THERAPY IN PATIENTS WITH ACUTE AND CHRONIC TEMPOROMANDIBULAR DISORDERS.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Salmos-Brito JA, de Menezes RF, Teixeira CE, Gonzaga RK, Rodrigues BH, Braz R, Bessa-Nogueira RV, Gerbi ME.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Jan 2013</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Dental School, University of Pernambuco, Pernambuco, Brazil.</td>
</tr>
<tr>
<td>Objective</td>
<td>To address the following question: among patients with acute or chronic temporomandibular disorders (TMD), does low-level laser therapy (LLLT) reduce pain intensity and improve maximal mouth opening?</td>
</tr>
</tbody>
</table>

## Study design & methods

**Comparative double-blind clinical study.**

**Subjects:** 58 myogenic TMD patients (according Research Diagnostic Criteria for TMD).

**Methods:**

- According to disease duration, patients were allocated into two groups, acute (<6 months) and chronic TMD (≥ 6 months).
- For each patient, 12 LLLT sessions were performed (GaAlAs; wavelength = 830 nm, Power = 40 mW, Energy Density = 8 J/cm²).

**Outcomes:**

- Pain intensity was recorded using a 10-cm visual analog scale
- Maximal mouth opening was measured using a digital ruler
- Both outcomes were recorded before/after LLLT.

## Results

- The mean pain intensity score before LLLT was 6 for acute TMD group and 9 for chronic TMD group. After therapy, all patients with acute TMD reported mean pain intensity score of 1, whereas all patients with chronic TMD reported pain intensity score of 5.
- Both groups had a significant pain intensity reduction and maximal mouth opening improvement after LLLT (Wilcoxon test, p < 0.001).
- Between the groups, acute TMD patient had a more significant pain intensity reduction (Mann-Whitney test, p = 0.002) and a more significant maximal mouth opening improvement (Mann-Whitney test, p = 0.011).

## Conclusion

Low-level laser therapy can be considered as an alternative physical modality or supplementary approach for management of acute and chronic myogenic temporomandibular disorder; however, patients with acute disease are likely to have a better outcome. Thus, LLLT could be used in the acute cases as monotherapy and in chronic cases as supplementary approach.

## Key message

**Significant improvement of pain and mouth opening** with LLLT in both acute and chronic TMD with highest effectiveness in acute conditions.

| Pubmed ID | 22367394 |
# The Efficacy of Low-Level Laser Therapy for the Treatment of Myogenous Temporomandibular Joint Disorder.

**Authors**
Ahrari F, Madani AS, Ghafouri ZS, Tunér J.

**Published**

**Date**
Jan 2013

**Place of origin**
Dental Research Center, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran.

**Background**
Low-level laser therapy (LLLT) has been commonly used for the treatment of painful musculoskeletal conditions, but the results of previous studies on this subject are controversial.

**Objective**
To evaluate the efficacy of LLLT in the management of patients with myogenic temporomandibular joint disorders (TMDs).

### Study design & methods

**Randomized, double-blind clinical trial.**

**Subjects:** 20 patients with myogenic TMD.

**Methods:** patients were randomly divided into laser and placebo groups.

- In the laser group, a pulsed 810-nm low-level laser (average power 50 mW, peak power 80 W, 1,500 Hz, 120 s, 6 J, and 3.4 J/cm²) was used on painful muscles three times a week for 4 weeks.
- In the placebo group, the treatment was the same as that in the laser group, but without energy output.

**Outcomes:** level of pain (VAS) and the amount of mouth opening were measured.

The patients were evaluated before laser therapy (T1), after 6 sessions of laser application (T2), at the end of treatment (T3), and 1 month after the last application (T4).

### Results

- Significant increase in mouth opening after 12 laser applications in laser group (36%, \( p < 0.05 \)) but not in placebo group (7%).
- Significant reduction of pain VAS score at insertion of masseter muscle in the laser group (73%, \( p < 0.05 \)) but not in placebo group (9%).
- The improvement in pain and mouth opening remained significant for 1 month after the last application.
- Between-group comparisons revealed no significant difference in pain intensity and mouth opening measurement at any of the evaluation time points (\( p > 0.05 \)). This may be related to the small sample size and the great variation in clinical symptoms of patients in both groups.

### Conclusion
Treatment with a pulsed 810-nm low-level laser caused a significant improvement in mouth opening and pain intensity in patients with myogenic TMD, while similar improvement was not observed in the placebo group during the course of the study. Therefore, LLLT can be considered as a suitable and non-invasive treatment alternative for myogenous pain.

**Key message**
LLLT can produce a significant improvement in pain level and mouth opening in patients affected with myogenic TMD.

**Pubmed**
23318917
### HERPES SIMPLEX

#### THE EFFECT OF 670-NM LOW LASER THERAPY ON HERPES SIMPLEX TYPE 1.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Muñoz Sanchez PJ, Capote Femenías JL, Díaz Tejeda A, Tunér J.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Jan 2012</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Leonardo Fernández Sánchez Dental Clinic, Cienfuegos, Cuba.</td>
</tr>
</tbody>
</table>

**Background**

Several pharmaceuticals are available to reduce symptoms and improve healing of labial herpes, but only LLLT has been reported to significantly influence the length of the recurrence period.

**Objective**

To study the effect of low-level laser therapy (LLLT) on the healing and relapse intervals in patients with recurrent labial herpes simplex infections.

**Study design & methods**

Randomised controlled pilot study followed by long-term recurrence study.

**Subjects**: patients affected by the Herpes simplex type 1 virus

- Pilot study: 232 patients
- Recurrence study: 322 patients

**Methods**

**Pilot study**:

- Patients were randomised to laser group (n=116) or control group (n=116).
- Patients in the laser group received 670-nm laser irradiation, 40 mW, 1.6 J, 2.04 J/cm², 51 mW/cm² per blister in the prodromal stage and 4.8 J in the crust and secondarily infected stages, plus 1.2 J at the C2-C3 vertebrae.
- Patients in the control group received treatment with antivirals (acyclovir cream and tablets) and other palliative therapies, such as an anesthetic cream and advice to avoid spicy and hot food.
- Patients were monitored daily during the first week to control healing, and monthly for 1 year to check on recurrence.

**Recurrence study**:

- All patients received LLLT (same dosage as pilot study) daily until they were clinically and subjectively asymptomatic and were followed during 5 years to observe the period of occurrences.

**Outcomes**: initial healing rate and recurrence frequency.

**Results**

**Pilot study**:

- After day 7 no patients in the laser group had any visible signs of HSV-1 blisters, whereas in the control group 77 patients still had vesicles, 29 had crust formation, and 10 had secondary infections.
- In total, there were 84 cases of recurrence in the laser group and 114 in the control group.

**Recurrence study**:

- Recurrence at 1 year follow-up: 35 patients
- Recurrence at 2 year follow-up: 42 patients
- Recurrence at 3 year follow-up: 149 patients
- Recurrence at 4 year follow-up: 41 patients
- Recurrence at 5 year follow-up: 22 patients
- 33 patients did not have one single recurrence after 5 years of observation.

**Conclusion**

An obvious effect of LLLT was found for both initial healing and for the length of the recurrence periods.
LLLT of herpes simplex virus 1 (HSV-1) appears to be an effective treatment modality without any observed side effects.

### Key message

LLLT appears to be a safe, inexpensive, and effective treatment modality for the treatment of HSV-1, with improved initial blister healing and prolonged period to recurrence compared to pharmaceutical methods.

### Pubmed ID

22047597

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**LOW-INTENSITY LASER THERAPY IS AN EFFECTIVE TREATMENT FOR RECURRENT HERPES SIMPLEX INFECTION. RESULTS FROM A RANDOMIZED DOUBLE-BLIND PLACEBO-CONTROLLED STUDY.**

**Authors** Schindl A, Neumann R.

**Published** J Invest Dermatol. 1999 Aug;113(2):221-3.

**Date** 1999

**Place of origin** Department of Dermatology, University of Vienna Medical School, Austria.

**Background** Recurrent infection with herpes simplex virus is a common disease. Recently, alternative therapies have been introduced. Among those, low-intensity laser therapy mainly used for the acceleration of wound healing and in pain therapy has previously been shown to be of benefit in herpes zoster infections.

**Objective** To evaluate the efficacy of low-intensity laser therapy in the treatment of recurrent herpes simplex infection in a randomized, double-blind placebo-controlled trial design.

**Study design & methods**

**Randomized, double-blind placebo-controlled trial.**

**Subjects**: 50 patients with recurrent perioral herpes simplex infection (at least once per month for more than 6 mo).

**Methods**:

- Patients were randomised to the laser group who received daily irradiations (wavelength 690 nm, intensity: 80 mW/cm², dose: 48 J/cm²) for 2 wk, or the placebo group who were sham-irradiated.
- After completion of the laser/sham treatment, patients were asked to return to the department at the time of recurrence. The total observation period was 52 wk.

**Outcome**: recurrence-free interval.

**Results**

The median recurrence-free interval in the laser-treated group was 37.5 wk (range: 2-52 wk) and in the placebo group 3 wk (range: 1-20 wk). This difference was found to be statistically significant (p < 0.0001; Wilcoxon's Rank Sum Test).

