

CAN LOW REACTIVE-LEVEL LASER THERAPY BE USED IN THE TREATMENT OF NEUROGENIC FACIAL PAIN? A DOUBLE-BLIND, PLACEBO CONTROLLED INVESTIGATION OF PATIENTS WITH TRIGEMINAL NEURALGIA

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Neurogenic facial pain has been one of the more difficult conditions to treat, but the introduction of laser therapy now permits a residual group of patients hitherto untreatable to achieve a life free from or with less pain. The present investigation was designed as a double-blind, placebo controlled study to determine whether low reactive-level laser therapy (LLLT) is effective for the treatment of trigeminal neuralgia. Two groups of patients (14 and 16) were treated with two probes. Neither the patients nor the dental surgeon were aware of which was the laser probe until the investigation had been completed. Each patient was treated weekly for five weeks. The results demonstrate that of 16 patients treated with the laser probe, 10 were free from pain after completing treatment and 2 had noticeably less pain, while in 4 there was little or no change. After a one year follow-up, 6 patients were still entirely free from pain. In the group treated with the placebo system, i.e. the non-laser probe, one was free from pain, 4 had less pain, and the remaining 9 patients had little or no recovery. After one year only one patient was still completely free from pain. The use of analgesics was recorded and the figures confirmed the fact that LLLT is effective in the treatment of trigeminal neuralgia. It is concluded that the present study clearly shows that LLLT treatment, given as described, is an effective method and an excellent supplement to conventional therapies used in the treatment of trigeminal neuralgia.

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DOUBLE BLIND CROSSOVER TRIAL OF LOW LEVEL LASER THERAPY IN THE TREATMENT OF POST HERPETIC NEURALGIA

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Post herpetic. neuralgia can be an extremely painful condition which in many cases proves resistant to all the accepted forms of treatment. It is frequently most severe in the elderly and may persist for years with no predictable course.

This trial was designed as a double blind assessment of the efficacy of low level laser therapy in the relief of the pain of post herpetic neuralgia with patients acting as their own controls. Admission to the trial was limited to patients with . established post herpetic neuralgia of at least six months duration and who had shown little or no response to conventional methods of treatment. Measurements of pain intensity and distribution were noted over a period of eight treatments in two groups of patients each of which received four consecutive laser treatments. The results indeed demonstrate a significant reduction in both pain intensity and distribution following a course of low level laser therapy.

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EFFICACY OF LOW REACTIVE-LEVEL LASER THERAPY FOR PAIN ATTENUATION OF POSTHERPETIC NEURALGIA

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The efficacy of low reactive-level laser therapy (LLLT) for pain attenuation in patients with postherpetic neuralgia (PHN) was evaluated in 63 patients (25 males, 38 females with an average age of 69 years) managed at our pain clinic over the past four years. A double blind assessment of LLLT was also performed in 12 PHN patients. The LLLT system is a gallium aluminum arsenide (GaAlAs) diode laser (830 nm, 60 mW continuous wave). Pain scores (PS) were obtained using a linear analog scale (i to 10)) before and after LLLT. The immediate effect after the initial LLLT was very good (PS: (3) in 26, and good (PS: 7-4) in 30 patients. The long-term effect at the end of LLLT (the average number of treatments 36 + 12) resulted in no pain (PS: 0) in 12 patients and slight pain (PS: 1-4) in 46 patients. No complications attributable to LLLT occurred. Although a placebo effect was observed, decreases in pain scores and increases of the body surface temperature by LLLT were significantly greater than those that occurred with the placebo treatment. Our results indicate that LLLT is a useful modality for pain attenuation in PHN patients and because LLLT is a noninvasive, painless and safe method of therapy, it is well acceptable by patients.

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DIODE LASER IN CERVICAL MYOFASCIAL PAIN: A DOUBLE-BLIND STUDY VERSUS PLACEBO.

