Misc. Low Level Laser Studies

A Comparison Between Laser Therapy and Drug Therapy in the Treatment of Vaginitis

Passeniouk A M, Michailov V A.

30 women with non-specific vaginitis and vaginal candidiasis were treated with LLLT and topical chlorhexidine application daily for ten days. 20 women with the same condition were treated with metronidazole (10 g as course dose) and fluconozole (150 mg single dose) and vaginal application of metronidazole. The results suggest that local laser therapy is able to remove signs of vaginitis more efficiently than drug therapy. Repair of normal vaginal microflora was significantly faster in the laser group. There were no side effects in the laser group whereas there were women on drug therapy who reported side effects.

Better Healing with Laser or Ultrasound?

Lasers Med Sci 2010 Jun 3.

The value of modalities is constantly being debated as to their true efficacy. This study elucidates prior studies that concluded that ultrasound is inferior to laser in terms of healing stimulation. The aim of this study was to investigate and compare the effects of low intensity pulsed ultra-sound (LIPUS) and low-level laser therapy (LLLT) during the process of bone healing.

The results showed intense new bone formation surrounded by highly vascularized connective tissue with strong bone deposition being observed in the group exposed to laser. No remarkable differences were noticed in the specimens treated with ultrasound. The researchers concluded that LLLT improves bone repair in rats and was more effective than US at accelerating bone healing.

Can Laser Cure Thyroid Disease?

Some clinicians worry that laser can impair thyroid function. In addition, there has been a lot of controversy over the years about whether or not laser can “cure” diseased organs or glands. This article concludes that laser therapy can actually treat thyroid problems! This interesting finding is in addition to a number of studies that demonstrate that laser can help regenerate the heart, brain, and other organs.

Can Laser Cure Tuberculosis?

Indian J Tuberc. 2010 Apr;57(2):80-6/

What if medication does not cure TB? Could Low level laser therapy (LLLT) help? In this controlled trial more than one hundred patients were treated two times per week for five weeks with LLLT and medication. One interesting aspect of this study is that the follow up was conducted for two years after treatments to insure accuracy. After 10 treatments 51% of the LLLT group were cured, compared to 16% in the medication group. The researchers concluded that LLLT is an effective adjunctive therapy along with antitubercular drugs in cases of chronic TB. The message for clinicians is that laser can be used to improve the results of almost any type of medication or natural therapy.

Can Laser Help Cure Liver Disease?

Photomed Laser Surg. 2010 Oct 9

Research clearly documents the ability of low level laser therapy (LLLT) to improve healing. There are also a number of studies that validate the ability of LLLT to heal cardiac, brain, nerve and thyroid issues.

This animal study adds to this knowledge by demonstrating improved liver healing. The study investigated the effect of LLLT on liver regeneration following removal of 70% of the liver (hepatectomy). It was found that the number of regenerated cells, blood vessels and immune cells was 2 to 3 times higher in the laser-treated animals! The researchers concluded that LLLT following acute hepatectomy stimulates a significant enhancement of liver regeneration.

This study helps to pave the way for future use of LLLT to stimulate regeneration of many parts of the body in addition to laser’s common use in the treatment of neuromusculoskeletal injuries.

Can Light Therapy Heal Eye Damage?

Invest Ophthalmol Vis Sci. 2011 Mar 18

Many of us worry about the possibility of cool lasers causing eye damage. This is an interesting study because it supports past research that cool or low level laser therapy (LLLT) and LED light are not damaging to the eyes.

In this study, rats were raised in dim light and then exposed to bright continuous light for 24 hours to create eye damage. Then, the animals were treated with 670nm light at the dose of 9 J/cm2. As you might expect, the bright light caused damage to the rats' eyes. Of interest is the fact that the cool, infrared light treatment healed the cellular damage.

The researchers expressed the belief that infrared light is protective against light induced retinal damage even when it is applied after exposure. They also expressed the belief that it has the potential to become an important treatment to prevent or treat light damage to the retina. The researchers also felt that it could be beneficial in the prevention and treatment of retinal conditions involving many inflammatory mechanisms.

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Can Low Level Lasers Really Kill Bacterial Sinusitis?

(Am J Rhinol Allergy. 2009 Nov-Dec;23(6):e29-32)

Among low level laser aficionados it is well known that LLLT, or Low Level Laser Therapy, helps sinusitis. However, although we have a lot of research to support the use of low level lasers with viral infections, the research on bacterial infection has been inconclusive.

A new study on acute bacterial rhinosinusitis has come out of the Department of Otolaryngology at Columbia University School of Medicine. These authors studied eight infected rabbits randomly allocated to two separate groups, each being exposed to different laser therapies. A near infrared laser with diffuser fiber tip was used in four rabbits. Nasal cultures were obtained before and after the laser treatments. Animals were killed 5-10 days after laser treatment and bacteriological/histological results were analyzed. A significant reduction in bacterial colony counts was achieved with laser therapy. Histological studies showed tissue integrity preservation without significant damage to nasal mucosa!

This pilot study shows an innovative method of bacterial killing without host tissue damaging and may have potential future clinical application (Am J Rhinol Allergy. 2009 Nov-Dec;23(6):e29-32). We know that LLLT can kill viruses and look forward to more research on LLLT for the treatment of bacterial infection.