**Conclusion**

A total of 10 irradiations with low-intensity laser therapy significantly lowers the incidence of local recurrence of herpes simplex infection. Since this athermic phototherapeutic modality represents a safe, noninvasive treatment, it might be considered as an alternative to established therapeutic regimens in this indication.

**Key message** LLLT is effective for reducing recurrence of herpes simplex infection.

**Pubmed ID** 10469307
NECK PAIN

The Effect of 300 MW, 830 NM Laser on Chronic Neck Pain: A Double-Blind, Randomized, Placebo-Controlled Study.

**Authors**  
Chow RT, Heller GZ, Barnsley L.

**Published**  

**Date**  
2006

**Place of origin**  
Castle Hill Medical Centre, Castle Hill, Australia

**Objective**  
To determine the efficacy of LLLT for neck pain in an appropriately designed and powered study.

**Study design & methods**

- **Double-blind, randomized, placebo-controlled study.**
- **Subjects**: 90 subjects with chronic neck pain.
- **Methods**: subjects were randomized to receive a course of 14 treatments over 7 weeks with either active or sham laser to tender areas in the neck.
- Laser parameters: wavelength 830nm, power 300mW, power density 0.67W/cm², irradiation time 30s per tender point, calculated energy density 20J/cm², up to 50 points treated per session.

**Outcomes:**

- The primary outcome measure was change in a 10 cm Visual Analogue Scale (VAS) for pain.
- Secondary outcome measures included Short-Form 36 Quality-of-Life questionnaire (SF-36), Northwick Park Neck Pain Questionnaire (NPNQ), Neck Pain and Disability Scale (NPAD), the McGill Pain Questionnaire (MPQ) and Self-Assessed Improvement (SAI) in pain measured by VAS.
- Measurements were taken at baseline, at the end of 7 weeks' treatment and 12 weeks from baseline.

**Results**

- The mean VAS pain scores improved by 2.7 in the treated group and worsened by 0.3 in the control group (difference 3.0, 95% CI 3.8-2.1).
- Significant improvements were seen in the active group compared to placebo for SF-36 Physical Score (SF36 PCS), NPNQ, NPAD, MPQVAS and SAI.
- The results of the SF-36 Mental Score (SF36 MCS) and other MPQ component scores (afferent and sensory) did not differ significantly between the two groups.

**Conclusion**

Low-level laser therapy (LLLT), at the parameters used in this study, was efficacious in providing pain relief for patients with chronic neck pain over a period of 3 months.

**Key message**  
Significant improvement of pain and disability with LLLT compared to placebo in chronic neck pain.

**Pubmed ID**  
16806710
EFFICACY OF LOW-LEVEL LASER THERAPY IN THE MANAGEMENT OF NECK PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMISED PLACEBO OR ACTIVE-TREATMENT CONTROLLED TRIALS.

Authors | Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM
Published | The Lancet, Volume 374, No. 9705, pp. 1897-908.
Date | Dec 2009
Place of origin | Nerve Research Foundation, Brain and Mind Research Institute, University of Sydney, Sydney, NSW, Australia.

Background
Neck pain is a common and costly condition for which pharmacological management has limited evidence of efficacy and side-effects. Low-level laser therapy (LLLT) is a relatively uncommon, non-invasive treatment for neck pain, in which non-thermal laser irradiation is applied to sites of pain.

Objective
To establish whether LLLT relieves acute and chronic neck pain and to systematically assess parameters of laser therapy to identify treatment protocols and dose ranges (therapeutic windows) associated with positive outcomes.

Study design & methods
Systematic review and meta-analysis.
- The authors searched computerised databases comparing efficacy of LLLT using any wavelength with placebo or with active control in acute or chronic neck pain.
- Effect size for the primary outcome, pain intensity, was defined as a pooled estimate of mean difference in change in mm on 100 mm visual analogue scale.

Results
- **16 randomised controlled trials** were identified, including a total of 820 patients.
- In acute neck pain, results of two trials showed a relative risk (RR) of 1.69 (95% CI 1.22-2.33) for pain improvement of LLLT versus placebo: 1.69 times more chance to improve acute neck pain with LLLT than with placebo.
- Five trials of chronic neck pain reporting categorical data showed an RR for pain improvement of 4.05 (2.74-5.98) of LLLT: 4 times more chance to improve chronic neck pain with LLLT than with placebo.
- Patients in 11 trials reporting changes in visual analogue scale had pain intensity reduced by 19.86 mm (10.04-29.68), which is a clinically important change.
- Seven trials provided follow-up data for 1-22 weeks after completion of treatment, with short-term pain relief persisting in the medium term with a reduction of 22.07 mm (17.42-26.72), which is clinically significant.
- Side-effects from LLLT were mild and not different from those of placebo.
- A distinct dose-response pattern was noted for each wavelength for which LLLT is effective within a narrow therapeutic window.
  - For 820–830 nm, mean dose per point ranged from 0·8 to 9·0 J, with irradiation times of 15–180 s. The author’s analysis suggests that the optimum mean dose per point for 820–830 nm was 5·9 J, with an irradiation time of 39·8 s.
  - For 904 nm doses, mean dose per point was 0·8–4·2 J, with irradiation times of 100–600 s. The author’s analysis suggests that the optimum mean dose per point for 904 nm was 2·2 J delivered with an irradiation time of 238 s.

Conclusion
LLLT reduces pain immediately after treatment in acute neck pain and up to 22 weeks after completion of treatment in patients with chronic neck pain.

Key message
LLLT is effective for treatment of acute and chronic neck pain in the short and medium term.

Pubmed ID | 19913903
# Shoulder Tendinitis & Impingement

## Low-Level Laser and Local Corticosteroid Injection in the Treatment of Subacromial Impingement Syndrome: A Controlled Clinical Trial

**Authors:** Kelle B, Kozanoglu E.

**Published:** Clin Rehabil. 2014 Feb 11. [Epub ahead of print]

**Date:** Feb 2014

**Place of origin:** Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Çukurova University, Adana, Turkey.

**Objective:** To investigate the effectiveness of low-level laser treatment and local corticosteroid injection in patients with subacromial impingement syndrome.

### Study design & methods

**Controlled clinical trial.**  
**Subjects:** 135 patients with subacromial impingement syndrome.  
**Methods:**  
- Local corticosteroid injection (group I) - injections were administered twice, with an interval of 10 days between each.  
- Sham laser treatment (group II) - the treatment procedure was the same as for group III, with the exception that the laser device was not turned on.  
- Low-level laser treatment (group III) - GaAs 904nm; 2J/cm² - performed 3x per week for a total of 9 sessions.  
**Outcomes:**  
- The primary outcome of the study was pain intensity (visual analog scale) during activity and at rest.  
- The secondary outcomes were, shoulder functional status and quality of life measured by the University of California at Los Angeles rating score (UCLA) and Nottingham Health Profile (NHP) scale respectively.

### Results

- Significant differences were observed between groups I and II and between groups II and III regarding pain during activity and at rest scores at all of the visits (p<0.05). Group I and III had significantly greater pain VAS reductions than group II at all time points.  
- Only for the post-treatment test, pain VAS score was significantly more improved in group I than group III. For all other time points there was no significant difference between group I and III.  
- The UCLA scores (shoulder function) were significantly changed in all three study groups at all of the visits. Improvements were significantly greater in group I and III versus group II.

### Conclusion

The effectiveness of low-level laser treatment was similar to that of local corticosteroid injection in patients with subacromial impingement syndrome. Both low-level laser treatment and corticosteroid injection were more effective than sham laser treatment.

### Key message

LLLT is equally effective to local corticosteroid injections for treatment of subacromial impingement syndrome and significantly more effective than sham laser.

**Pubmed ID:** 24519921
### LOW-LEVEL LASER THERAPY VERSUS ULTRASOUND THERAPY IN THE TREATMENT OF SUBACROMIAL IMPINGEMENT SYNDROME: A RANDOMIZED CLINICAL TRIAL.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Yavuz F, Duman I, Taskaynatan MA, Tan AK.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Published</td>
<td>J Back Musculoskelet Rehabil. 2013 Dec 17. [Epub ahead of print]</td>
</tr>
<tr>
<td>Date</td>
<td>Dec 2013</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Ankara, Turkey.</td>
</tr>
<tr>
<td>Objective</td>
<td>To compare the effectiveness of low-level laser therapy and ultrasound therapy in the treatment of subacromial impingement syndrome.</td>
</tr>
<tr>
<td>Tested products</td>
<td>Chattanooga Intelect Mobile laser</td>
</tr>
</tbody>
</table>

#### Study design & methods

**Prospective, observer-blinded, randomized clinical trial.**  
**Subjects:** 31 patients with subacromial impingement syndrome.  
**Methods:**  
- patients were randomly assigned to low-level laser therapy group (n=16) and ultrasound therapy group (n=15).  
- Study participants received 10 treatment sessions of low-level laser therapy (3J/cm², total 15J) or ultrasound therapy (1MHz, 2W/cm²) over a period of two-consecutive weeks (5 days/wk).  
**Outcomes:**  
- visual analogue pain scale (0-100mm),  
- Shoulder Pain and Disability Index (SPADI),  
- patient’s satisfactory level (VAS 1-100mm)  
- sleep interference score (0-10 points scale)  
Patients were assessed before treatment and at the 1st and 3rd months after treatment. All patients were analyzed by the intent-to-treat principle.