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We present a double-blind trial in which a pulsed infrared beam was compared with a placebo in the treatment of myofascial pain in the cervical region. The patients were submitted to 12 sessions on alternate days to a total energy dose of 5 J each. At each session, the four most painful muscular trigger points and five bilateral homometameric acupuncture points were irradiated. Those in the placebo group submitted to the same number of sessions following an identical procedure, the only difference being that the laser apparatus was nonoperational. Pain was monitored using the Italian version of the McGill pain questionnaire and the Scott-Huskisson visual analogue scale. The results show a pain attenuation in the treated group and a statistically significant difference between the two groups of patients, both at the end of therapy and at the 3-month follow-up

PAIN SCORES AND SIDE EFFECTS IN RESPONSE TO LOW LEVEL LASER THERAPY (LLLT) FOR MYOFASCIAL TRIGGER POINTS

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Clinically, Low Level Laser Therapy - LLLT has been used successfully in the treatment of chronic pain but many have questioned the scientific basis for its use. Many studies have been poorly designed or poorly controlled. A double-blind, placebo-controlled, random allocation study was designed to analyse the effect of second daily infrared (IR) laser (820 nm, 25 mW) and visible red laser (670 nm, 10 mW) at 1 J/cm² and 5 J/cm² on chronic pain. Forty-one consenting subjects with chronic pain conditions exhibiting myofascial trigger points in the neck and upper trunk region underwent five treatment sessions over a two week period. To assess progress, pain scores were measured using visual analogue scales before and after each treatment. The incidence of side effects was recorded. All groups demonstrated significant reductions in pain over the duration of the study with those groups which received infrared (820 nm) laser at 1 J/cm² and 5 J/cm². demonstrating the most significant effects ($p < 0.001$). Only those subjects who had active laser treatment experienced side effects. Results indicated that responses to LLLT at the parameters used in this study are subject to placebo and may be dependant on power output, dose and/or wavelength.

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EFFICACY OF LASER IRRADIATION ON THE AREA NEAR THE STELLATE GANGLION IS DOSE-DEPENDENT: DOUBLE-BLIND CROSSOVER PLACEBO-CONTROLLED STUDY

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In the present study we evaluate the effects of laser irradiation on the area near the stellate ganglion on regional skin temperature and pain intensity in patients with postherpetic neuralgia. A double blind, crossover and placebo-controlled study was designed to deny the placebo effect of laser irradiation. Eight inpatients (male 6, female 2) receiving laser therapy for pain attenuation were enrolled in the study after institutional approval and informed consent. Each patient received three sessions of treatment on a separate day in a randomised fashion. Three minutes irradiation with a 150 mW laser (session 1), 3 minutes irradiation with a 60 mW laser (session 2), and 3 minutes placebo treatment without laser irradiation. Neither the patient nor the therapist was aware which session type was being applied until the end of the study. Regional skin temperature was evaluated by thermography of the forehead, and pain intensity was recorded using a visual analogue scale (VAS). Measurements were performed before treatment, immediately after (0 minutes) then 5, 10, 15, and 30 min after treatment. Regional skin temperature increased following both 150 mW and 60mW laser irradiation, whereas no changes were obtained by placebo treatment. VAS decreased following both 150 mW and 60 mW laser treatments, but no changes in VAS were obtained by placebo treatment. These changes in the temperature and VAS were further dependent on the energy density, i.e the dose. Results demonstrate that laser irradiation

near the stellate ganglion produces effects similar to stellate ganglion block. Our results clearly indicate that they are not placebo effects but true effects of laser irradiation.

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THE EFFECT OF INFR-ARED LASER IRRADIATION ON THE DURATION AND SEVERITY OF POSTOPERATIVE PAIN: A DOUBLE BLIND TRIAL

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This trial was designed to test the hypothesis that LLLT reduces the extent and duration of postoperative pain. Twenty consecutive patients for elective cholecystectomy were randomly allocated for either LLLT or as controls. The trial was double blind. Patients for LLLT received 6-8-min treatment (GaAlAs: 830 nm: 60 mW CW: CM) to the wound area immediately following skin closure prior to emergence from GA. All patients were prescribed on demand postoperative analgesia (IM or oral according to pain severity). Recordings of pain scores (0-10) and analgesic requirements were noted by an independent assessor. There was a significant difference in the number of doses of narcotic analgesic (IM) required between the two groups. Controls n = 5.5: LLLT n = 2.5. No patient in the LLLT group required IM analgesia after 24 h. Similarly the requirement for oral analgesia was reduced in the LLLT group. Controls n = 9: LLLT n = 4. Control patients assessed their overall pain as moderate to severe compared with mild to moderate in the LLLT group. The results justify further evaluation on a larger trial population.