Cold Lasers Safe Around Eyes?

Retina. 2008 Apr;28(4):615-21

There is no question that you cannot allow your hot laser anywhere near the eyes due to the serious risk of eye damage. However, we are continuing to see studies showing that cold laser actually may IMPROVE eye function. In the last issue we discussed a study that demonstrated excellent results with macular degeneration. This is another study that touts the effectiveness of laser treatment to reduce macular degeneration and stabilize eye damage. The researchers caution their readers to not treat the eyes with laser until there is more information to support proper protocols. However, this and other studies are an important first step in understanding how laser therapy can improve visual acuity and, more importantly, regarding the ocular safety of cold lasers when treating orofacial pain.

Collagen Changes and Realignment Induced by Low-Level Laser Therapy and Low-Intensity Ultrasound in the Calcaneal Tendon

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Lasers Surg Med. 2010 Aug;42(6):559-65

BACKGROUND AND OBJECTIVE: The treatment of calcaneal tendon injuries requires long-term rehabilitation. Ultrasound (US) and low-level laser therapy (LLLT) are the most used and studied physical agents in the treatment of tendon injuries; however, only a few studies examined the effects of the combination of US and LLLT. Therefore, the purpose of this study was to investigate which treatment (the exclusive or combined use of US and LLLT) most effectively contribute to tendon healing.

STUDY DESIGN/MATERIALS AND METHODS: This was a controlled laboratory study with 50 rats whose Achilles tendon was injured by direct trauma. The rats were randomly divided into five groups and treated for 5 consecutive days, as follows: group 1 (control) received no treatment; group 2 was treated with US alone; group 3 was treated with LLLT alone; group 4 was treated first with US followed by LLLT; and group 5 was treated first with LLLT followed by US. On the sixth post-injury day, the tendons were removed and examined by polarized light microscopy. The organization of collagen fibers was assessed by birefringence measurements. Picrosirius-stained sections were examined for the presence of types I and III collagen.

Results: There was a significantly higher organization of collagen fibers in group 2 (US) than in the control group (P = 0.03). The amount of type I collagen found in groups 2 (US), 3 (LLLT), and 5 (LLLT + US) was significantly higher than that in the control group (P < or= 0.01), but no significant differences were found between treatment groups. There were no differences in theamount of type III collagen between groups.

CONCLUSION: Ultrasound, LLLT, and the combined use of LLLT and US resulted in greater synthesis of type I collagen; US

was also effective in increasing collagen organization in the early stages of the healing process.

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Effect of Laser Acupoint Treatment on Blood Pressure and Body Weight-a Pilot Study

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J Chiropr Med. 2008 Dec;7(4):134-9

OBJECTIVE: This study reports on the effects of laser acupuncture on blood pressure, body weight, and heart rate variability by stimulating acupuncture points and meridians on college students and faculty members.

METHODS: Forty-five students and faculty members from a chiropractic college were recruited in the study. All subjects signed a written informed consent before their participation in the study. This study was a randomized controlled pilot study with subjects divided into control and experimental groups. The control group received a sham low-level laser therapy treatment with no power output to the laser during their “treatment.” The experimental group was treated with an activated laser. The acupuncture points used in this study were LI 4 and LI 11 for body weight and blood pressure. The treatment groups received 16 J of laser energy output for a total treatment time of 8 minutes (4 minutes for each of the 2 points).

Results: After using the laser treatment for 90 days (at least 12 treatments per subject), both the systolic and diastolic blood pressures decreased significantly (P < .01). The mean systolic blood pressure was 129.6 ± 14.7 mm Hg before the treatment and was reduced to 122.5 ± 17.2 mm Hg (P < .001). The mean diastolic blood pressure was 85.6 ± 8.0 mm Hg before treatment and was reduced to 77.2 ± 8.7 mm Hg (P < .001). Subject’s body weight was reduced in the active acupoint group, but the weight reduction did not reach a significant level. There were no significant changes in the heart rate variability.

CONCLUSION: It was concluded that low-level laser treatment of acupoint resulted in lower blood pressure by stimulating the LI 11 and LI 4. No significant difference was observed in both the body weight and heart rate variability after the laser acupoint treatment.

Effect of Low-Level Laser Therapy in the Inflammatory Response Induced by Bothrops Jararacussu Snake Venom

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His article reports the effect of low-level laser therapy (LLLT) on the edema formation and leukocyte influx caused by Bothrops jararacussu snake venom as an alternative treatment for Bothrops snakebites. The inflammatory reaction was induced by injection of 0.6mg/kg of B. jararacussu venom, in gastrocnemius muscle. Cell influx and edema were evaluated at 3 or 24h after venom injection. Mice were irradiated at the site of injury by a low-level laser (685nm) with a dose of 4.2J/cm(2). A therapy that combines LLLT and antivenom was also studied. B. jararacussu venom caused a significant edema formation 3 and 24h after its injection, and a prominent leukocyte infiltrate composed predominantly of neutrophils at 24h after venom inoculation. LLLT significantly reduced edema formation by 53% and 64% at 3 and 24h, respectively, and resulted in a reduction of neutrophils accumulation (P<0.05). The combined therapy showed to be more efficient than each therapy acting separately. In conclusion, LLLT significantly reduced the edema and leukocyte influx into the envenomed muscle, suggesting that LLLT should be considered as a potentially therapeutic approach for the treatment of the local effects of Bothrops species.