#### Results

- Mean reduction in VAS pain, SPADI disability and sleep interference scores from baseline to after 1 month, and 3 months of treatment was statistically significant in both groups (P< 0.05).  
- There was no significant difference in the mean change in VAS pain, SPADI disability and sleep interference scores between the two groups (P > 0.05).  
- The mean level of patient satisfaction in group 1 at the first and third months after treatment was 72.45 mm and 71.50 mm, respectively. The mean level of patient satisfaction in group 2 at the first and third months after treatment was 70.38 mm and 72.09 mm, respectively. There was no significant difference in the mean level of patient satisfaction between the two groups (p > 0.05).

#### Conclusion

- The results show that both LLLT and US therapy provide significant pain relief and functional improvement in patients with SAIS. In addition, there is no significant difference between outcomes (primary and secondary) of two physical therapy modalities.  
- LLLT may be considered as an effective alternative to ultrasound based therapy in patients with subacromial impingement syndrome especially ultrasound based therapy is contraindicated.

#### Key message

Both LLLT and US therapy provide **significant pain relief and functional improvement** in patients with SAIS.

#### Pubmed ID

24346151
### Background
The subacromial syndrome is the most common source of shoulder pain. The mainstays of conservative treatment are non-steroidal anti-inflammatory drugs and exercise therapy. Recently, low-level laser therapy (LLLT) has been popularized in the treatment of various musculoskeletal disorders.

### Objective
To evaluate the additive effects of LLLT with exercise in comparison with exercise therapy alone in treatment of the subacromial syndrome.

### Study design & methods
**Randomised, double-blind, controlled trial.**

**Subjects:** 80 patients with subacromial syndrome (rotator cuff and biceps tendinitis).

**Methods:** patients were randomly allocated into two groups.

- In group I (n = 40), patients were given laser treatment (pulsed infrared laser, wavelength 890 nm in pulsed mode) and exercise therapy for 10 sessions during a period of 2 weeks. In each treatment session, three points on the shoulder, including anterior (coracoid), posterior (glenohumeral joint) and lateral (rotator cuff tendon) were irradiated for 2 min (a total of 6 min). The energy density was 2–4J/cm² in each three points.
- In group II (n = 40), placebo laser and the same exercise therapy were given for the same period.

**Outcomes:**
- Pain with visual analogue scale (VAS)
- Shoulder range of motion (ROM) in an active and passive movement of flexion, abduction and external rotation

Patients were assessed before and after treatment.

### Results
- In both groups, significant post-treatment improvements were achieved in all parameters (P = 0.00).
- In comparison between the two groups, the laser group showed significantly greater improvements than the placebo group in all parameters(P = 0.00).

### Conclusion
**LLLT combined exercise is more effective than exercise therapy alone** in relieving pain and in improving the shoulder ROM in patients with subacromial syndrome.

### Key message
Significantly greater improvement in shoulder pain and ROM when LLLT is added to exercise therapy.

### Pubmed
# THE USE OF LOW-LEVEL LASER THERAPY (LLLT) IN THE TREATMENT OF TRIGGER POINTS THAT ARE ASSOCIATED WITH ROTATOR CUFF TENDONITIS.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Al-Shenqiti A, Oldham J.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Published</td>
<td>Proc SPIE. 2003;5287:91-101</td>
</tr>
<tr>
<td>Date</td>
<td>2003</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Univ. of Manchester, UK.</td>
</tr>
</tbody>
</table>

## Objective
To investigate the efficacy of LLLT in the treatment of trigger points (TrPs) that are associated with rotator cuff tendonitis.

## Study design & methods
**Double-blind randomized controlled trial.**

**Subjects:** 60 patients with rotator cuff tendinitis (duration between 6 wks and 18 months).

**Methods:** patients were randomly allocated to one of two groups: sham or laser therapy.

- The laser parameters used were a wavelength of 820 nm, a power output of 100 mW, a frequency of 5000 Hz (modulated) and energy density of 32 J/cm².
- The two groups received a course of 12 treatment sessions for four weeks (3 sessions per week).

**Outcomes:**
- Pain
- Functional activities measured using the Shoulder Pain and Disability Index (SPADI)
- Pressure pain threshold (PPT)
- Range of motion (ROM)

Outcomes were assessed pre and post treatment, with a 3-month follow-up assessment.

## Results
- Significant improvements in pain (p < 0.001) were observed for the laser group (6 cm median improvement on a 10 cm VAS) compared to the sham group (2 cm median improvement) immediately post treatment.
- The improvements in the laser group continued post treatment with a 7 cm median improvement observed at three month follow-up. Continued improvement was not observed in the sham group.
- Similar between group differences were observed for ROM (p < 0.01), functional activities (p ≤ 0.001) and PPT (p ≤ 0.05).

## Conclusion
The findings of the current study suggest that LLLT is effective in treating patients with TrPs associated with rotator cuff tendonitis, when using the parameters described. The difference with sham therapy was highly significant after treatment and at follow-up.

## Key message
**Significant improvement of pain, ROM and function** with LLLT trigger point treatment in patients with rotator cuff tendinitis.

## Pubmed
### Effects of Low-Level Laser and Plyometric Exercises in the Treatment of Lateral Epicondylitis

**Authors**  
Stergioulas A.

**Published**  

**Date**  
2007

**Place of origin**  
Faculty of Human Movement & Quality of Life, Peloponnese University, Sparta, Greece.

**Background**  
The use of LLLT has been recommended for the management of tennis elbow with contradictory results. Also, plyometric exercises was recommended for the treatment of the tendinopathy.

**Objective**  
To compare the effectiveness of a protocol of combination of laser with plyometric exercises and a protocol of placebo laser with the same program, in the treatment of tennis elbow.

**Study design & methods**  
**Randomised placebo-controlled stud.**

**Subjects**: 50 patients with tennis elbow.

**Methods**: patients were randomised into two groups.
- Group A (n = 25) was treated with a 904 Ga-As laser CW, frequency 50 Hz, intensity 40 mW and energy density 2.4 J/cm², plus plyometric exercises
- Group B (n = 25) that received placebo laser plus the same plyometric exercises.

During 8 weeks of treatment, the patients of the two groups received 12 sessions of laser or placebo, two sessions per week (weeks 1-4) and one session per week (weeks 5-8).

**Outcomes**:
- Pain at rest, at palpation on the lateral epicondyle, during resisted wrist extension, middle finger test, and strength testing was evaluated using Visual Analogue Scales.
- Grip strength, range of motion and weight test.
- Parameters were determined before the treatment, at the end of the 8 week course of treatment (week 8), and 8 weeks after the end of treatment.

**Results**  
Relative to the placebo group B, the active laser group A had:
- a significant decrease of pain at rest at the end of 8 wks of the treatment (p < 0.005) and at the end of following up period (p < 0.05),
- a significant decrease in pain at palpation and pain on isometric testing at 8 wks of treatment (p < 0.05), and at 8 wks follow-up (p < 0.001),
- a significant decrease in pain during middle finger test at the end of 8 wks of treatment (p < 0.01), and at the end of the follow-up period (p < 0.05),
- a significant decrease of pain during grip strength testing at 8 wks of treatment (p < 0.05), and at 8 wks follow-up (p < 0.001),
- a significant increase in the wrist range of motion at 8 wks follow-up (p < 0.01),
- an increase in grip strength at 8 wks of treatment (p<0.05) and at 8 wks follow-up (p<0.01),
- signif increase in weight-test at 8 wks of treatment (p<0.05) and at 8 wks follow-up (p<0.005)

**Conclusion**  
The results suggested that the combination of laser with plyometric exercises was more effective treatment than placebo laser with the same exercises at the end of the treatment as well as at the follow-up.

**Key message**  
**Significant pain relief and strength gains** when laser therapy is added to plyometric exercises in tennis elbow.

**Pubmed ID**  
17603862
EFFECTS OF 904-NM LOW-LEVEL LASER THERAPY IN THE MANAGEMENT OF LATERAL EPICONDYLITIS: A RANDOMIZED CONTROLLED TRIAL

<table>
<thead>
<tr>
<th>Authors</th>
<th>Lam LK, Cheing GL.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>2007</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Physiotherapy Department, Queen Elizabeth Hospital, Hong Kong.</td>
</tr>
</tbody>
</table>

**Background**
Lateral epicondylitis is characterized by pain and tenderness over the lateral elbow, which may also result in reduction in grip strength and impairment in physical function. LLLT has been shown effective in its therapeutic effects in tissue healing and pain control.

**Objective**
To evaluate the effectiveness of 904-nm low-level laser therapy (LLLT) in the management of lateral epicondylitis.

**Study design & methods**
Randomized controlled trial.
*Subjects:* 39 patients with lateral epicondylitis
*Methods:* patients were randomly assigned to receive either active laser with an energy dose of 0.275 J per tender point (laser group) or sham irradiation (placebo group) for a total of 9 sessions.
*Outcomes:*
- mechanical pain threshold,
- maximum grip strength,
- level of pain at maximum grip strength as measured by the Visual Analogue Scale (VAS)
- subjective rating of physical function with Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire.

The outcome measures were assessed in the following time intervals: session 1 (baseline); session 5; session 9 (last session); and 3-wk follow-up session.

