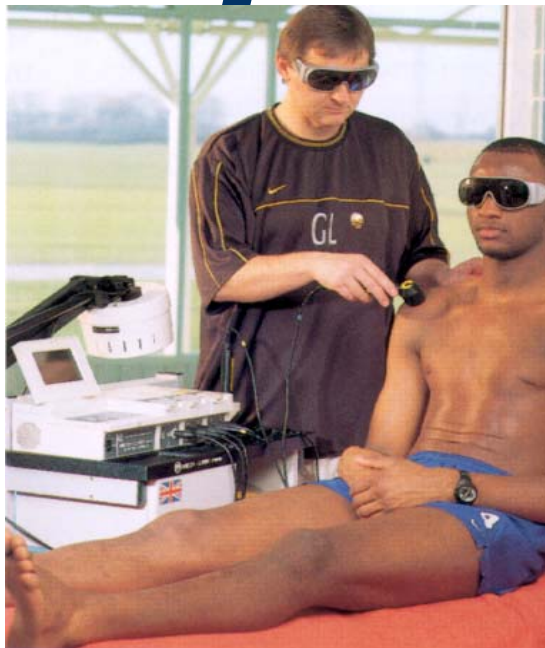


LASER

Therapeutic effects



รศ.สมชาย รัตน์ทองคำ

Effect of Laser

- ***High power Laser***
 - *coagulation of protein*
 - *thermolysis*
 - *evaporation*
- ***Low Power Laser (LILT)***
 - *pain relieve*
 - *bio-stimulation*

Therapeutic effect LILT

- ***Pain relieve***
- ***Bio-stimulation***

Therapeutic effects: Laser Evidence-based



Collagen Synthesis

- *Mester, 1971: " effects of ruby laser on wound healing in mice and rats"*
- *McKibbin et al, 1983; Abegel, 1984: " biostimulation of procollagen production by HeNe, ALAs laser in human skin fibroblast"*

- เชื่อว่าเลเซอร์มีส่วนช่วยกระตุ้น *mRNA transcription rate*
- แนะนำให้ใช้กับผู้ป่วย: *burn, nonhealing wound, pressure sore, tendon & ligament injured*

Pain management: local therapy

- *Honmura, 1992: "therapeutic effect of GaAlAs laser irradiation on experimentally" (GaAlAs, 780 nm, CW, 31.8J/s/cm²)*

- *เชื่อว่าเลเซอร์มีส่วนช่วย ลดปริมาณของเหลวออกจากเซลล์*
- *แนะนำให้ใช้กับผู้ป่วย: ลดบวม โดยเฉพาะระยะเฉียบพลัน*

Pain management: local therapy

- ***Essman, 1984, Brennan 1982: "effects of HeNe upon mouse skin and mouse skin injury"***

• ***เชื่อว่า HeNe ช่วยเพิ่ม superoxide dismutase (SOD)***

prostaglandins -----> inflammation, tenderness, hyperalgia

SOD inhibit prostaglandins

Pain management: local therapy

- *stimulated sympathetic afferent fiber ----> CNS*
Bischko, 1980
- *increase serotonin (5HTA) Walker, 1982*
- *decrease depolarization of c-fiber Wakabayashi, 1993*
- *Increase membrane potential Balaban, 1992*

Decrease edema

- *Essman, 1984, Brennan 1982: "effects of HeNe upon mouse skin and mouse skin injury"*

• *เชื่อว่า HeNe ช่วยเพิ่ม superoxide dismutase (SOD) ผลจากการเพิ่ม SOD ทำให้เกิดการลดบวมของเนื้อเยื่อ*

Decrease edema

- *Honmura, 1992: "therapeutic effect of GaAlAs laser irradiation on experimentally"*

•เชื่อว่า GaAlAs มีส่วน ช่วยลดของเหลวออกนอกเซลล์ ลดบวม

Wound healing

- *Mester, 1971; Trelles, 1981: " the biostimulative effect of HeNe laser beam"*

• *เชื่อว่าเลเซอร์มีส่วนช่วย: เพิ่ม phagocytosis, epithelization, granulation tissue formation*