Effects of Laser Irradiation on Tricophytum Rubrum Growth

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Lasers Med Sci (2008) 23:349-353

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Abstract: The effects of various laser wavelengths and fluences on the fungal isolate, Trichophyton rubrum, were examined in vitro. Standard-size isolates of T rubrum were irradiated by using various laser systems. Colony areas were compared for growth inhibition on days 1, 3, and 6 after laser irradiation. Statistically significant growth inhibition of T rubrum was detected in colonies treated with the 1,064-nm Q-switched Nd:YAG laser at 4 and 8 J/cm2 and 532-nm Q-switched Nd:YAG laser at 8 J/cm2. Q-switched Nd:YAG laser at 532- and 1,064-nm wavelengths produced significant inhibitory effect upon the fungal isolate T rubrum in this in vitro study. However, more in vitro and in vivo studies are necessary to investigate if lasers would have a potential use in the treatment of fungal infections of skin and its adnexa.

Introduction: Trichophyton rubrum—a keratinophilic filamentous fungus that infects skin, nails, and hair follicles—is the most common causative agent of dermatophytosis worldwide [1-6]. Current management of T rubrum includes topical and systemic antifungal pharmacologic treatments. However, these approaches may not be successful in every case due to such factors as difficulty with long-term application of topical medications, side effects of certain medications in systemic use, and failure to deliver the medication to the target area in sufficient concentration [7, 8]. It is not uncommon that a fungal infection persists despite appro-priate topical and/or systemic chemical treatment(s), and this may be one of the most important factors responsible for the high cost of treatment in dermatophyte infections [9-11]. Obviously, there is a need for safe, efficient, easily performed, and cost-effective treatment modalities without the abovementioned disadvantages of

topical and systemic antifungals in the management of dermatophyte infections.

Photodynamic therapy has been recently proposed to treat T rubrum infections, and promising results were obtained from these in vitro studies using certain photo-sensitizers and light sources [12-14]. However, the direct effect of laser light on fungal isolates has not been rigorously examined for their possible inhibitory potential.

In this in vitro study, we report the effects of various laser systems on T rubrum colonies.

MATERIALS AND METHODS:An isolate of T rubrum obtained from a toenail scraping was serially passed on DifcoTM Sabouraud Dextrose Agar (BD diagnostics, Sparks, MD). After pure culture was obtained, this fungal strain was used for the entire experiment to provide standardization. Four-millimeter punch biopsy samples (total of 18) of the primary colonies were transplanted to three new fungal plates (six colonies per plate). Standardized photographs were obtained utilizing a Nikon CoolPix 5400 digital camera (Nikon, Torrence CA) at 4x optical magnification with 10-cm distance from the fungal plates. Twenty-four hours after obtaining standardized photographs, the colonies were exposed to various wavelengths and fluences of laser light (Table I). Fluences for each laser system were chosen based on tolerable fluences that are commonly used for treating unwanted hair, tattoo, or port-wine stains in clinical settings. Each colony was treated with a sufficient number of pulses to cover the entire area of the colony with minimal overlapping. One colony in each plate was left untreated as the control colony and marked accordingly. The colonies were rephotographed under identical photog-raphy parameters as described above on the first, third, and sixth posttreatment days. Assessment of growth was made by converting the standardized digital images into bitmap format and calculating the size of each fungal colony in pixels utilizing Microsoft™ Paint program (Microsoft, Seattle, WA).

Colonies irradiated with IPL, FPDL, Er:YAG, or KTP lasers did not show any inhibitory effect, and thus were not further studied (data not shown). A second phase focusing on 532- and 1,064-nm wavelengths of Q-switched Nd:YAG laser system was conducted, as these were the only two wavelengths showing inhibitory effect on fungal isolates. For this purpose, Q-switched Nd:YAG laser system was used at 532-nm wavelength with 1, 2, 4, 6, 8, and 10 J/cm2 and at 1,064 nm wavelength with 2, 4, 6, 8, and 10 J/cm2.

We used a 2-mm-diameter beam and a pulse frequency of 10 Hz for both wavelengths. In this series, each laser fluence was used to treat five colonies in an agar plate containing six colonies. One colony was left untreated for control. Areas of treated colonies and control colonies were calculated in pixels from standardized photographs obtained before treatment, and 1, 3, and 6 days after treatment as described above.

The effect of laser treatment on fungal growth was analyzed in two ways. First, the general effect of laser treatment on colony size was assayed, using a paired sample t test. Second, the effect of specific laser treatments on fungal growth rate was determined, using the slope of a simple regression of colony size against colony age. Before analysis, all the colony-size data were log transformed to ensure homogeneity of variance, normality of error, and to linearize the relationship between colony size and age. All analyses were conducted on JMP 5.0 (SAS Institute).