**Results**
- From session 5 onward through the 3-wk FU session, there was a significantly greater improvement in mechanical pain threshold in the laser group compared with the placebo group (p < 0.0125).
- From session 9 onwards, there was also a significantly greater improvement in the score of VAS in the laser group compared with the placebo group (p < 0.0125).
- By the 3-wk FU session, the laser group demonstrated significantly greater improvement in maximum grip strength and score of DASH (Main Section) than did the placebo group (p < 0.0125).

**Conclusion**
Significantly greater improvements were shown in pain, grip strength and subjective rating of physical function with the laser group than with the placebo group.

**Key message**
LLLT in addition to exercise is effective in relieving pain, increasing grip strength, and improving function in patients with lateral epicondylitis, and the effect can be maintained for at least 3 weeks.

**Pubmed ID** 17508839
# Placebo-controlled investigation of low-level laser therapy to treat carpal tunnel syndrome.

**Authors:** Lazovic M, Ilic-Stojanovic O, Kocic M, Zivkovic V, Hrkovic M, Radosavljevic N.

**Published:** Photomed Laser Surg. 2014 Jun;32(6):336-44.

**Date:** Jun 2014

**Place of origin:** Institute for Rehabilitation, Belgrade, Serbia, Medical Faculty Belgrade, Serbia.

**Objective:** To investigate the short-term efficacy of low-level laser therapy (LLLT) in patients with mild to moderate carpal tunnel syndrome (CTS), lasting for <1 year.

## Study design & methods

**Double-blinded randomised placebo-controlled study.**

**Subjects:** 79 patients with CTS (<1 year, mild to moderate CTS based on NCSs)

**Methods:** subjects were randomly divided in two treatment groups:

- **Experimental group (EG) = active laser group (40 patients).** A GaAlAs diode laser [780 nm, 30 mW continuous wave (CW), 0.785 cm², 38.2 mW/cm²] was applied in contact with four points perpendicularly to the skin over the carpal tunnel area for 90 sec per point (2.7 J/point, 3.4 J/cm²).
- **Control group (CG) = placebo (sham) laser group (39 patients).**

Both groups were treated 5x/week, once a day over 2 weeks, followed by 10 treatments every other day for 3 weeks, that is, for a total of 20 treatments.

**Outcomes:**

- Visual analogue scale (VAS) pain rating
- Tinel's sign (carpal tunnel provocative maneuver)
- Median nerve conduction studies (NCSs)

Outcomes were evaluated before, and 3 weeks after the last LLLT treatment.

## Results

- There were no significant between-group differences in pain intensity based on the VAS scores, Tinel’s sign, and NCS parameters before treatment (p>0.05).
- After treatment, the EG showed a significantly lower level of pain than did the CG (p=0.001).
- Within the EG, significant reduction of pain was observed after treatment, irrespective of the classifications of degree of pain prior to LLLT (p<0.001), whereas there was no significant reduction of pain within the CG (p>0.05).
- At 3 weeks after the last LLLT treatment, there were significantly fewer cases with a positive Tinel’s sign in the EG, than in the CG (p<0.05).
- After treatment, there was an increase in the median sensory nerve conduction velocity (SNCV) in both groups. This change was significant within the EG (p<0.001), but not in CG (p>0.05).
- After treatment the median SNCV was significantly higher in the EG than in the CG (p>0.05).
- Within the EG, median motor distal latency (MDL) decreased at the end of treatment (p<0.01), while there was no decrease in the CG.
- The difference in mean MDL changes between groups was not significant (p>0.05).

## Conclusion

LLLT produces statistically significant short-term effects in CTS patients in comparison with a placebo group. The results support the use of LLLT in CTS, especially if the LLLT is applied in the earlier stages of CTS, and with mild to moderate cases.

**Key message:** Significant reduction in pain and improvement of nerve conduction parameters with LLLT in CTS.

**Pubmed:** 24905929
### Background
Carpal tunnel syndrome (CTS) is the most common neuropathy that can be diagnosed with confidence by the nerve conduction study (NCS). One of the recent treatments of CTS is the application of low power laser (LPL) therapy.

### Objective
To evaluate the effects of LPL irradiation through nerve conduction study and clinical signs and symptoms.

### Study design & methods
Randomised placebo-controlled study.

**Subjects:** 80 patients with diagnosis of CTS based on both clinical examination and electromyographic (EMG) findings.

**Methods:** patients were randomly assigned into two groups.
- Test group (group A) underwent laser therapy (9-11 joules/cm²) over the carpal tunnel area.
- Control group (group B) received sham laser therapy.
- All patients underwent 15 sessions of irradiation (5 times per week)

**Outcomes:** Pain, hand grip strength, median proximal sensory and motor latencies, transcarpal median sensory nerve conduction (SNCV) were recorded. Pain was evaluated by Visual Analog Scale (VAS; day-night). Hand grip was measured by Jamar dynometer.

Outcomes were recorded at baseline and after 15 sessions of irradiation in both groups.

### Results
- There was a significant improvement in clinical symptoms and hand grip in group A (p < 0.001).
- Proximal median sensory latency, distal median motor latency and median sensory latencies were significantly decreased (p < 0.001). Transcarpal median SNCV increased significantly after laser irradiation (p < 0.001).
- There were no significant changes in group B except changes in clinical symptoms (p < 0.001).

### Conclusion
Laser therapy as a new conservative treatment is effective in treating CTS paresthesia and numbness and improves the subjects' power of hand grip and electrophysiological parameters.

### Key message
**Significant improvement of clinical symptoms and nerve conduction after laser treatment over the carpal tunnel area.**

### Pubmed
18754533
## Low Level Laser Therapy in Primary Raynaud’s Phenomenon—Results of a Placebo Controlled, Double Blind Intervention Study.

<table>
<thead>
<tr>
<th><strong>Authors</strong></th>
<th>Hirschl M, Katzenschlager R, Francesconi C, Kundi M.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Published</strong></td>
<td>J Rheumatol. 2004 Dec;31(12):2408-12.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>2004</td>
</tr>
<tr>
<td><strong>Place of origin</strong></td>
<td>Department of Angiology, Hanusch Hospital, Vienna, Austria.</td>
</tr>
</tbody>
</table>

### Background

Objective: To assess the efficacy of low level laser therapy in patients with primary Raynaud's phenomenon and predict the success of laser therapy by clinical characteristics.

### Study design & methods

**Double blind randomised controlled cross-over study.**

**Subjects:** 48 patients with primary Raynaud's phenomenon.

**Methods:**

- Patients were randomised to receive laser treatment (2J/cm²) or sham laser treatment.
- The irradiated area was the fingers and back of the hands.
- Duration of exposure was 30 to 40 minutes.
- Each therapeutic sequence had a duration of 3 weeks with 5 sessions/week. After this sequence the device was changed and another 3-week sequence was started.
- The initial device was randomly selected. Neither the investigators nor the clinical staff or patients knew which of the devices labeled A and B were the laser or the sham exposure device.

**Outcomes:**

- Primary endpoint was the average intensity of attacks.
- Secondary endpoints were average number of attacks and thermography results.
- Age, sex, duration of symptoms, age at onset of symptoms, evoking conditions other than cold, maximum temperature drop after cold provocation, and rewarming time after cold provocation were tested as potential predictors.

### Results

- Number of attacks and their intensity were significantly reduced during laser therapy compared to sham treatment.
- Thermographic parameters did not reach statistical significance.
- Analysis of factors that may allow prediction of the effectiveness of LLLT revealed that patients with cold as the only trigger, and patients with more pronounced temperature decrease after cold provocation and/or shorter rewarming time showed a more favorable response to LLLT.

### Conclusion

Low level laser therapy reduces frequency and severity of Raynaud attacks. The effect is most pronounced in patients with signs of decreased threshold for vasospasm and less effective in patients with delayed hyperemia.

### Key message

Low level laser therapy reduces frequency and severity of Raynaud attacks.

### Pubmed ID

15570642
# LOW LEVEL LASER THERAPY FOR TREATMENT OF PRIMARY AND SECONDARY RAYNAUD’S PHENOMENON.

<table>
<thead>
<tr>
<th>Authors</th>
<th>al-Awami M, Schillinger M, Maca T, Pollanz S, Minar E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>2004</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Department of Medical Angiology, University of Vienna, Austria.</td>
</tr>
</tbody>
</table>

**Background**
The authors recently performed a pilot study which suggested that clinical and thermographic improvements occurred in patients with primary and secondary Raynaud’s phenomenon (RP) following treatment with low level laser irradiation (LLLT).

**Objective**
To demonstrate the efficacy of low level laser irradiation treatment in patients with primary or secondary Raynaud Phenomenon.

## Study design & methods

**Double blind randomised placebo-controlled study.**

**Subjects:** 47 patients suffering from primary or secondary RP.

**Methods:** patients were randomly assigned in a double-blind manner to receive either 10 sessions of distant LLLT (n=24) or placebo irradiation (n=23) during winter months.

- Patients in the laser group received 10 sessions of low level laser distant irradiation treatment by means of a 400 mW, 670 nm continuous wave diode laser;
- the exposure time was 1000 sec per session, intensity 400 mW, power density 2.2 mW/cm², energy density 2.2J/cm², applied to the palms and fingers of both hands simultaneously.