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THE EFFECTIVENESS OF THE ND:YAG LASER IN THE TREATMENT OF DENTAL HYPERSENSITIVITY.

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Dentin hypersensitivity is one of the most painful and least predictably treated chronic conditions in dentistry. The effectiveness of laser therapy in the reduction of dentin hypersensitivity and its effects on pulpal vitality were studied. Nineteen subjects participated in the randomized, double-blind study, and were followed up for three months. Two sites were treated. One received helium neon (He:Ne) laser treatment and the other received He:Ne plus Nd:YAG (He:Ne+Nd:YAG) laser treatment. Laser treatment consisted of 30 millijoules (mJ) to 100 mJ per pulse, at 10 pulses per second (pps) in increments of 10-40 seconds each over a total treatment time of less than two minutes, without local anesthesia. Hypersensitivity was assessed by mechanical stimulus (using a sharp explorer), and thermal stimulus (using a blast of cold air from a dental syringe). Pulpal vitality was measured using an electrical stimulus. The results indicate that immediately following laser treatment and for three months thereafter, the subjects' perceived level of discomfort decreased. He:Ne treatment reduced dentin hypersensitivity to air by 63 per cent and to mechanical stimulation by 61 per cent over three months. The He:Ne + Nd:YAG treatment reduced dentin sensitivity to air by 58

per cent and to mechanical stimulation by 61 per cent. All teeth remained vital after laser treatment, with no adverse reactions or complications. He:Ne and He:Ne + Nd:YAG laser treatment can be used to reduce dentin hypersensitivity without detrimental pulpal effects.

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LOW LEVEL LASER THERAPY FOR DENTINAL TOOTH HYPERSENSITIVITY.

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A comparative double blind study testing low level laser therapy (Gallium/Aluminium/Arsenide laser [GaAlAs]) against placebo was carried out in the management of dentinal tooth hypersensitivity. Subjects demonstrating dentinal hypersensitivity and complying with strict selection criteria were randomly assigned to an active and placebo group. Low level laser therapy was applied for one minute to both the apex and cervical area of the tooth; and reapplied at one week, two-week and eight-week intervals. Dentinal hypersensitivity was rated at each visit. There were 28 subjects in the placebo group and 22 and 21 subjects, respectively, in the tactile sensitivity and thermal sensitivity groups. Comparisons between the groups were conducted using independent groups t-test. In both the tactile and thermal sensitivity groups differences between the active and placebo groups were significant from the first week and increased further in the second and eighth weeks. The mean value of thermal sensitivity decreased 67 per cent ($p < 0.001$) compared with placebo (17 per cent) and tactile sensitivity decreased 65 per cent ($p = .002$) compared with placebo (21 per cent) at eight weeks. Results demonstrate that the GaAlAs laser is an effective method for the treatment of both thermal and tactile dentinal hypersensitivity. There were no reported adverse reactions or instances of oral irritation.

Lasers Surg Med 1980;1(1):93-101

LASER THERAPY OF RHEUMATOID ARTHRITIS.

Goldman JA, Chiapella J, Casey H, Bass N, Graham J, McClatchey W, Dronavalli RV, Brown R, Bennett WJ, Miller SB, Wilson CH, Pearson B, Haun C, Persinski L, Huey H, Muckerheide M