To detect whether laser treatment affects fungal growth, a paired sample t test was used to compare the mean size of the laser-treated and untreated colonies on a plate, across all plates, for days 1, 3, and 6. Growth rate of fungal colonies receiving different laser treatments was subsequently compared using a general linear model (GLM). The statistical model was: log(colony size)=day treatment day x treatment error, where day is a continuous variable and treatment is a categorical variable. Differences in fungal growth rate between treatments were detectable as a significant interaction between the factors “day” and “treatment” (day x treatment). The analysis subsequently tested whether the interaction term for each treatment was significantly different from zero using a t test; that is, whether a particular laser treatment resulted in slower or more rapid growth of the fungal colonies compared to average growth across all laser treatments.

Results: With the exception of Q-switched Nd:YAG laser with 532 and 1,064-nm wavelengths, none of the lasers tested in the first phase of this study revealed significant growth inhibition on T rubrum colonies (Table 1, data not shown). Figure 1 shows the average size of the control colonies and laser-treated colonies on days 0 to 6 after treatment. For days 1, 3, and 6, the mean size of colonies that had been laser treated was significantly smaller than the size of colonies that had been untreated on the same plate, across all plates (paired sample t test, tday 1=4.28, tday 3=3.67, tday 3=2.744; df=21, $p<0.05$ for all). Different laser-treatments had significantly different effects on the growth rate of the fungal colonies (GLM, Fday×treatment, 10, 198=22.75, $p<0.0001$). Specifically, treatment with 1,064-nm Q-switched Nd:YAG laser at 4 and 8 J/cm2 and 532-nm Q-switched Nd: YAG laser at 8 J/cm2 resulted in a much lower growth rate than the average for all laser-treated fungal colonies (t3.54, $p<0.0005$ for all; Figs. 1 and 2).

Discussion: We have investigated the effects of various laser systems on the growth of a common dermatophyte T rubrum in this in vitro study as a potential research area for the treatment of dermatophyte infections. Only a few articles have previously examined the effects of laser irradiation on the growth of fungal colonies. One such study examined the effects of argon fluoride gas excimer laser at 193 nm on Candida albicans and Aspergillus niger. This study indicated eradication of the target organisms as evidenced by the loss of viability of the colonies on subculture [16]. Laser irradiation has been studied experimentally in the agricultural industry to decrease the burden of opportunistic fungi on germinating seedlings, and it has been shown that a substantial diminution of Fusarium solani colonization of seedlings can be achieved by using He/Ne gas laser emitting light at 632.8-nm wavelength with a power output of 7.3 mW [17]. However, we did not find data regarding the effects of direct laser light irradiation on dermatopathogens.

The inhibitory effect of Q-switched Nd:YAG laser on fungal colonies seen in this study is most probably due to more than a nonspecific thermal damage. It is known that 532-nm Q-switched Nd:YAG laser is well absorbed by red pigment, which is abundant in T rubrum because of its xanthomegnin content [18, 19]. Xanthomegnin was originally isolated from T megninii

and subsequently demonstrated to be the diffusible pigment produced by T rubrum which confers its prominent red pigment seen in culture [19]. The presence of this red chromophore may explain the sensitivity of T rubrum to 532-nm range.

It is known that IPL system used between 695- and 1,000-nm-wavelength range at 38 to 47 J/cm2 and 585-nm pulsed dye laser at 8 to 14 J/cm2 can induce significant thermal damage [20-23]. Lack of growth inhibition in our study with these settings might also be a supporting evidence regarding pigment-related photothermolysis of T rubrum rather than inhibition due to nonspecific thermal damage. Although the wavelength of Q-switched Nd:YAG laser at 1,064 nm is beyond the absorption spectrum of xanthomegnin, we have observed similar inhibitory effects on the colonies treated with this wavelength. This might be due to another chromophore absorbing at 1,064 nm, such as melanin, as it is known that Trichophyton species contain melanin in their cell walls [24, 25].

In addition to its wavelength, another important feature of Q-switched Nd:YAG laser is its relatively short pulse width (i.e., nanoseconds). These short pulses will induce microcavitation and acoustic shock waves that could result in significant inhibition of the fungal colonies [26]. The short pulse times (much shorter than the thermal relaxation time) will also induce thermal shocks in the target chromophore via rapid heating and cooling. These extreme thermal cycles and shock waves do not occur when the laser light is delivered in relative long pulse times, as seen in this study with the use of continuous wave KTP laser with 532-nm wavelength or a pulsed dye laser. Therefore, it can be speculated that effective inhibition of the T rubrum also requires very short pulses of 532-nm wavelength that generates mechanical damage in the irradiated fungal colony.

Considering epidermal colonization of dermatopathogens within the skin, one can speculate that a laser light mainly being absorbed within the epidermis might cause significant fungal inhibition in dermatophyte infections by nonspecific thermal damage. One such laser system that we used in the first phase of this study was Er:YAG laser with a 2,940-nm wavelength. This laser is well known for its epidermal absorption because of the epidermal water content and has been extensively used in skin resurfacing [27]. However, we did not observe any significant inhibition on fungal colonies with Er:YAG laser. This may suggest that the inhibitory effects seen on the colonies not be related to nonspecific thermal damage or water content of T rubrum.