**Outcomes:**

- The attack frequency of RP was measured by a diary count;
- Severity of RP was assessed by means of visual analogue scale.
- Response to cold challenge test before and after LLL or placebo treatment was assessed by infrared thermography.

Frequency and severity were assessed at baseline and at 6 weeks and 3 months after treatment; cold challenge test was performed at baseline and 6 weeks after treatment.

## Results

- Overall a significant reduction of the frequency as well as the severity of RP in patients with either LLLT (frequency p < 0.0001, severity p < 0.0001) or placebo treatment (frequency p < 0.0001, severity p = 0.02) was found, but patients in the LLLT group exhibited a statistically more significant improvement of the frequency and the severity of RP at 6 weeks and 3 months.
- Thermographic response to cold challenge improved only in patients treated with LLLT but not in those treated with placebo.

## Conclusion

Low level laser irradiation significantly lowers the frequency and severity of Raynaud’s attacks in patients with primary and secondary RP. Since this therapeutic modality is a safe and non-invasive treatment, it might be considered as an alternative to existing therapeutic regimes.

## Key message

Significantly more improvement of symptoms with low level laser therapy versus placebo in patients with RP.

**Pubmed ID** 15061044
## LOW-LEVEL LASER THERAPY FACILITATES SUPERFICIAL WOUND HEALING IN HUMANS: A TRIPLE-BLIND, SHAM-CONTROLLED STUDY

### Authors
Hopkins, McLoda, Seegmiller, Baxter

### Published

### Date
2004

### Place of origin
Utah, Illinois, Ohio - USA

### Background
Low-level laser therapy (LLLT) has been promoted for its beneficial effects on tissue healing and pain relief. However, according to the results of in vivo studies, the effectiveness of this modality varies.

### Objective
To assess the putative effects of LLLT on healing using an experimental wound model.

### Tested products
46-diode cluster head (Omega Excel, Omega Laser Systems, Crawley, UK). The cluster head (surface area = 19.6 cm²) has a single laser (820 nm) in the center surrounded by concentric rings of superluminous diodes of varying wavelengths. The average energy density of the treatment was 8 J/cm² (treatment time = 2 minutes, 5 seconds; pulse rate = 700 Hz).

### Study design & methods
Randomized, triple-blind, placebo-controlled study with 2 within-subjects factors (wound and time) and 1 between-subjects factor (group). Data were collected in the laboratory setting.

**Subjects:** 22 healthy subjects.

**Methods:**
- Subjects were randomly assigned to active or sham laser group.
- Two standardized 1.27-cm² abrasions were induced on the anterior forearm of all patients.
- After wound cleaning, standardized digital photos were recorded.
- Each subject then received LLLT (8 J/cm²; treatment time = 2 minutes, 5 seconds; pulse rate = 700 Hz) to 1 of the 2 randomly chosen wounds from either a laser or a sham 46-diode cluster head.
- Subjects reported back to the laboratory on days 2 to 10 to be photographed and receive LLLT and on day 20 to be photographed.

**Outcomes:**
- Wound contraction (area),
- Color changes (chromatic red)
- Luminance.

### Results
- **Wound contraction:** at days 6, 8, and 10, follow-up testing revealed that the laser group had smaller wounds than the sham group for both the treated and the untreated wounds (P < .05). The greatest difference between groups in wound contraction was seen on treatment day 6, when the laser-treated wounds of the study group demonstrated 153% greater wound contraction than the treated wounds of the sham group.
- No significant changes were detected for chromatic red or luminance.

### Conclusion
The LLLT resulted in enhanced healing as measured by wound contraction. It also facilitates wound contraction of untreated wounds on the same arm, suggesting an indirect effect on surrounding tissues.

### Key message
LLLT is an effective treatment for enhancing wound contraction of partial-thickness wounds.

### Pubmed ID
15496990
**TISSUE REPAIR**

<table>
<thead>
<tr>
<th>Low-level laser therapy on tissue repair of partially injured achilles tendon in rats.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Authors</strong></td>
</tr>
<tr>
<td><strong>Date</strong></td>
</tr>
<tr>
<td><strong>Place of origin</strong></td>
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<tr>
<td><strong>Background</strong></td>
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<tr>
<td><strong>Objective</strong></td>
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<table>
<thead>
<tr>
<th>Tested products</th>
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</thead>
<tbody>
<tr>
<td><strong>Study design &amp; methods</strong></td>
</tr>
<tr>
<td><strong>Subjects</strong>: 65 male Wistar rats.</td>
</tr>
<tr>
<td><strong>Methods</strong>: the rats were distributed into seven groups:</td>
</tr>
<tr>
<td>- LASER 1, 3, and 7: the rat's Achilles tendons were partially injured and submitted to treatment for 1, 3, or 7 days, respectively. The 780 nm LLLT (GaAlAs) was applied once a day, with 70 mW of mean power, fluence of 17.5 J/cm² for 10 sec. The contact technique and continuous emission were used in all irradiations.</td>
</tr>
<tr>
<td>- Sham group 1, 3, and 7 for each of LASER group: same injury, but the LLLT was only simulated)</td>
</tr>
<tr>
<td>- 5 remaining animals were allocated to the control group: no procedures were performed.</td>
</tr>
<tr>
<td><strong>Outcomes</strong>: after the rats were euthanized, the tendons were surgically removed and assessed by birefringence technique (collagen alignment) and picrosirius red (collagen I and III).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The collagen composition (median) was significantly different (p&lt;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.</td>
</tr>
<tr>
<td>- Sham versus LASER analysis did not show differences (p&gt;0.05) for collagen alignment.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LLLT stimulated collagen I proliferation</strong>, improving the injured Achilles tendons' healing process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key message</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LLLT stimulated the healing process of injured Achilles tendons, and is an adequate tool to enhance and optimize their repair.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PubMed</th>
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<tbody>
<tr>
<td>24831690</td>
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</table>
# THERAPEUTIC OUTCOMES OF LOW-LEVEL LASER THERAPY FOR CLOSED BONE FRACTURE IN THE HUMAN WRIST AND HAND.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Chang WD, Wu JH, Wang HJ, Jiang JA.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Apr 2014</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Department of Sports Medicine, China Medical University, Taichung City, Taiwan (R.O.C)</td>
</tr>
<tr>
<td>Background</td>
<td>Animal research has confirmed that LLLT increases osteocyte quantity; however, little research has been conducted to determine the effect of LLLT on the treatment of human bone fractures.</td>
</tr>
<tr>
<td>Objective</td>
<td>To investigate the therapeutic outcomes of low-level laser therapy (LLLT) on closed bone fractures (CBFs) in the wrist and hand.</td>
</tr>
</tbody>
</table>

**Study design & methods**

**Double blind randomised controlled study.**

**Subjects:** 50 patients with CBFs in the wrist and hand, who had not received surgical treatment.

**Methods:** patients were randomly assigned to two groups.

- The laser group underwent a treatment program in which 830 nm LLLT (average power 60 mW, peak power 8 W, 10 Hz, 600 sec, and 9.7 J/cm² per fracture site) was administered 5 times per week for 2 weeks.
- Participants in a placebo group received sham laser treatment.

**Outcomes:**

- Pain (VAS)
- Functional disability (Quick DASH)
- Grip strength
- Radiographic parameters of bone healing

Patients were evaluated before and after treatment and at a 2-week follow-up.

**Results**

- After treatment and at the follow-up, the laser group exhibited significant changes in all of the parameters compared with the baseline (p<0.05).
- The results of comparing the two groups after treatment and at the follow-up indicated significant between-group differences among all of the parameters (p<0.05).

**Conclusion**

LLLT can relieve pain and improve the healing process of CBFs in the human wrist and hand.

**Key message**

**Significant improvement of pain, function and bone healing** with LLLT versus placebo.

**Pubmed ID**

24649935
# EFFECT OF LOW-LEVEL LASER THERAPY IN PATIENTS WITH CHRONIC KNEE OSTEOARTHRITIS: A SINGLE-BLINDED RANDOMIZED CLINICAL STUDY.

## Authors
Alghadir A, Omar MT, Al-Askar AB, Al-Muteri NK.

## Published

## Date
Mar 2014

## Place of origin
Department of Rehabilitation Health Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia.

## Objective
To investigate the effect of low-level laser therapy (LLLT) on pain relief and functional performance in patients with chronic knee osteoarthritis (OA).

## Study design & methods
**Single-blinded randomized placebo-controlled clinical trial.**

**Subjects:** 40 patients with knee OA.

**Methods:** patients were randomly assigned into
- **Active laser group** (n = 20). The LLLT device used was a Ga-As diode laser with a power output of 50mW, a wavelength of 850 nm, and a diameter beam of 1 mm. 8 points were irradiated and received dosage of 6 J/point for 60 s, with a total dosage of 48 J/cm² in each session.
- **Placebo laser group** (n = 20). The placebo group was identical but treated without emission of energy.
- LLLT was applied 2 times per week over the period of 4 weeks.

**Outcomes:** measurements were collected at baseline and post-intervention:
- Pain intensity at rest and at movement on visual analog scale
- Knee function using Western Ontario McMaster Universities Osteoarthritis Index scale
- Ambulation duration.