Bactericidal Effects

Lasers Med Sci (2003) 18: 51–55
DOI 10.1007/s10103-002-0243-5

ORIGINAL ARTICLE

You Chan · Chern-Hsiung Lai

Bactericidal effects of different laser wavelengths on periodontopathic germs in photodynamic therapy

Received: 29 November 2001 / Accepted: 18 June 2002
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Abstract This study was an attempt to clarify whether the bactericidal effects of photodynamic therapy (PDT) are wavelength or dose-dependent. We also attempted to create an optimised protocol for a light-based bactericidal modality to eliminate periodontal pathogens. Cultures of *Actinobacillus actinomycetemcomitans*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Streptococcus sanguis*, were exposed to a He-Ne laser (632.8 nm) with a 30 mW power output, a 100 mW diode laser at 665 nm, or a

dosage, in combination with an appropriate photosensitiser, is a practical bactericidal modality. We concluded that using a diode laser of proper power and wavelength to deliver 60 s of irradiation could be a useful adjunct with mechanical debridement in the prevention of the re-colonisation of subgingival lesions by pathogenic microorganisms.

Keywords Bactericidal · Diode laser · Methylene blue · Oral bacteria · Photodynamic therapy

Pain management

169

Pain, 43 (1990) 169–179
Elsevier

PAIN 01673

Low power laser biostimulation of chronic oro-facial pain. A double-blind placebo controlled cross-over study in 40 patients

Hans Jørgen Hansen and Ulla Thorøe

*Department of Oral and Maxillofacial Surgery, Z 3084, University Hospital (Rigshospitalet), Copenhagen (Denmark),
and Department of Oral and Maxillofacial Surgery, Royal Dental College, Copenhagen (Denmark)*

(Received 30 November 1989, revision received 30 May 1990, accepted 31 May 1990)

Summary The efficacy of low power laser stimulation in the treatment of chronic oro-facial pain conditions was investigated in a double-blind placebo controlled modified cross-over study in 40 patients. The laser was an invisible infrared (IR) diode laser with an emission at 904 nanometer (nm). Treatment effect was evaluated by means of VAS-scales and global assessment of pain. Outcome of treatment was correlated to changes in urinary excretion of 5-hydroxyindoleacetic acid (5-HIAA). The clinical impression was that placebo was superior to laser stimulation. No statistically significant difference between the analgesic effect of the laser and placebo irradiation was found on VAS-scales. A significant ($P = 0.05$) increase in 5-HIAA excretion was found in the placebo group. It is concluded that the possibility of a substantial placebo response should be taken into consideration using 904 nm (IR) lasers for pain treatment in patients with this type of chronic oro-facial pain.

Bone defect healing

Lasers Med Sci 2002, 17:216–220
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Laser Stimulation on Bone Defect Healing: An In Vitro Study

G.A. Guzzardella¹, M. Fini¹, P. Torricelli¹, G. Giavaresi¹ and R. Giardino^{1,2}

¹Department of Experimental Surgery, Codivilla-Putti Research Institute/Rizzoli Orthopaedic Institute, Italy; ²Department of Surgical Pathophysiology, University of Bologna, Italy

Abstract. The aim of this in vitro study was to evaluate whether low-power laser (LPL) stimulation can accelerate bone healing. Bone defects of a standard area were created in the distal epiphysis of 12 femora explanted from six rats, and they were cultured in BGJb medium for 21 days. Six defects were treated daily with Ga-Al-As, 780 nm LPL for 10 consecutive days (lased group, LG), while the remainder were sham-treated (control group, CG). Alkaline phosphatase/total protein (ALP/TP), calcium (Ca), and nitric oxide (NO) were tested on days 7, 14 and 21 to monitor the metabolism of cultured bone. The percentage of healing of the defect area was determined by histomorphometric analysis. After 21 days significant increases were observed in ALP/TP in LG versus CG ($p < 0.001$), in NO in the LG versus CG ($p < 0.0005$) and in Ca in CG versus LG ($p < 0.001$). The healing rate of the defect area in the LG was higher than in the CG ($p = 0.007$). These in vitro results suggest that Ga-Al-As LPL treatment may play a positive role in bone defect healing.