Laser irradiation with the capability of delivering destructive high energy pulses to specific targets with minimized surrounding tissue damage would seem to be well suited for the task of eradicating superficially located organisms in the skin. The current experiment differs significantly from other studies, as we have selected the same strain of a specific organism and serially tested it against a wide array of laser wavelengths and fluences. Although this preliminary in vitro study does show a statistically significant level of growth inhibition at two separate laser wavelengths at certain fluences, the study design makes accurately determining percent viability problematic because of the thickness of the colonies treated. In typical dermatophyte infections, the thickness of the layer of organisms is rarely more than a few organisms. In this study, we examined the effects of laser irradiation on cultured colonies with an estimated thickness of 2-3 mm. It is likely that the more superficial organisms absorbed the majority of radiant energy, thus suffering the burden of damage, leaving the subjacent organisms protected, even at the critical fluences. This may have confounded our growth analysis, leading to an erroneous underestimation of growth inhibition. To ad-dress this issue, future in vitro studies are needed to develop thin agar preparations which may confine fungal growth to a significantly thinner layer and may render interpretation of growth inhibition more accurate. In addition to more in vitro studies, in-vivo studies are necessary to investigate the possible therapeutic effects of various laser systems on various dermatopathogens, as laser-fungus interaction might be different when these microorganisms are embedded within the skin and its adnex a.

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Fibroblast Cells Subjected to Low-Level Laser Therapy and Low-Intensity Pulsed Ultrasound

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Photomedicine and Laser Surgery. June 2009, 27(3): 461-466. doi:10.1089/pho.2008.2290

OBJECTIVE:The aim of the present study was to compare the effect of low-level laser therapy (LLLT) and low-intensity pulsed ultrasound (LIPUS) on the cytoskeleton and endoplasmic reticulum of L929 cells. Thermal and non-thermal physical mechanisms such as LLLT and LIPUS induce clinically significant responses in cells, tissues, and organs.

MATERIALS AND METHODS: L929 fibroblast cell cultures were irradiated with LLLT and subjected to LIPUS. Cultures irradiated with the laser (904nm) were divided into three groups: group I, control (no irradiation); group II, irradiated at 6J/cm2; and group III, irradiated at 50mJ/cm2. Cultures subjected to ultrasound were divided into five groups: group I, control (no LIPUS); group II, LIPUS at 0.2W/cm2 in pulsed mode at 10% (1:9 duty cycle); group III, LIPUS at 0.6W/cm2 in pulsed mode at 10% (1:9 duty cycle); group IV, LIPUS at 0.2W/cm2 in pulsed mode at 20% (2:8 duty cycle); and group V, LIPUS at 0.6W/cm2 in pulsed mode at 20% (2:8 duty cycle). Each group was irradiated at 24-h intervals, with the following post-treatment incubation times: 24, 48, and 72h. The effects of LLLT and LIPUS on the cytoskeleton and endoplasmic reticulum was evaluated by the use of fluorescent probes and with fluorescence microscopy analysis.

Results: The results following LLLT and LIPUS demonstrate that ultrasound was more effective than laser on fibroblast cell cultures when the endoplasmic reticulum was assessed, whereas there was a better distribution of the filaments of the cytoskeleton in the cells subjected to laser irradiation.

CONCLUSION:: The study demonstrated that both LLLT and LIPUS promote changes on the cellular level. However, LIPUS was more effective than LLLT at the doses used here, as assessed by fluorescence microscopy, which revealed increased

reticulum activity and increased protein synthesis. However, when the organization of actin filaments was assessed, LLLT achieved a better result.

Is Laser Similar to Acupuncture?

Anesth Analg 2009 Feb;108(2):635-40

This study done by anesthesiologists at least takes a first step in answering that question. They compared a far infrared lamp, acupuncture, and infrared laser for their effect on ear acupoints. In the acupuncture group, an acupuncture needle was placed in the auricle of the ear for 20 min. The lamp group repeatedly received near infrared irradiation. The laser group continuously received 60 mW of laser irradiation. In the lamp and laser groups, the auricle was irradiated for 10 min with a contact probe at exactly the same points.

Arteriolar diameter and blood flow velocity were measured to see if these treatments provided similar or different results. Maximum circulation was reached 20 min after the end of the acupuncture stimulation, and 10 min after the end of lamp and laser irradiation.

The three groups showed significant increases in arteriolar diameter when compared with the control group ($P < 0.005$). Blood flow velocity and blood flow rate showed similar trends to arteriolar diameter. Treatment effect persisted for 40-50 min after the end of stimulation and irradiation.

It was their conclusion that acupuncture stimulation and laser both increase the diameter of the local vessels and increase blood flow. There are other areas that need to be studied for us to know how these therapies are similar and different. However, now we know that their effect on blood flow is similar.

Laser Can Treat Hiccups!

Scandinavian Journal of Gastroenterology, (2008; 435):538-44.

There has been a lot of mainstream press coverage of laser therapy applied to acupoints in the ear and extremities to treat addictions to tobacco, cocaine, and heroin by improving the function of the central nervous system (CNS). This study is interesting because they researched using infrared light to treat intractable hiccups. Chronic intractable hiccups can be a serious medical problem and the result of many diseases of the CNS as well as other types of pathology. This study, a well controlled randomized blinded clinical trial, was published in the Scandinavian Journal of Gastroenterology, (2008; 435):538-44. Out of the 35 patients enrolled in the study, 34 had complete remission! This is probably another supporting study that demonstrates how light therapy can modulate the CNS.