## Results
- Significant improvements in all assessment parameters in both groups compared to baseline.
- Active laser group showed significantly greater improvements in pain intensity at rest and movement, knee function, and ambulation duration when compared with the placebo group.
  - The mean percentages of reduction in pain intensity at rest and during movement were significantly greater in the active laser (40.39%) compared to the placebo laser group (20.15%).
  - The mean percentage of reduction in WOMAC pain score was significantly greater for active laser (66.96 %) compared to placebo laser (41.67 %).
  - The mean percentage of reduction in WOMAC function score was significantly greater for active laser (64.89 %) compared to placebo laser (40.70 %).
  - The percentage reduction in WOMAC stiffness score was significantly greater for active laser (74.25 %) compared to placebo laser (58.74 %).
  - The mean percentage of reduction in walking time was significantly higher in the laser group (14.59 %) when compared with placebo laser (7.6 %) post-intervention.

## Conclusion
The active laser group had a significant improvement in respect to all variables such as pain, ambulation duration, and functional activities in comparison to the placebo group immediately after intervention. Therefore, LLLT seemed to be an effective modality for short-term pain relief and function improvement in patients with chronic knee OA.

## Key message
**Significant improvement of pain and function** with LLLT compared to placebo in patients with knee OA.

## Pubmed ID
23912778

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Date</td>
<td>Jun 2012</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Sao Paulo University, Sao Paulo, Brazil</td>
</tr>
</tbody>
</table>

**Background**

The European League Against Rheumatism (EULAR) suggests that low level laser therapy and exercises should be considered when planning optimal treatment for osteoarthritis. Discrepancies in the literature regarding the clinical efficacy may be associated with the parameters (wave length, dose, time, area, technique) used in treatments by different studies.

**Objective**

To estimate the effects of low level laser therapy in combination with a programme of exercises on pain, functionality, range of motion, muscular strength and quality of life in patients with osteoarthritis of the knee.

**Study design & methods**

Randomized double-blind placebo-controlled trial with sequential allocation of patients to different treatment groups.

**Subjects:** 40 participants with knee osteoarthritis, 2-4 osteoarthritis degree, aged between 50 and 75 years and both genders.

**Methods:** participants were randomized into one of two groups:

- the laser group (low level laser therapy dose of 6J/cm² and exercises), n=20
- placebo group (placebo laser and exercises), n=20.

the subjects received 3 treatment sessions per week during 3 weeks.

**Outcomes:**

- Pain was assessed using a visual analogue scale (VAS),
- Functionality using the Lequesne questionnaire,
- Range of motion with a universal goniometer,
- Muscular strength using a dynamometer,
- Activity using the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) questionnaire.

Assessments were done at three time points:

- T1 baseline,
- T2 after the end of laser therapy (three weeks)
- T3 after the end of the exercises (11 weeks).

**Results**

- Participants in the laser group had significant improvement, relative to baseline, on pain (P = 0.001), range of motion (P = 0.01), functionality (P = 0.001) and activity (P < 0.001).
- No significant improvement was seen in the placebo group.

**Conclusion**

The application of LLLT three times per week during three weeks, in combination with exercises, produced improvement of pain, function and activity in knee OA patients.

**Key message**

The combination of LLLT and exercise can improve pain, function and activities in subjects with knee osteoarthritis.

**Pubmed ID** 22169831
THE EFFECT OF LOW-LEVEL LASER IN KNEE OSTEOARTHRITIS: A DOUBLE-BLIND, RANDOMIZED, PLACEBO-CONTROLLED TRIAL.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Hegedus B, Viharos L, Gervain M, Gálfi M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Aug 2009</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Physio- and Balneotherapy Center, Orosháza-Gyopáros, Hungary.</td>
</tr>
<tr>
<td>Background</td>
<td>Low-level laser therapy (LLLT) is thought to have an analgesic effect as well as a biomodulatory effect on microcirculation.</td>
</tr>
<tr>
<td>Objective</td>
<td>To examine the pain-relieving effect of LLLT and possible microcirculatory changes measured by thermography in patients with knee osteoarthritis (KOA).</td>
</tr>
</tbody>
</table>

**Study design & methods**

Double-blind, randomized, placebo-controlled trial.

**Subjects**: 27 patients with mild or moderate knee OA.

**Methods**: patients were randomly assigned to receive active (n=18) or placebo (n=9) laser treatment.

Active laser treatment was applied with a GaAlAs laser, wave length 830 nm, power 50 mW, continuous mode, energy 6J/cm², 8 irradiation points, total energy dose per treatment session 48J/cm².

**Outcomes**:
- thermography was performed (bilateral comparative thermograph by AGA infrared camera)
- joint flexion
- joint circumference
- pressure sensitivity
- pain on visual analogue scale

Patients were examined at before treatment (BT) and immediately, 2 weeks, and 2 months after completing the therapy (AT).

**Results**

- In the group treated with active LLLT, a significant improvement was found for pain, knee flexion and pressure sensitivity (p<0.05) while this was not found in the placebo group.

<table>
<thead>
<tr>
<th>Active laser group</th>
<th>BT</th>
<th>imm. AT</th>
<th>2 wk AT</th>
<th>2 mo AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain VAS</td>
<td>5.75</td>
<td>1.71</td>
<td>1.05</td>
<td>1.18</td>
</tr>
<tr>
<td>Pressure sensitivity</td>
<td>2.33</td>
<td>0.83</td>
<td>0.33</td>
<td>0.77</td>
</tr>
<tr>
<td>Circumference</td>
<td>40.45cm</td>
<td>39.61cm</td>
<td>39.58cm</td>
<td>39.86cm</td>
</tr>
<tr>
<td>Flexion</td>
<td>105.83°</td>
<td>122.27°</td>
<td>124.33°</td>
<td>122.94°</td>
</tr>
</tbody>
</table>

- Thermographic measurements showed at least a 0.5°C increase in temperature and thus an improvement in circulation compared to the initial values. In the placebo group, these changes did not occur.

**Conclusion**

The study results show that LLLT reduces pain in knee OA and improves microcirculation in the irradiated area.

**Key message**

*Improvement of pain, ROM and microcirculation* with LLLT in knee OA.

**Pubmed ID**

19530911
## Low-Level Laser Therapy in Meniscal Pathology: A Double-Blinded Placebo-Controlled Trial

**Authors**
Malliaropoulos N, Kiritsi O, Tsitas K, Christodoulou D, Akritidou A, Del Buono A, Maffulli N.

**Published**

**Date**
Oct 2012

**Place of origin**
National Track & Field Centre, Sports Injury Clinic, Sports Medicine Clinic of S.E.G.A.S., Thessaloniki, Greece

### Background

#### Objective
To assess the effectiveness of the application of LLLT in patients with knee pain related to meniscal pathology.

#### Tested products
GaAs laser - wavelength 904 nm

### Study design & methods

**Randomized, double-blinded, placebo-controlled study.**

**Subjects:** 64 patients with meniscal pathology, including only symptomatic patients with tiny focus of grade 3 attenuation (seen only on 0.7 thickness sequences) or intrasubstance tears with spot of grade 3 signal intensity approaching the articular surface.

**Methods:** patients were randomly assigned to receive LLLT (n=32) twice per week for the first 3 weeks and once per week for the next 3 weeks (giving a total of nine sessions). The control group (n=32) received sham treatment.

LLLT dosage: 2.52J/cm², total 100.8J per knee per session. pulsed mode 700Hz & 2400Hz.

**Outcomes:**
- **Subjective knee pain** was assessed at baseline and after either therapy using a subjective-based 100-mm visual analog scale (VAS) ranging from 0 (no pain) to 100 (maximal pain).
- Participants were also asked to complete the Lysholm Knee Scoring System, a knee-specific questionnaire evaluating pain, function, and swelling of the knee.

### Results

- **VAS pain score improved 65% after LLLT treatment** and improvement was maintained at 6m and 1yr follow-up (p<0.0001).
- In control group pain VAS score improved with 22% after treatment, but this improvement was not maintained at follow-up.
- **Lysholm knee score improved with 7% (p<0.05) after LLLT treatment** and improvement was maintained at 6m and 1yr follow-up.
- Lysholm knee score did not improve in the control group.

### Conclusion
Treatment with LLLT was associated with a **significant decrease of symptoms compared to the placebo group:** it should be considered in patients with meniscal tears who do not wish to undergo surgery.

**Key message**
Significant improvement of symptoms with LLLT treatment compared to placebo. LLLT is a **potential useful non-surgical treatment option for patients with meniscal tears.**

**Pubmed id**
23093133
## ANKLE SPRAIN

### LOW-LEVEL LASER TREATMENT CAN REDUCE EDEMA IN SECOND DEGREE ANKLE SPRAINS.

**Authors**  
Stergioulas A.

**Published**  

**Date**  
2004

**Place of origin**  
Faculty of Human Motion, University of Peloponnese, Attica, Greece.

### Background

**Objective**  
To compare three therapeutic protocols in treating edema in second degree ankle sprains that did not require immobilization with a splint, under placebo-controlled conditions.

