**Laser Treatment for Tendinitis**

Jan M. Bjordal, PT-MSc, Faculty of Medicine, University of Bergen, Norway Christian Couppe, PT, Copenhagen, Denmark

Tendinitis is a common disorder of the musculoskeletal system. Cardinal symptoms from the tendon are pain from increased tension like muscle contraction or stretching and pain on pressure. In an acute stage inflammation is the most common pathophysiological manifestation, while degeneration of the collagen structure is observed in subacute and chronic cases. However, the episodic nature of chronic tendinitis with increased pain after strenous use of the affected tendon, may indicate that inflammation also play a part at this stage. A successful strategy of treatment should include reduction of inflammation and regeneration of collagen. In the laboratory several experiments have shown that laser treatment may have the potential to achieve both these goals. The findings of the laboratory also shows that these effects are highly dependent on dose.

1. A synthesis of dose from 4 laboratory trials on inflamed collagen producing cell cultures gives the following dose for optimal reduction of tendon tissue inflammation:
Dose : 3 - 8 J/cm2
Intensity : 5 - 21 mW/cm2

2. A synthesis from 10 laboratory trials investigating collagen proliferation gives the following optimal dose for stimulation of tendon regeneration :
Dose : 0.2 - 4 J/cm2
Intensity : 2 - 10 mW/ cm2

3. For the treatment of tendinitis an optimal suggested dosage at target location will be :
Dose : 0.2 - 4 J/cm2
Intensity : 2 - 10 mW/ cm2

Treatment should be applied daily for at least five days to reduce inflammation, and for at least 10 days to increase collagen production.

**Determination of clinical dose**

The clinical dose depends on several factors such as laser type, depth to target from skin surface, the type of tissue between skinsurface and target location and the volume of injured tissue.

*Characteristics for common tendon disorders*

The various tendon locations have different characteristics that affects determination of dose.

Tendon Depth to target tendon (mm)
Tendon thickness (mm)
Typical area of tendon defect (cm2)

Values for different conditions are as follows:

**Plantar fasciitis**
10.0 - 12.0
3.0 - 4.0
0.1 - 0.8

**Achilles**
1.5 - 3.0
4.5 - 6.0
0.5 - 2.0

**Patellar**
2.5 - 4.0
5.5 - 8.0
1.0 - 4.0

**Epicondylitis**
1.5 - 2.5
2.0 - 4.0
0.09 - 0.3

**Rotator cuff**
5.0 - 10.0
5.5 - 8.0
0.5 - 1.5

**Recommendations for optimal laser therapy for common tendon disorders:**
Infrared lasers (GaAlAs 820/830 nm) are recommended when :
* Power density on skin does not exceed 30 mW/cm2, when treating superficial disorders
* Spot size should not be smaller than 0.5 cm2

| Dose on skin: | Number of points: |
|---|---|
| Lateral epicondylitis : | 2 J/cm2 1 - 2 |
| Rotatorcuff : | 2.5 J/cm2 2 - 4 |
| Patellar : | 8 J/cm2 :3 - 5 |
| Achilles : | 6 J/cm2 2 - 3 |

It must be added that there are only two clinical trials showing effect on tendinitis (rotatorcuff) with these lasers and that the dose recommendations for other locations are extrapolations and have ot yet been tested clinically.

*Infrared pulse lasers (GaAs 904 nm) are recommended when :*
* Power density on skin does not exceed 20 mW/cm2, when treating superficial disorders
* Spot size should not be smaller than 0.5 cm2

| Dose on skin: | Number of points: |
|---|---|
| Lateral epicondylitis : | 0.5 - 2 J/cm2 1 - 2 |
| Rotato rcuff : | 0.8 - 6 J/cm2 2 - 4 |
| Patellar : | 0.8 - 6 J/cm2 :3 - 5 |
| Achilles : | 0.5 - 4 J/cm2 2 - 3 |

Clinical results from seven trials suggests that pulse lasers overcome the skin barrier with less need for variation of dose for the different tendon locations.