Laser Light – a New, Non Invasive Treatment for Erectile Dysfunction: a Placebo-Controlled, Single Blinded Pilot Study

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BACKGROUND: In vitro and animal studies have shown that the application of laser light may induce vasorelaxation, which is the event that produces penile erection. The hypothesis was that application of laser light to the vascular bed of the penis might restore erectile function.

Purpose: To prove this hypothesis, a specifically designed device, emitting laser light, was externally applied to the penis of patients with erectile dysfunction (ED). This study has been conducted to prove the efficacy and safety of laser therapy for the treatment of ED.

Material and Methods: 44 volunteers were randomly assigned to treatment with placebo or 808 nm GaAlAs laser light. 39 patients completed all treatments and follow up visit: 18 patients in the treatment group (A) and 21 in the placebo group (B). The treatments were delivered for 19 minutes, twice a week, total of 6 treatment sessions. The laser unit has 2 rows of 5 treatment points each and the unit is applied on the dorsal aspect of the penis, every row corresponds to the corpus cavernosum of the penis. Treatment is given for 20 minutes, twice a week, 6-8 times. Power of each diode is 150 mW. Questions 3 and 4, as well as the Erectile Function Domain from the International Index of Erectile Function (IIEF) assessed the improvement in ED.

Results: The baseline median values for questions 3 and 4 were identical in both groups – 2.0. In group B the median remained 2.0 after the treatment for question 3 and 4 while in group A it increased by 1.5 to 3.5 (for question 3 – p=0.0536; for question 4 – p=0.03). Median Erectile Function domain score (question 1-5 and 15) was 14 in group B and decreased to 12. In group A baseline score was 13 and it increased to 20.5 after treatment (p=0.02). Many patients in the treatment group reported occurrence of morning erections. Improvements were usually reported after the 4th or 5th treatment sessions. There were no adverse effects as a result of the treatment.

DISCUSSION and CONCLUSION: The treatment performed by the laser parameters used in this study has showed improvement in ED. The improvement duration in avarage was of 6 month. Further studies are needed for optimiziation of treating parameters: wavelength, dose and sessions.

Laser

Popular Therapy for Tinnitus in Europe

In Europe there are a number of clinics that treat tinnitus using laser therapy combined with natural therapies such as diet, meditation, relaxation, etc. In this study (Int Tinnitus K. 2008;14(2):175-80) from Italy the researchers recruited 46 adult

patients affected by disturbing tinnitus lasting for at least 3 years. All were treated with a combined counseling protocol constituting hypnosis and relaxation techniques.

They randomly assigned 26 patients to the group receiving low-level lase stimulation treatment and 20 to the placebo group. A reduction in tinnitus was noted in all groups but more significantly in the group receiving low-level laser stimulation. From the point of view of clinical classification, approximately 61% of irradiated patients had tinnitus severity decreased in comparison to 35% of the placebo group.

This study lends support for the value of laser in the treatment of tinnitus. If you do not have a powerful cold laser or a point probe that allows penetration close to the ear drum, you will find this treatment difficult. You will need a powerful infrared laser cluster of at least 1,000-2,000 mW to get sufficient photons into the ear or have a narrow point probe that you can insert directly into the ear canal. Both of these probes are available from Laser Allergy Relief Centers.

Laser Relieves Pain Through the Autonomic Nervous System

Zhongguo Zhen Jiu. 2008 Sep;28(9):662-4

One question that often comes up concerns the safety of laser therapy with infants. Here we see the value of light therapy treating infants with the colds and flu. In this hospital based study, 255 babies suffering from colds and upper respiratory symptoms were exposed to either laser therapy or Amantadine, a common medication for colds and flu. The study demonstrated that 69% of the laser group that received treatment to acupoints and 42% of the medication group achieved objective benefit. The benefit of laser therapy above medication was significant ($P < 0.001$).

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Light Therapy (LLLT) Alters Gene Expression after Acute Spinal Cord Injury

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2. Center for Devices and Radiological Health, Food and Drug Administration,Rockville, MD, USA.
Laser Therapy.1997; 9 (4): 151

Secondary injury in the spinal cord, which results in axonal degeneration, scar and cavity formation and cell death, occurs around the site of the initial trauma and is a primary cause for the lack of axonal regeneration observed after spinal cord injury (SCI). The immune response after SCI is under investigation as a potential mediator of secondary injury. Treatment of SCI with 810 nm light suppresses the immune response and improves axonal regeneration. We hypothesize that these beneficial effects observed in the injured spinal cord are accompanied by alterations in gene expression within the spinal cord, particularly of those genes involved in secondary injury and the immune response. To test this hypothesis, a dorsal hemisection at vertebral level T9 was performed. The injured spinal cord from rat was then exposed to laser light (810nm, 150mW, 2,997 seconds, 0.3cm2 spot area, 1589 J/cm2) and spinal cord samples, including the injury site, were harvested at 6 and 48 hours and 4 days post-injury. Total RNA was extracted and purified from the lesioned spinal cord and cDNA copies were either labeled with [32P] for microarray analysis or amplified and analyzed with a polymerase chain reaction (PCR). Microarray results revealed a suppression of genes involved in the immune response and excitotoxic cell death at 6 hours post-injury, as well as cell proliferation and scar formation at 48 hours post-injury in the light treated group. Analysis of the PCR products revealed that light treatment resulted in a significant suppression of expression of genes that normally peak between 6 and 24 hours post-injury, including the pro-inflammatory cytokine interleukin 6 (IL6), the chemokine monocyte chemoattractant protein 1 (MCP- 1) and inducible nitric oxide synthase (iNOS; $p<0.05$). Genes expressed earlier than 6 hours post-injury, such as IL1b, tumor necrosis factor a (TNFa) and macrophage inflammatory protein 1a (MIP-1a) were not affected by light treatment. Although the precise role some of these genes play in axonal regeneration after spinal cord injury is currently unclear, these data demonstrate that light therapy has an antiinflammatory effect on the injured spinal cord, and may reduce secondary injury, thus providing a possible mechanism by which light therapy may result in axonal regeneration.