### Study design & methods

**Double blind randomised controlled study.**

**Subjects:** 47 soccer players with second degree ankle sprains.

**Methods:** subjects were divided into the following groups:

- the first group (n = 16) was treated with the conventional initial treatment (RICE, rest, ice, compression, elevation),
- the second group (n = 16) was treated with the RICE method plus placebo laser
- the third group (n = 15) was treated with the RICE method plus an 820-nm GaAlAs diode laser with a radiant power output of 40 mW at 16 Hz, energy density 7.5 J/cm²

**Outcomes:** the volume of the edema was measured before the treatment, and 24, 48, and 72 h later.

### Results

- The group treated with the RICE and an 820-nm GaAlAs diode laser presented a statistically significant reduction in the volume of the edema after 24 h (40.3 +/- 2.4 mL, p < 0.01), 48 h (56.4 +/- 3.1 mL, p < 0.002), and 72 h (65.1 +/- 4.4 mL, p < 0.001).
- In the other groups the change was not significant.

### Conclusion

After a second-degree ankle sprain, treatment with the traditional RICE modality combined with an 820-nm GaAlAs diode laser with a radiant power output of 40 mW at 16 Hz continuous wave, produces better results than the RICE plus placebo laser GaA1As as well as the RICE-only protocol.

### Key message

**Better edema resolution** after a 2nd degree ankle sprain when LLLT is added to the RICE regimen.

**Pubmed ID**  
15165387
**ACHILLES TENDINOPATHY**

**EFFECTS OF LOW-LEVEL LASER THERAPY AND ECCENTRIC EXERCISES IN THE TREATMENT OF RECREATIONAL ATHLETES WITH CHRONIC ACHILLES TENDINOPATHY.**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Stergioulas A, Stergioula M, Aarskog R, Lopes-Martins RA, Bjordal JM.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>2008</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Institute of Physical Therapy, Bergen University College, Bergen, Norway.</td>
</tr>
</tbody>
</table>

**Background**

Eccentric exercises (EEs) are recommended for the treatment of Achilles tendinopathy, but the clinical effect from EE has a slow onset.

**Objective**

To investigate if the addition of low-level laser therapy (LLLT) to eccentric exercises may cause more rapid clinical improvement in chronic Achilles tendinopathy.

**Study design & methods**

*Randomized controlled trial; Level of evidence, 1.*

**Subjects:** 52 recreational athletes with chronic Achilles tendinopathy symptoms.

**Methods:**

- Subjects were randomized to groups receiving either EE + LLLT or EE + placebo LLLT over 8 weeks in a blinded manner.
- Low-level laser therapy (GaAlAs wavelength 820 nm) was administered in 12 sessions by irradiating 6 points along the Achilles tendon with a power density of 60 mW/cm², energy density 1.8 J/cm² and a total dose of 5.4 J per session.

**Outcomes:**

- Primary outcome: pain intensity during physical activity on the 100-mm visual analog scale.
- Secondary outcomes: morning stiffness, active dorsiflexion, palpation tenderness, and crepitation

**Results**

- There were no significant differences in baseline values for all outcomes between the groups.
- Significantly lower pain VAS score in the LLLT group than in the placebo LLLT group, with 53.6 mm versus 71.5 mm (P = .0003) at 4 weeks, 37.3 mm versus 62.8 mm (P = .0002) at 8 weeks, and 33.0 mm versus 53.0 mm (P = .007) at 12 weeks after randomization.
- The secondary outcomes were significantly better (P < .05) in the laser group than in the placebo groups at 4, 8, and 12 weeks after randomization.

**Conclusion**

Low-level laser therapy, with the parameters used in this study, accelerates clinical recovery from chronic Achilles tendinopathy when added to an EE regimen. For the LLLT group, the results at 4 weeks were similar to the placebo LLLT group results after 12 weeks.

**Key message**

Faster clinical recovery from chronic Achilles tendinopathy when LLLT is added to an eccentric training program.

**Pubmed ID** 18272794
# EFFICACY OF LOW LEVEL LASER THERAPY ON WOUND HEALING IN PATIENTS WITH CHRONIC DIABETIC FOOT ULCERS: A RANDOMISED CONTROL TRIAL.

**Authors**  
Kajagar BM, Godhi AS, Pandit A, Khatri S.

**Published**  

**Date**  
Oct 2012

**Place of origin**  
Department of Surgery, Jawaharlal Nehru Medical College, Nehru Nagar, Belgaum, Karnataka India.

**Background**  
Foot ulcers are serious complications of Diabetes Mellitus (DM) and are known to be resistant to conventional treatment. They may herald severe complications if not treated wisely.

**Objective**  
To evaluate the efficacy of Low Level Laser Therapy (LLLT) in diabetic ulcer healing dynamics.

**Study design & methods**  
Randomized Control Study.

**Subjects**: 68 patients with Type 2 DM having Meggitt-Wagner Grade I foot ulcers of at least more than 4 weeks duration, less than 6 × 6 cm² with negative culture.

**Methods**: patients were randomized into two groups of 34 each.

- Patients in study group received LLLT with conventional therapy. LLLT (2-4J/cm², 50mW) was applied daily for 15 days. The ulcer floor and edge were irradiated.
- Patients in control group were treated with conventional therapy (dressings and debridement) alone.

**Outcome**: healing or percentage reduction in ulcer area over a period of 15 days after commencement of treatment was recorded.

**Results**

- There was no significant difference between control and study group with respect to mean FBS (fasting blood sugar) and HbA1c (glycosylated haemoglobin) levels (p > 0.05), suggesting no biochemical differences between two groups.
- Initial ulcer area was 2608.03 mm² in study group and 2747.17 mm² in control group (p = 0.361).
- Final ulcer area was 1564.79 mm² in study group and 2424.75 mm² in control group (p = 0.218).
- Percentage ulcer area reduction was 40% in study group and 11.7% in control group (p < 0.001).

**Conclusion**

The wounds in subjects treated with LLLT contracted significantly more than the wounds in the nontreated group.

Low Level Laser Therapy is beneficial as an adjunct to conventional therapy (dressings and debridement) in the treatment of diabetic foot ulcers (DFU).

**Key message**

Significantly greater ulcer area reduction in subjects treated with LLLT than in the nontreated group, which indicates that LLLT is an effective modality to facilitate wound contraction in patients suffering from diabetes and can be used as an adjunct to conventional mode of treatment for healing of diabetic wounds.

**Pubmed ID**  
24082586
# Low-Intensity Laser Irradiation Improves Skin Circulation in Patients with Diabetic Microangiopathy

**Authors**  Schindl A, Schindl M, Schön H, Knobler R, Havelec L, Schindl L.

**Published**  Diabetes Care. 1998 Apr;21(4):580-4.

**Date**  1998

**Place of origin**  Division of Special and Environmental Dermatology, University of Vienna Medical School, Austria.

**Background**  Diabetic foot problems due to angiopathy and neuropathy account for 50% of all nontraumatic amputations and constitute a significant economic burden to society. Low-intensity laser irradiation has been shown to induce wound healing in conditions of reduced microcirculation.

**Objective**  To investigate the influence of low-intensity laser irradiation by means of infrared thermography on skin blood circulation in diabetic patients with diabetic microangiopathy.

**Study design & methods**  Double-blind randomised controlled study.

**Subjects**  30 consecutive patients with diabetic ulcers or gangrenes and elevated levels of glycosylated hemoglobin.

**Methods**  Patients were randomized by blocks of two to receive either a single low-intensity laser irradiation with an energy density of 30 J/cm² or a sham irradiation over both forefoot regions.

**Outcomes**  Skin blood circulation as indicated by temperature recordings over the forefoot region was detected by infrared thermography.

**Results**

- After a single transcutaneous low-intensity laser irradiation, a statistically significant rise in skin temperature was noted (P < 0.001 by ANOVA for repeated measurements), whereas in the sham-irradiated control group, a slight but significant drop in temperature (P < 0.001) was found.
- Subsequently performed contrasts for comparison of measurements before and after irradiation revealed significant temperature increases at 20 min of irradiation time (P < 0.001), at the end of the irradiation (P < 0.001), and 15 min after stopping the irradiation (P < 0.001).
- In the sham-irradiated feet, the drop in local skin temperature was not significant at 20 min (P = 0.1), but reached significance at the end of the sham-irradiation procedure (P < 0.001) and 15 min after the end of sham irradiation (P < 0.001).

**Conclusion**  The data from this study demonstrate an increase in skin microcirculation due to athermic laser irradiation in patients with diabetic microangiopathy.

**Key message**  Improved skin blood flow which persisted up to 15 min after stopping laser exposure.

**Pubmed ID**  9571346
### Plantar Fasciitis

#### Low-Level Laser Therapy for the Treatment of Chronic Plantar Fasciitis: A Prospective Study.

**Authors**: Jastifer JR, Catena F, Doty JF, Stevens F, Coughlin MJ.

**Published**: Foot Ankle Int. 2014 Feb 7. [Epub ahead of print]

**Date**: Feb 2014

**Place of origin**: Saint Alphonsus Coughlin Foot & Ankle Clinic, Boise, ID, USA.

**Background**: Plantar fasciitis affects nearly 1 million people annually in the United States. Traditional nonoperative management is successful in about 90% of patients, usually within 10 months. Chronic plantar fasciitis develops in about 10% of patients and is a difficult clinical problem to treat. A newly emerging technology, low-level laser therapy (LLLT), has demonstrated promising results for the treatment of acute and chronic pain.