*Red HeNe lasers (632 nm)* are only recommended for superficially situated tendon disorders like epicondyitis and paratendonitis of the achilles or patellar tendon. Use of HeNe laser on rotatorcuff, deeply situated patellar tendinitis (jumpers' knee), plantar fascitis or carpal tunnel is not recommended, due to the poor penetration of visible red light.

Editors note: The master thesis in Physiotherapy Science of Jan Bjordal is called "Low Level Laser therapy in shoulder tendinitis/bursitis, epicondylalgia and ankle sprain. A critical review on clinical effects". Division of Physiotherapy Science, University of Bergen. 1997.

Part of this thesis can be found in Physical Therapy Reviews. 1998; 3: 121-132. "What may alter the conclusions of reviews?".

**LLLT is as well documented as NSAIDs and steroid injections for shoulder tendinitis/bursitis and epicondylaglia.**

**The Norwegian physiotherapist Jan M Bjordal published his thesis "Low level laser therapy in shoulder tendinitis/bursitis, epicondylalgia and ankle sprain" in 1997, at the Division of Physiotherapy Science, University of Bergen. It has also been published in Physical Therapy Reviews. 1998; 3: 121-132.**

Here is the Conclusion of the thesis: "A systematic review has been performed on the effect of LLLT for three diagnoses. LLLT was evaluated on similar criteria for methodological assessments of trials as previously established for medical interventions.

No evidence was found to indicate that randomized controlled trials on LLLT for tendinitis/bursitis of the shoulder, lateral epicondylalgia and ankle sprains were methodologically inferior to RCTs on medical interventions. The clinical effects of LLLT were found to be supported by scientific evidence regarding short (0-4 weeks) and medium term (<3 months) efficacy for subacute or chronic lateral epicondylitis, and short term efficacy (>3 months) for subacute or chronic lateral epicondylitis, and short term efficacy (> 3 months) for subacute or chronic shoulder tendinitis/bursitis. The evidence of effect from LLLT for acute ankle sprain is inconclusive, although there seems to be a slight tendency in favour of LLLT. Adverse effects of LLLT are rarely seen and only in minor forms (nausea, headache) compared to medication, where more serious gastrointestinal discomfort or ulcers are not uncommon. It has also been shown that trials in favour of active treatment had more treatments per week than the trials showing no difference in effect. In short one could say that LLLT should be used much in the same way as NSAID are used for short periods of time. Most trials showing significant effects used an IR 904 nm laser, but some results in favour of IR lasers with wavelengths of 780, 820 and 830 nm were also observed.

Clinical effects of LLLT were best in subacute conditions. In chronic conditions a higher dosage and more treatments seem to be needed. The results of the high quality LLLT trials were all in favour of treatment with confidence intervals not including zero, and the trials came from several different research groups. Evidence was found to be at the highest or the second highest level depending on what level of clinical significance is decided according to the classification of Oxman (1994) and McQuay (1997). The review found little support for the alleged large placebo effects of LLLT. In chronic cases the placebo effect is probably less that 10%, after the natural history of the complaints is taken into account."

In the "Summary of discussion on clinical effect estimates for LLLT" the author writes: "The majority of the included LLLT-trials found significant clinical effect from LLLT. Seven of the eleven LLLT-trials with acceptable methods included calculations of 95% confidence limits above zero, and one LLLT-trial on anke sprain included zero (Axelsen & Bjerno 1993). The clincal effect estimates from LLLT-trials for shoulder tendinitis/bursitis are similar or higher than for NSAID or steroid injections. For lateral epicondylalgia estimates for short term clinical effects are similar or lower for LLLT than for steroid injections, but medium clinical effect estimates are similar or higher for LLLT. Recurrence of symptoms in lateral epicondylalgia is less likely after LLLT than after steroid injections. Evidence of clinical effects from ankle sprain is inconclusive. Adverse effects from LLLT are seldom seen and they appear less serious than for patients treated with NSAID and steroid injections."