Keywords: Bone healing; Experiment; Low-power laser; Organ culture

Carpal tunnel syndrome

Lasers Med Sci 1999, 14:196–202
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Clinical Outcome and Neurophysiological Results of Low-Power Laser Irradiation in Carpal Tunnel Syndrome

L. Padua^{1,2}, R. Padua⁴, C. Moretti³, M. Nazzaro³ and P. Tonali^{1,5}

¹Institute of Neurology, Università Cattolica; ²CRCCS, A.Fa.R., Fatebenefratelli Isola Tiberina; ³Fondazione Pro Iuventute Don Gnocchi; ⁴Institute of Orthopaedics, Università Cattolica; ⁵CSS IRCCS, San Giovanni Rotondo, Roma, Italy

Abstract. The present study evaluates the effects of Low Power Laser (LPL) irradiation (pulsed wave 830 nm GaAs laser tri-diode) on 17 primary carpal tunnel syndrome (CTS) hands through nerve conduction studies and through a validated clinical patient-oriented questionnaire. Systematic early and late follow-up (six evaluations) was achieved and showed transitory improvement of clinical and neurophysiological patterns; the maximum effect was observed at the end and 15 days after therapy. Later evaluations (2 and 12 months) showed that almost all parameters progressively returned to the pretreatment pattern. The results were compared with those obtained from an untreated control group.

The data suggest that low power laser treatment can improve the condition of CTS hands, but it seems that this is transitory. Our observations suggest that LPL may be a useful therapy in selected cases of CTS.

Keywords: Carpal tunnel questionnaire; Carpal tunnel syndrome; Low-power laser; Neurophysiology; Patient oriented

Cell proliferation

Lasers Med Sci 1998, 13:143–147
© 1998 Springer-Verlag London Limited

Effect of Helium-Neon (He-Ne) Laser Irradiation on Dog Neoplasm Cells in Culture

J.M. Ocaña-Quero¹, R. Gomez-Villamandos², M. Moreno-Millán¹ and J.M. Santisteban-Valenzuela²

¹Departamento de Genética and ²Departamento de Patología Animal, Facultad de Veterinaria de Córdoba, Spain

Abstract. The effects of laser light on the cellular proliferation have been extensively characterised. Low-power laser sources, such as the helium–neon (He-Ne) laser irradiation with a wavelength of 632.8 nm, have been found to produce photobiological and photodamaging effects with evidence of interference with cell proliferation functions. The present study has investigated the in vitro effect of He-Ne laser irradiation on the proliferative action of dog tumour cells in culture. Dose–response studies showed that repeated He-Ne irradiation (irradiance 12.8 mW/cm²) once a day for 4 consecutive days in a dose range between 0.13 and 2.08 J/cm² significantly increased with increasing energy density up to a laser dose of 0.26 J/cm², whereas at >1.04 J/cm², the cell proliferation decreased with increasing energy densities. It is concluded that the application of He-Ne laser irradiation at energy densities ranging from 0.13 J/cm² to 2.08 J/cm² produced different effects on cell proliferation in dog tumour cells in culture.

Keywords: Cell proliferation; Dog tumour cell; He-Ne laser; Photobiology; Photodynamic therapy

LASER: Therapeu

Dose dependency

Lasers Med Sci 2001, 16:44–51
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Dose-dependency of Low-energy HeNe Laser Effect in Regeneration of Skeletal Muscle in Mice

A.C. Amaral, N.A. Parizotto and T.F. Salvini

Departamento de Fisioterapia, Universidade Federal de São Carlos, SP, Brazil

Abstract. We evaluated the effect on mice skeletal muscle regeneration of different doses (2.6, 8.4, and 25 J/cm²) of HeNe laser (λ 632.8 nm; power, 2.6 mW; spot size, 0.007 cm²) applied directly to intact skin of injured muscle. Muscle injury was induced in both right and left Tibialis anterior (TA) muscles by ACL myotoxin (5 mg/kg). Right TA muscles were irradiated daily for 5 days while contralateral muscles received a sham treatment. Only the 2.6 J/cm² dose resulted in changes such as increased mitochondrial density and muscle fibre in the TA muscles as compared to sham groups ($3280 \pm 704 \mu\text{m}^2$ versus $2110 \pm 657 \mu\text{m}^2$, $p=0.02$). We concluded that the HeNe effect on mouse muscle regeneration is dose-specific: only 2.6 J/cm² increased muscle fibre area and mitochondrial density.