Thirty people with classical or definite rheumatoid arthritis received laser exposure to a Q-switch neodymium laser that operated at 1.06 micrometer with an output of 15 joules/cm² for 30 nsec. One hand was lased at the proximal interphalangeal (PIP) and metacarpal phalangeal (MCP) joints, whereas the other hand was sham lased. The patient, physician, and occupational therapy evaluators did not know which hand was being lased. Twenty-one patients noted improvement of both their MCP and PIP joints of both hands during laser therapy. Twenty-seven noted improvement of their PIP joints and 26 noted improvement of the MCP joints during therapy. Heat, erythema, pain, swelling, and tenderness all improved with time in both hands, but the lased hand had more significant improvement in erythema and pain. There was also significant improvement in grasp and tip pressure on the lased side. The level of circulating immune complexes as measured by platelet aggregation decreased during lasing. The improvement may be related to laser exposure. The exact role that laser radiation has upon rheumatoid arthritis and its mechanism of action remain

TREATMENT OF MEDIAL AND LATERAL EPICONDYLITIS--TENNIS AND GOLFER'S ELBOW--WITH LOW LEVEL LASER THERAPY: A MULTICENTER DOUBLE BLIND, PLACEBO-CONTROLLED CLINICAL STUDY ON 324 PATIENTS.

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BACKGROUND AND OBJECTIVE: Among the other treatment modalities of medial and lateral epicondylitis, low level laser therapy (LLLT) has been promoted as a highly successful method. The aim of this clinical study was to assess the efficacy of LLLT using trigger points (TPs) and scanner application techniques under placebo-controlled conditions. **STUDY DESIGN/MATERIAL AND METHODS:** The current clinical study was completed at two Laser Centers (Locarno, Switzerland and Opatija, Croatia) as a double-blind, placebo controlled, crossover clinical study. The patient population (n = 324), with either medial epicondylitis (Golfer's elbow; n = 50) or lateral epicondylitis (Tennis elbow; n = 274), was recruited. Unilateral cases of either type of epicondylitis (n = 283) were randomly allocated to one of three treatment groups according to the LLLT technique applied: (1) Trigger points; (2) Scanner; (3) Combination Treatment (i.e., TPs and scanner technique). Bilateral cases of either type of epicondylitis (n = 41) were subject to crossover, placebo-controlled conditions. Laser devices used to perform these treatments were infrared (IR) diode laser (GaAlAs) 830 nm continuous wave for treatment of TPs and HeNe 632.8 nm combined with IR diode laser 904 nm, pulsed wave for scanner technique. Energy doses were equally controlled and measured in Joules/cm² either during TPs or scanner technique sessions in all groups of patients. The treatment outcome (pain relief and functional ability) was observed and measured according to the following methods: (1) short form of McGill's Pain Questionnaire (SF-MPQ); (2) visual analogue scales (VAS); (3) verbal rating scales (VRS); (4) patient's pain diary; and (5) hand dynamometer. **RESULTS:** Total relief of the pain with consequently improved functional ability was achieved in 82% of acute and 66% of chronic cases, all of which were treated by combination of TPs and scanner technique. **CONCLUSIONS:** This clinical study has demonstrated that the best results are obtained using combination treatment (i.e., TPs and scanner technique). Good results are obtained from adequate treatment technique correctly applied, individual energy doses, adequate medical education, clinical experience, and correct approach of laser therapists. We observed that under- and overirradiation dosage can result in the absence of positive therapy effects or even opposite, negative (e.g., inhibitory) effects. The current clinical study provides further evidence of the efficacy of LLLT in the management of lateral and medial epicondylitis.

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SUCCESSFUL MANAGEMENT OF FEMALE OFFICE WORKERS WITH "REPETITIVE STRESS INJURY" OR "CARPAL TUNNEL SYNDROME" BY A NEW TREATMENT MODALITY- APPLICATION OF LOW LEVEL LASER

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Abstract. Female office workers with desk jobs who are incapacitated by pain and tingling in the hands and fingers are often diagnosed by physicians as "repetitive stress injury" (RSI) or "carpal tunnel syndrome" (CTS). These patients usually have poor

posture with their head and neck stooped forward and shoulders rounded; upon palpation. they have pain and tenderness at the spinous processes C5 - T1 and the medial angle of the scapula. In 35 such patients we focused the treatment primarily at the posterior neck area and not the wrists and hands. A low level laser (100 mW) was used and directed at the tips of the spinous processes C5 - T1. The laser rapidly alleviated the pain and tingling in the arms, hands and fingers. and diminished tenderness at the involved spinous processes. Thereby, it has become apparent that many patients labeled as having RSI or CTS have predominantly cervical radicular dysfunction resulting in pain to the upper extremities which can be managed by low level laser. Successful long-term management involves treating the soft tissue lesions in the neck combined with correcting the abnormal head, neck and shoulder posture by taping. cervical collars, and clavicle harnesses as well as improved work ergonomics.