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Low-Level Laser Therapy Increases Antioxidant Activity

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Photomed Laser Surg. 2005 Jun;23(3):273-7

OBJECTIVE: The aim of this study was to investigate the effect of low-level laser therapy (LLLT) on ischemic-reperfusion (I-R) injury in the gastrocnemius muscle of the rat.

BACKGROUND DATA: Ischemic injury in skeletal muscle is initiated during hypoxia and is aggravated by reoxygenation during blood reperfusion and accumulation of cytotoxic reactive oxygen superoxides. LLLT has been found to biostimulate various biological processes, such as attenuation of ischemic injury in the heart.

MATERIALS AND METHODS: The injury was induced in the gastrocnemius muscles of 106 rats by complete occlusion of the blood supply for 3 h, followed by reperfusion. Another group of intact rats served to investigate the effect of LLLT on intact nonischemic muscles. Creatine phosphokinase, acid phosphatase, and heat shock protein were determined 7 days after I-R injury and antioxidant levels 2 h after reperfusion. Results: Laser irradiation (Ga-As, 810 nm) was applied to the muscles immediately and 1 h following blood supply occlusion. It was found that laser irradiation markedly protects skeletal

muscles from degeneration following acute I-R injury. This was evident by significantly ($p < 0.05$) higher content of creatine phosphokinase activity and lower ($p < 0.05$) activity of acid phosphatase in the LLLT-treated muscles relative to the injured non-irradiated ones. The content of antioxidants and heat shock proteins was also higher ($p < 0.05$) in the LLLT-treated muscles relative to that of injured non-irradiated muscles.

CONCLUSION: The present study describes for the first time the ability of LLLT to significantly prevent degeneration following ischemia/reperfusion injury in skeletal muscles, probably by induction of synthesis of antioxidants and other cytoprotective proteins, such as hsp-70i. The elevation of antioxidants was also evident in intact muscle following LLLT. The above phenomenon may also be of clinical relevance in scheduled surgery or microsurgery requiring extended tourniquet applications to skeletal muscle followed by reperfusion.

Semiconductor Laser Rays Therapy for the Treatment of Chronic Prostatitis

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Introduction: Chronic prostatitis (ACP) hasn't a universally successful therapy yet. A lot of studies demonstrated that LASER therapy has an anti-inflammatory effect on tissues and can increase lymphatic and venous drainage reducing inflammatory swelling. For this reasons in the early 90s we proposed a new therapeutic system for ACP using semiconductor LASER rays consisting of a gallium-arsenide diode. At the beginning an endorectal probe was used; then we invented a particular endourethral probe for laser therapy. This is a brief abstract of what we achieved during these years.

Histological preliminary studies: Many authors studied biological effects of LASER on animal tissues (1). Before clinical practice LASER therapy was tested on a cancer cell line (SW 626) in order to evaluate if laser stimulation could increase mitosis cell rate (2) and therefore have a carcinogenic-like effect. We didn't observe any change in mitosis cell rate. Another study (3) was made on rabbits to test in vivo any immediate histopathological damages and temperature rising in rectal ampulla using transrectal probe. Temperature rising was about 2/10th of a degree centigrade. No histopathological alterations of rectal wall and the prostate were observed with particular care of signs of swelling, flogosis or fibrosis.

MATERIALS AND METHODS: The gallium-arsenide diode in use has a wave lenght of 904 nm and a frequency of 3000 Hz. The Laser beam reaches the prostate with a special optic probe. This is divided in two sections: one contains the laser generator, the other has five optic fibers and it is screwed onto the first creating a single body of reduced dimensions. It can be sterilized and it is atoxic. We experimented 2 different approaches to the prostate: the first was an endorectal approach and the second was an endourethral approach. At the beginning we used a "Laser Super Sonic" machine with endorectal probe according to Strada. The treatment schedule was 1 treatment every two days (treatment's time of 12 minutes,wave lenght 3000 Hz)) for a total of 12 applications. Transrectal laser therapy was not indicated in prostate larger than 4 cm because this is the maximum depth of the laser beam's efficacy. Then we experimented an urethral probe (Med 130 Lasotronic ÃƒÂ¢ Wave lenght 820 nm, power 30 mW) in order to reduce energy leakage and increase patient's tolerability. In this case patients underwent 1 treatment every 3 days for a total of 8 applications (treatment's time of 4 minutes). From 1990 to 1999 more than 200 patients underwent this kind of treatment. We published results in previous studies (4-5).