**Low Level Laser Therapy Can Be Effective For Tendinitis: A Meta-Analysis**
J.M. Bjordal, C. Couppe University of Bergen, Dept. Physiotherapy Science, Bergen, Norway

**Purpose:** To investigate if low level laser therapy (LLLT) with previously defined optimal treatment parametres can be effective for tendinitis. Material : Randomized controlled trials with LLLT for tendinitis.

**Method :** Literature search for trials published after 1980 using LLLT on Medline, Embase, Cochrane Library and handsearch of physiotherapy journals in English and Scandinavian languages. Only trials that compared laser exposure of the skin directly over the injured tendon with optimal treatment parametres with identical placebo treatment were included.

**Results:** The literature search identified 77 randomized controlled trials with LLLT, of which 18 included tendinitis. Three trials were excluded for lack of placebo control, of which one trial was comparative, another lacked patients with tendinitis in the treatment group, while the last unwittingly gave the placebo group active treatment. Four trials used too high power density or dose, and three trials did not expose the skin directly overlying the injured tendon. The remaining eight trials were included in a statistical pooling, where the mean effect of LLLT over placebo in tendinitis was calculated to 32% [25.0- 39.0, 95% CI].

**Conclusion:** Low level laser therapy with optimal treatment procedure/parametres can be effective in the treatment of tendinitis.

**The Use Of Low Level Laser Therapy (Lllt) In The Treatment Of Trigger Points That Are Associated With Rotator Cuff Tendonitis**
Al-Shenqiti, J Oldham

60 patients were randomly allocated to either sham or laser therapy. The active laser parameters included a wavelength 820 nm, power output 100 mW, frequency 5000 Hz (modulated) and energy density 32 J/cm2. 12 treatments were given over four weeks. The blinded outcome measures were pain, range of motion (ROM), functional activities and pressure pain threshold (PPT). Outcome measures were carried out pre and post treatment, then 3 months later. Considerable improvement in pain ($p < 0.001$) was seen for the laser compared to sham group post treatment, and at follow-up (6 points on a 10 VAS compared to 2 points respectively). Similarly, significant differences in favour of laser were seen for ROM ($p < 0.01$), functional activities ($p < 0.001$) and PPT ($p < 0.05$).

**The Biological Effects of Laser Therapy and Other physical Modalities on Connective Tissue Repair Processes**
Chukuka S. Enwemeka, P.T., Ph.D., FACSM, G. Kesava Reddy, Ph.D.,
Department of Physical Therapy and Rehabilitation Sciences,
University of Kansas Medical Center,
Kansas City, KS 66160-7601, USA

Connective tissue injuries, such as tendon rupture and ligamentous strains, are common. Unlike most soft tissues that require 7-10 days to heal, primary healing of tendons and other dense connective tissues take as much as 6 - 8 weeks during which they are inevitably protected in immobilization casts to avoid re-injury. Such long periods of immobilization impair functional rehabilitation and predispose a multitude of complications that could be minimized if healing is quickened and the duration of cast immobilization reduced. In separate studies, we tested the hypothesis that early function, ultrasound, 632.8 nm He-Ne laser, and 904 nm Ga-As laser, when used singly or in combination, promote healing of experimentally severed and repaired rabbit

Achilles tendons as evidenced by biochemical, biomechanical, and morphological indices of healing. Our results demonstrate that: (1) appropriate doses of each modality, i.e., early functional activities, ultrasound, He-Ne and Ga-As laser therapy augment collagen synthesis, modulate maturation of newly synthesized collagen, and overall, enhance the biomechanical characteristics of the repaired tendons. (2) Combinations of either of the two lasers with early function and either ultrasound or electrical stimulation further promote collagen synthesis when compared to functional activities alone. However, the biomechanical effects measured in tendons receiving the multi-therapy were similar, i.e., not better than the earlier single modality trials. Although tissue repair processes in humans may differ from that of rabbits, these findings suggest that human cases of connective tissue injuries, e.g., Achilles tendon rupture, may benefit from appropriate doses of He-Ne laser, Ga-As laser, and other therapeutic modalities, when used singly or in combination. Our recent meta-analysis of the laser therapy literature further corroborate these findings.