**Objective**: To determine the effectiveness of LLLT in the treatment of chronic plantar fasciitis.

**Study design & methods**

**Prospective clinical study.**

**Subjects**: 30 patients with chronic heel pain.

**Methods**: patients were treated with LLLT (635nm, 1.5J/cm²) twice a week for 3 weeks for a total of 6 treatments and completed 12 months of follow-up.

**Outcomes**:

- Pain: Visual Analog Scale (VAS)
- Function: Foot Function Index (FFI)

Patients were evaluated at baseline, 2 weeks post procedure, and 6 and 12 months post procedure.

**Results**:  
- Mean pain VAS score improved significantly from 67.8 out of 100 at baseline to 6.9 out of 100 at the 12-month follow-up period (p<0.0001).
- Total FFI score improved significantly from a mean of 106.2 at baseline to 32.3 at 12 months post procedure (p<0.0001).

**Conclusion**: In this prospective study, patients with chronic plantar fasciitis improved after treatment with low-level laser therapy for up to the 6-month follow-up. Thereafter, the treatment effect was maintained but additional improvement was minimal. Although further studies are warranted, low-level laser therapy may be considered as an alternative treatment for patients with chronic plantar fasciitis.

**Key message**: Significant improvement of pain and function with LLLT in chronic plantar fasciitis.

**Pubmed ID**: 24510123
## Ultrasoundographic Evaluation of Plantar Fasciitis After Low-Level Laser Therapy: Results of a Double-Blind, Randomized, Placebo-Controlled Trial

<table>
<thead>
<tr>
<th>Authors</th>
<th>Kiritsi O, Tsitas K, Malliaropoulos N, Mikroulis G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Mar 2010</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Prognosis, Diagnostic Center, Larnaca, Thessaloniki, Greece.</td>
</tr>
</tbody>
</table>

### Background

#### Objective

To investigate the effect of low-level laser therapy (LLLT) on plantar fasciitis documented by the ultrasonographic appearance of the aponeurosis and by patients' pain scores.

#### Study Design & Methods

**Randomized, double-blind, placebo-controlled trial.**

**Subjects:** 30 patients with a diagnosis of unilateral plantar fasciitis.

**Methods:**

- The contralateral asymptomatic fascia was used as control.
- After enrolment, symptomatic individuals were randomly assigned to receive LLLT, or identical placebo, 3x per week for 6 weeks (total 18 sessions).
- LLLT was administered with a GaAs laser with an infrared wavelength of 904 nm, 240mW. Energy density was 8.4J/cm², pulse frequency 5000Hz.

**Outcomes:**

- Ultrasonography (plantar fascia thickness) was performed at baseline and after completion of therapy.
- The subjective subcalcaneal pain was recorded at baseline and after treatment on a visual analogue scale (VAS).

### Results

- At baseline a significant increase in the plantar aponeurosis thickness was observed in symptomatic feet compared with the contralateral asymptomatic side of the patients.
- There was no significant difference at baseline in plantar thickness between laser and placebo group.
- **Plantar fascia thickness decreased** in both groups after treatment but was significantly more decreased in the LLLT than the placebo group (p < 0.007).
- **Pain (VAS) at night rest and during daily activities decreased** in both groups after treatment but was significantly more decreased in the LLLT than the placebo group (p < 0.001).

### Conclusion

The results suggest 904 nm GaAs infrared (IR) laser therapy may contribute to plantar fasciitis healing and pain reduction.

**Key message:** LLLT may promote plantar fasciitis healing and pain relief.

**Pubmed ID:** 19841862
**Effects of Pre- or Post-Exercise Low-Level Laser Therapy (830 nm) on Skeletal Muscle Fatigue and Biochemical Markers of Recovery in Humans: Double-Blind Placebo-Controlled Trial.**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Dos Reis FA, da Silva BA, Laraia EM, de Melo RM, Silva PH, Leal-Junior EC, de Carvalho Pde T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Feb 2014</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Department of Physiotherapy, University Anhanguera-Uniderp, Campo Grande, MS, Brazil.</td>
</tr>
</tbody>
</table>

**Background**

To investigate the effect of low-level laser therapy (LLLT) before and after exercise on quadriceps muscle performance, and to evaluate the changes in serum lactate and creatine kinase (CK) levels.

**Study design & methods**

**Randomized, double blind, placebo controlled study.**

**Subjects:** 27 healthy volunteers (male soccer players)

**Methods:** subjects were divided into three groups:

- placebo,
- pre-fatigue laser,
- post-fatigue laser.

- The fatiguing exercise consisted of a quadriceps leg extension test.
- The experiment was performed in two sessions, with a 1 week interval between them.
- Laser treatment was applied right before or after the fatigue exercise.
- During each session blood collection (measurement of lactate and CK) was done for each subjects at baseline and after the quadriceps fatigue exercise.

**Outcomes:**

- Maximum load, time to fatigue, number of repetitions tolerated were primary outcomes,
- Secondary outcomes included serum lactate levels (measured before and 5, 10, and 15 min after exercise), and CK levels (measured before and 5 min after exercise).

**Results**

- The number of repetitions (p=0.8965), RM (p=0.9915), and duration of fatigue (p=0.8424) were similar among the groups.
- Intergroup analysis showed significant reductions in the lactate levels 10 and 15 min after fatigue in the post-fatigue laser group versus the placebo group (p<0.01 and p<0.05, respectively) during the first session (day 1). There was also a reduction in the lactate level 15 min after fatigue in the post-fatigue laser group relative to the placebo group in the second session (day 8).
- Pre-fatigue laser treatment tended to reduce the lactate levels 10 and 15 min after fatigue, but these differences were not significant.
- Intergroup analysis showed significant reductions in the CK concentration in the post-fatigue laser group relative to the placebo (p<0.01) and pre-fatigue laser (p<0.05) groups during the second session (day 8).

**Conclusion**

Laser application either before or after fatigue exercise reduced the post-fatigue concentrations of serum lactate and CK. The results were more pronounced in the post-fatigue laser group.

**Key message**

Significantly lower lactate and CK levels with LLLT applied to the quadriceps as recovery method after fatiguing exercise.

**Pubmed ID** 24456143
**PERIPHERAL NERVE INJURY**

**LASER PHOTOTHERAPY (780 NM), A NEW MODALITY IN TREATMENT OF LONG-TERM INCOMPLETE PERIPHERAL NERVE INJURY: A RANDOMIZED DOUBLE-BLIND PLACEBO-CONTROLLED STUDY.**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Rochkind S, Drory V, Alon M, Nissan M, Ouaknine GE.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>2007</td>
</tr>
<tr>
<td>Place of origin</td>
<td>Tel Aviv Sourasky Medical Center, Tel Aviv University, Israel.</td>
</tr>
<tr>
<td>Background</td>
<td>Injury of a major nerve trunk frequently results in considerable disability associated with loss of sensory and motor functions. Spontaneous recovery of long-term severe incomplete peripheral nerve injury is often unsatisfactory.</td>
</tr>
<tr>
<td>Objective</td>
<td>To prospectively investigate the effectiveness of low-power laser irradiation (780 nm) in the treatment of patients suffering from incomplete peripheral nerve and brachial plexus injuries for 6 months up to several years.</td>
</tr>
</tbody>
</table>
| Study design & methods | Randomized, double-blind, placebo-controlled trial.  
  *Subjects*: 18 patients suffering from incomplete peripheral nerve and brachial plexus injuries for 6 months up to several years with a stable neurological deficit and significant weakness.  
  *Methods*: patients were randomized to receive either 780-nm laser or placebo (non-active light) irradiation. The laser-irradiated and placebo groups were in clinically similar conditions at baseline.  
  *Laser treatment dosage*:  
  - **Spinal cord area**: laser irradiation was performed transcutaneously directly above the projection of the corresponding segments of the spinal cord, which was divided into two intravertebral levels. Each level was irradiated for 60 min a day (150 J/mm²), totaling 120 min a day (300 J/mm²).  
  - **Peripheral nerve area**: laser irradiation was performed transcutaneously directly above the projection of the injured nerve, which was divided into three parts: proximal, injured area, and distal. Each section was irradiated for 60 min a day (150 J/mm²), totaling 180 min a day (450 J/mm²). The irradiating spot size was 3x2 mm (6 mm²).  
| Outcomes         |  
  - Clinical examination  
  - Neurological examination: motor and sensory function.  
  - Electrophysiological examination: sensory and motor nerve conduction tests and EMG.  
| Results          |  
  - Statistically significant improvement of motor function during the 6-month follow-up period compared to baseline (p = 0.0001) in the laser-treated group compared to the placebo group.  
  - No statistically significant difference was found in sensory function.  
  - Electrophysiological analysis also showed statistically significant improvement in recruitment of voluntary muscle activity in the laser group (p = 0.006), compared to the placebo group.  
| Conclusion       | The laser-irradiated group showed statistically significant improvement in motor function and in recruitment of voluntary muscle activity in the previously partially paralyzed limbs, compared to the placebo group, in whom no statistically significant change in neurological status was found. This pilot study suggests that in patients with long-term peripheral nerve injury noninvasive laser phototherapy can progressively improve nerve function, which leads to significant functional recovery.  
| Key message      | LLLT produced significant improvement of motor function and voluntary recruitment in patients with long term motor deficits while placebo laser did not produce any change in neurological status.  
| Pubmed ID        | 17975958                                          |
Questions?

francine.vansteenkiste@DJOglobal.com