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PHYSIOLOGICAL RESPONSES IN CHRONIC PAIN PATIENTS LLLT PROTOCOL

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Use of Low Reactive Level Laser Therapy (LLLT) utilising helium-neon lasers has increased lately especially in pain control. New protocols are being developed aimed at a complex of primary and secondary symptomologies. One of these protocols Stellate Ganglion Stimulation has shown in our research a unique set of developments. Targeting the area of the stellate ganglion is showing great promise in the rehabilitation of patients with a history of chronic musculoskeletal pain syndromes, but several patients with preexisting psychological symptomology have exacerbated during the initial stages of utilization of this protocol. Patients with a history of psychological diagnosis for dysthymia, anxiety, post traumatic stress disorder or minor diffuse brain injury have shown an exacerbation of these symptomologies during the initial phases of stimulation treatment. Overall, response to this form of therapy seems to be positive but some patients require dermatomal and/or site-specific therapy to maximize outcome. With specific psychological treatment combined with a more conservative amount of stimulation initially the increase in these symptoms shows a tendency to remit with the pain response. Our continued research is currently focusing on the mechanisms for this type of response as well as protocol refinement to maximize its effectiveness.

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MECHANISMS OF THE ANALGESIC EFFECT OF THERAPEUTIC LASERS IN VIVO

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The analgesic effects in the course of application of therapeutic lasers to affected tissue have been described in a number of works in the literature. Although a few scientific-based reports have appeared, those on laser-induced analgesia are mainly clinical works describing the effect of the therapy which, however, do not study the mechanism of the laser action. There are several different possible responses induced by non-invasive low level laser therapy (LLLT). The purpose of the present communication is to review the arrangement and characterisation of these responses. By being aware of these effects, the laser therapist can acquire a physiological and morphological scheme making possible

the appropriate choice of the site of application of LLLT, choice of the irradiation technique, and selection of appropriate doses.

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MECHANISTIC APPROACH TO GaAlAs DIODE LASER EFFECTS ON PRODUCTION OF REACTIVE OXYGEN SPECIES FROM HUMAN NEUTROPHILS AS A MODEL FOR THERAPEUTIC MODALITY AT CELLULAR LEVEL

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There have been many reports on the applications of low reactive level laser (LLL) therapy for pain attenuation or pain removal. Our group has reported previously on the effects of in vitro irradiation of LLLT particularly on the phagocytic activity of human Neutrophils. using luminol-dependent chemiluminescence (LmCL) for measurement of reactive oxygen species (ROS) production from human Neutrophils. But the mechanisms of the attenuation of phagocytic activity of NEUTROPHILS by LLL irradiation is not yet full understood,

In this study. we used luminol-dependent and lucigenin-dependent chemiluminescence (LgCL) for detection of affected ROS producing process of human Neutrophils by LLL irradiation. Two soluble action stimuli. N-formyl-Met-Leu-Phe (fMLP) and phorbol myristate acetate (PMA) were used to avoid the possible influence of lag-time from recognition to uptake of particles at the ROS production.

In case of using fMLP as a stimulus, the maximum luminescence intensity of LULL was increased hut LgCL luminescence was decreased by LLL irradiation. When PMA was used as a stimulus, the times to reach the maximum luminescence intensity of LmCL and LgCL were shortened by LLL irradiation but there was no effect on the maximum luminescence intensity of both.

These results suggest that LLL irradiation enhances the ROS production activity of human Neutrophils by the activation of the superoxide converting system, the active clement in which is mainly myeloperoxidase. LLL irradiation enabled a more rapid activation of the superoxide production system, NADPH -oxidase.