Keywords: Muscle injury; Muscle regeneration; Skeletal muscle; Tibialis anterior; ACL myotoxin

LASER: Therapeu

Ulcers: case reports

Arch Orthop Trauma Surg (1998) 117:156–158

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CLINICAL AND EXPERIMENTAL FORUM

Z. Landau

Topical hyperbaric oxygen and low energy laser for the treatment of diabetic foot ulcers

Received: 3 January 1997

Abstract Fifty patients with chronic diabetic foot ulcers in whom conventional therapy had failed were treated with topical hyperbaric oxygen alone (15 patients) or in combination with a low energy laser (35 patients). Eleven of these patients were treated on an ambulatory basis with topical hyperbaric oxygen. The mean time the ulcer was present before therapy was 9 ± 6.6 months. The mean number of treatments was 25 ± 13 , and the mean duration of therapy was 3 ± 1.8 months. Forty-three of the 50 patients were cured. No adverse reactions were noted. Our impression is that topical hyperbaric oxygen alone or in combination with a low power laser are valuable adjuncts to conventional therapy for diabetic foot ulcers.

has not received enough attention. A low energy laser has a biostimulating effect on cell mitosis [7], keratinocyte motility and proliferation [2], and cytokine production [4]. Animal experimental studies showed an enhancing effect on wound healing [1]. Clinical studies with helium neon (Ne-Ne) as a source of the laser energy showed a beneficial effect on wound healing [5, 8].

In this study we used topical hyperbaric oxygen alone or combined with a low energy laser for the treatment of patients with chronic diabetic foot ulcers in whom conventional therapy with antibiotics, debridement, and weight reduction had failed.

Fibromyalgia

Lasers Med Sci 2002, 17:57–61
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Efficacy of Low Power Laser Therapy in Fibromyalgia: A Single-blind, Placebo-controlled Trial

A. Gür, M. Karakoç, K. Nas, R. Çevik, J. Saraç and E. Demir

Physical Medicine and Rehabilitation, School of Medicine, Dicle University, Diyarbakir, Turkey

Abstract. Low energy lasers are widely used to treat a variety of musculoskeletal conditions including fibromyalgia, despite the lack of scientific evidence to support its efficacy. A randomised, single-blind, placebo-controlled study was conducted to evaluate the efficacy of low-energy laser therapy in 40 female patients with fibromyalgia. Patients with fibromyalgia were randomly allocated to active (Ga-As) laser or placebo laser treatment daily for two weeks except weekends. Both the laser and placebo laser groups were evaluated for the improvement in pain, number of tender points, skinfold tenderness, stiffness, sleep disturbance, fatigue, and muscular spasm. In both groups, significant improvements were achieved in all parameters ($p < 0.05$) except sleep disturbance, fatigue and skinfold tenderness in the placebo laser group ($p > 0.05$). It was found that there was no significant difference between the two groups with respect to all parameters before therapy whereas a significant difference was observed in parameters as pain, muscle spasm, morning stiffness and tender point numbers in favour of laser group after therapy ($p < 0.05$). None of the participants reported any side effects. Our study suggests that laser therapy is effective on pain, muscle spasm, morning stiffness, and total tender point number in fibromyalgia and suggests that this therapy method is a safe and effective way of treatment in the cases with fibromyalgia.

Keywords: Fibromyalgia; Low power laser therapy

The Influence of Low Intensity Infrared Laser Irradiation on Conduction Characteristics of Peripheral Nerve: A Randomised, Controlled, Double Blind Study on the Sural Nerve

D. Cambier, K. Blom, E. Witvrouw, G. Ollevier, M. De Muyenck and G. Vanderstraeten

University of Gent, Faculty of Medicine, Department of Motor Rehabilitation and Physical Therapy, University Hospital Gent, Gent, Belgium