Clinical results: More than 65% of the patients obtained a symptoms' relief even at 6 months after treatment. We observed a decrease in IPSS score and an improvement in maximum and mean urinary flow rate. We analyzed spermatic fluid before and after treatment (6) and we found that there was an increase in total germinal cells count, improvement in motility and in morphology. Concentration of zinc, fructose and citric acid was higher after treatment (Zinc:9.5 mg% vs 5.5 mg%; Fructose: 64.5 mg% vs 58 mg%; Citric acid: 360 mg% vs 305 mg%). Prostate ultrasounds allowed to appreciate a consistent reduction of prostate volume (21.9 cc vs 29.9 cc), probably due to resolution of edema.

CONCLUSION: In our experience laser therapy for chronic prostatitis can be an effective treatment in improving symptoms and modifying clinical and sonographyc parameters.

Comparison Between the Effect of Low-Level Laser Therapy and Low-Intensity Pulsed Ultrasonic Irradiation in Vitro

De Oliveira RF, Oliveira DA, Monteiro W, Zangaro RA, Magini M, Soares CP.
Photomed Laser Surg. 2008 Feb;26(1):6-9

OBJECTIVE: The objective of this study was to compare the effect of low-level laser therapy (LLLT) and low-intensity pulsed ultrasound (LIPUS) on fibroblast cell culture. Several methods, including ultrasound treatment and LLLT, are being used to facilitate tissue repair and healing processes.

MATERIALS AND METHODS: L929 fibroblast cell cultures were irradiated with low-level laser energy and LIPUS. Cultures irradiated with ultrasound were divided into five groups: group 1: control (did not receive irradiation); group 2: 0.2 W/cm(2) in pulsed mode at 10% (1:9 duty cycle); group 3: 0.6 W/cm(2) in pulsed mode at 10% (1:9 duty cycle); group 4: 0.2 W/cm(2) in pulsed mode at 20% (2:8 duty cycle); and group 5: 0.6 W/cm(2) in pulsed mode at 20% (2:8 duty cycle). Cultures irradiated with laser energy were divided into three groups: group 1: control (did not receive irradiation); group 2: 6 J/cm(2); and group 3: 50 mJ/cm(2). Each group was irradiated at 24-h intervals, with the following incubation periods post-irradiation: 24, 48, and 72 h; after each irradiation cycle the cultures were analyzed using MTT [3-(4.5-dimethylthiazol-2-yl)-2.5 diphenyltetrazolium bromide].

Results: Analysis of results after LLLT and LIPUS demonstrated that the effect of laser therapy on fibroblast cell culture was greater than that of LIPUS ($p < 0.05$).
CONCLUSION: Results demonstrated that LLLT significantly increased fibroblastic activity more than LIPUS. Therefore, in

the first and second phases of tissue repair, laser treatment may be more effective than ultrasound treatment.

The Effectiveness of Conservative Treatments of Carpal Tunnel Syndrome: Splinting, Ultrasound, and Low-Level Laser Therapies

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Photomed Laser Surg. 2009 Feb;27(1):119-25

OBJECTIVE: The objective of this study was to investigate the effectiveness of splinting, ultrasound (US), and low-level laser (LLL) in the management of carpal tunnel syndrome (CTS).

BACKGROUND DATA: CTS is the entrapment mononeuropathy most frequently seen in clinical practice, caused by compression of the median nerve at the wrist. Although several treatment modalities are routinely in use, there is no consensus about the best way to manage CTS.

MATERIALS AND METHODS: In our study, patients were randomly allocated to three groups that received the following treatment protocols: splinting only, splinting plus US, and splinting plus LLL therapy. Patients were assessed with the Boston Questionnaire, patient satisfaction inquiry, visual analogue scale for pain, and electroneuromyography.

Validity of Using Physical Therapy in Combined Treatment of Chronic Prostatitis

Razumov SV, Egorov AA.
Urologiia. 2002 Jan-Feb;(1):14-7

To evaluate efficacy of combined physiotherapy in patients with chronic prostatitis (chronic bacterial, chronic abacterial prostatitis), an open comparative trial was made by specialists of the Research Institute of Urology in 2003-2004 of the unit Andro-Gin. Before the treatment, a standard examination was made including analysis of case history and complaints, rectal palpation, questionnaire filling-in, prostatic secretion tests, PCR diagnosis, transrectal ultrasonic scanning and uroflowmetry. In group 1 (chronic bacterial prostatitis) given monotherapy with an etiotropic drug (ED) or combination of ED with Andro-Gin treatment, a significant improvement was achieved by the scale NIH-CPSI, Sorensen scale ($p < 0.05$). In group 2 (chronic abacterial prostatitis with inflammation) subgroups C,D,E patients showed significant improvement by the scales NIH-CPSI and Sorensen ($p < 0.05$). The highest symptomatic effect was recorded in the subgroup D in combined treatment with ED and Andro-Gin physiotherapy. In group 3 low NIH-CPSI scale score occurred due to alleviation of pain in subgroup F ($p < 0.05$), In subgroup G symptoms by the above scales did not change.Uroflowmetry featured moderate dynamics of the increment in maximal voiding speed. Voiding improved significantly in subgroup F in patients with chronic abacterial prostatitis in the absence of inflammation.

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