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THE EFFICACY OF LASER THERAPY FOR MUSCULOSKELETAL AND SKIN DISORDERS: A CRITERIA-BASED META-ANALYSIS OF RANDOMIZED CLINICAL TRIALS.

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The efficacy of laser therapy for musculoskeletal and skin disorders has been assessed on the basis of the results of 36 randomized clinical trials (RCTs) involving 1,704 patients. For this purpose, a criteria-based meta-analysis that took into account the methodological quality of the individual trials was used. The studies with a positive outcome were generally of a better quality than the studies with a negative outcome. No clear relationship could be demonstrated between the laser dosage applied and the efficacy of laser therapy, or between the dosage and the methodological score. In general, the methodological quality of these studies appeared to be rather low. Consequently, no definite conclusions can be drawn about the efficacy of laser therapy for skin disorders. The efficacy of laser therapy for musculoskeletal disorders seems, on average, to be larger than the efficacy of a placebo treatment. More specifically, for rheumatoid arthritis, posttraumatic joint disorders, and myofascial pain, laser therapy seems to have a substantial specific therapeutic effect. Further RCTs, avoiding the most prevalent methodological errors, are needed in order to enable the benefits of laser therapy to be more precisely and validly evaluated.

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Lasers Surg Med 1993;13(4):463-9

ANALGESIC EFFECT OF GA-AL-AS DIODE LASER IRRADIATION ON HYPERALGESIA IN CARRAGEENIN-INDUCED INFLAMMATION.

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This study concerned the effect of Ga-Al-As diode laser irradiation (780 nm, continuous wave, 31.8 J/s/cm², spot size of 0.2 mm, 3 minutes/dose) on hyperalgesia induced in the hind paw of rats by injecting carrageenin. The pressure-pain thresholds of hind paws were measured by the Randall-Selitto test for evaluation of hyperalgesia. Two doses of laser irradiation, given to the inflamed region immediately before and after the injection of carrageenin, partially (approximately 50%) inhibited the occurrence of hyperalgesia accompanied with a progression of inflammation. This analgesic effect was equal to that of indomethacin (4 mg/kg, i.o.). In another group, the hyperalgesia was removed almost completely for at least 24 hours by one dose of laser irradiation, which was given 3 hours after the carrageenin injection, whereas the edema was not inhibited. This analgesic effect, however, was partially (approximately 50%) antagonized with a dose of 10 mg/kg (i.p.) of naloxone and totally inhibited with 30 mg/kg. These results suggest that low-power laser irradiation on inflamed regions of carrageenin-treated rats has a marked analgesic effect and that certain mechanisms that are not related to endogenous opioids are involved in a part of the mechanisms of the analgesic effects.

THERAPEUTIC EFFECT OF GA-AL-AS DIODE LASER IRRADIATION ON
EXPERIMENTALLY INDUCED INFLAMMATION IN RATS.

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We produced experimental inflammation models in rats by carrageenin and studied the effect of Ga-Al-As diode laser irradiation (780 nm, continuous wave, 31.8 j/sec/cm², spot size of 0.2 mm) on inflamed regions compared with those of indomethacin, a potent anti-inflammatory agent. We found that a low-power infrared laser has an anti-inflammatory effect on carrageenin inflammation. A low-power laser inhibits: (1) the increase of vascular permeability during the occurrence of an acute inflammation in the carrageenin-air-pouch model, (2) edema in the acute stage in the carrageenin-paw-edema model, and (3) the granuloma formation in the carrageenin-granuloma model after receiving laser irradiation once daily. In all cases, irradiation for less than 10 min was sufficient to inhibit the inflammation by 20-30%. The inhibitory effect of laser irradiation was not comparable to that of indomethacin (4 mg/kg, i.o.) in the air-pouch model and the paw-edema model, whereas laser irradiation was more potent than that of daily administration of indomethacin (1 mg/kg, i.o.) in the granuloma model. In future studies of the mechanism of laser effect, it should be noted that irradiating a rat twice, before and after the provocation of inflammation, was essential in order to achieve an effective