Abstract. The aim of this study was to investigate the effects of low intensity laser therapy (LILT) on the conduction characteristics of peripheral sensory nerve. Fifteen healthy subjects participated in this experiment. Six points on the sural nerve of the left leg were irradiated with an 830 nm GaAlAs laser with different parameters. All 15 subjects received at random one of the following treatments: an average power of 400 mW at a dose of 1.5 J per point (7.65 J/cm²) (treatment A); an average power of 140 mW and a dose of 1.0 J per point (5.1 J/cm²) (treatment B); an average power of 30 mW, 0.5 J per point (2.55 J/cm²) (treatment C) and to evaluate possible placebo effects in a fourth moment, no power was given (sham). The influence of skin temperature on conduction characteristics of peripheral nerve was taken into account by using correction factors for conduction velocity (1.47 m/s per °C) and negative peak latency (0.2 ms per °C) to a reference temperature of 32°C.

One way analysis of variation with repeated measurements of the data collected within 15 min postirradiation showed a significant decrease in conduction velocity and increase in negative peak latency in treatment B. Those results could explain possible laser-mediated pain relief.

Keywords: Electromyography; Laser therapy; Negative peak latency; Nerve conduction velocity; Pain relief, Sural nerve

Wound Healing: review

Lasers Med Sci 2000, 15:84–93
© 2000 Springer-Verlag London Limited

REVIEW

Efficacy of Low-Level Laser Therapy on Wound Healing in Human Subjects: A Systematic Review

C. Lucas¹, R.W. Stanborough², C.L. Freeman² and R.J. De Haan³

¹Department of Research and Innovation in Health Sciences and ²Institute of Physical Therapy, University of Professional Education: Hogeschool van Amsterdam, The Netherlands; and ³Department of Clinical Epidemiology and Biostatistics, Academic Medical Center, University of Amsterdam, The Netherlands

Abstract. This systematic review summarises the efficacy of infrared low-level laser therapy (LLLT) on wound healing in human subjects. In order to retrieve randomised clinical trials, we performed computer-aided searches of databases and bibliographic indexes. Furthermore, congress reports, reviews and handbooks were checked for relevant citations. Subsequently, all retrieved and masked studies were scored on methodological quality. We found four randomised clinical trials that investigated the effects of LLLT versus placebo or any other intervention. Only one trial demonstrated a beneficial effect. Overall, study quality ranged from poor to insufficient. For three studies we could perform a meta-analysis. The overall effect size estimate indicates that LLLT had no significant beneficial effect on wound healing (pooled RR=0.76, 95% CL 0.41–1.40). We conclude that there are no scientific arguments for routine application of infrared (904 nm) LLLT on wound healing in patients with decubitus ulcers, venous leg ulcers (ulcus cruris) or other chronic wounds.

Keywords: Laser therapy; Pressure ulcer; Systematic review; Wound healing

Effect of Nerve

- *Increase collateral nerve sprouting and regeneration of damage nerve* **Cheng & McKibbin, 1985**
- *decrease spasticity* **Walker, 1982**
- *Increase rate of regeneration of facial nerve* **Aders, 1992**
- *Increase membrane potential* **Balaban, 1992**

Indication

- *symtomatic relief & treatment of pain*
- *reduced pain in OA joint*
- *acceleration wound healing (granulation formation)*
- *reduced of edema*
- *reduced of inflamation*
- *stimulated peripheral nerve regeneration*

Contraindication

- ผู้ที่เป็นโรคลมชัก
- ผู้ที่มีไข้สูง
- ผู้ป่วยมะเร็ง
- บริเวณท้องหรือหลังของหญิงมีครรภ์/มีระดู
- บริเวณ *epiphyses* ของเด็ก
- ผู้ป่วยภาวะโรคจิต
- บริเวณสูญเสียความรู้สึกรับรู้
- บริเวณที่มีการติดเชื้อ
- บริเวณ *sympathetic ganglian, vagus n, cardiac region*
- ผู้ป่วยภาวะโรคหัวใจต่างๆ

Precaution

- รังสีส่องเข้านัยน์ตาโดยตรง
- ในผู้ที่ได้รับการฉายแสง (*radiotherapy*) ในระยะเวลา 4-6 เดือน
- บริเวณที่มีเลือดออกมาก
- บริเวณผิวหนังที่ไวต่อแสง
- บริเวณที่เป็นต่อมไร้ท่อ

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