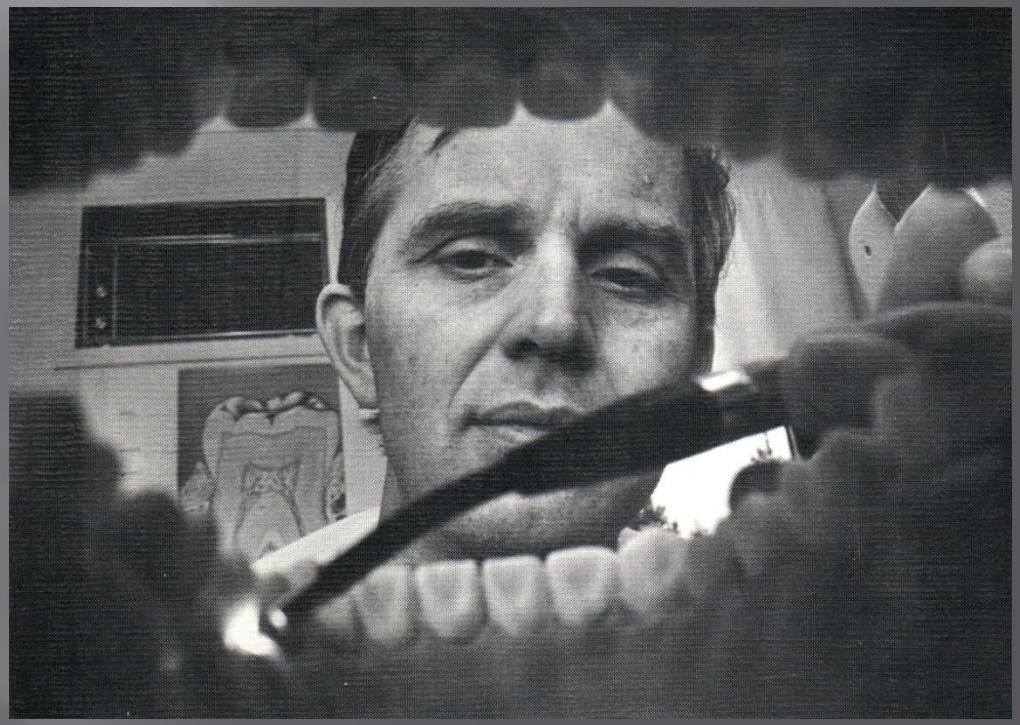
Laser Phototherapy

science and clinic

- **Jan Tunér**

D.D.S.

Nordic Dental Laser Association

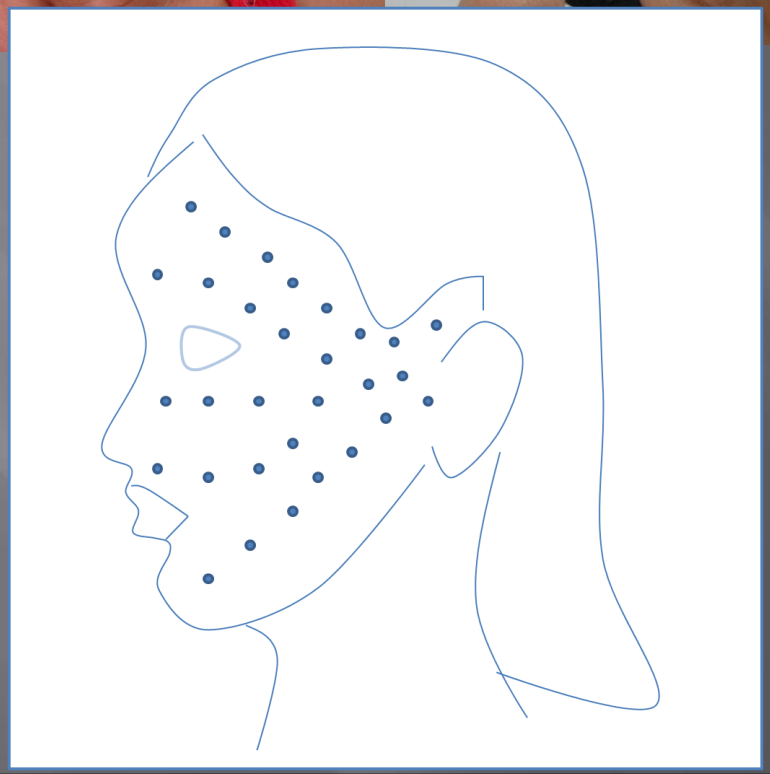






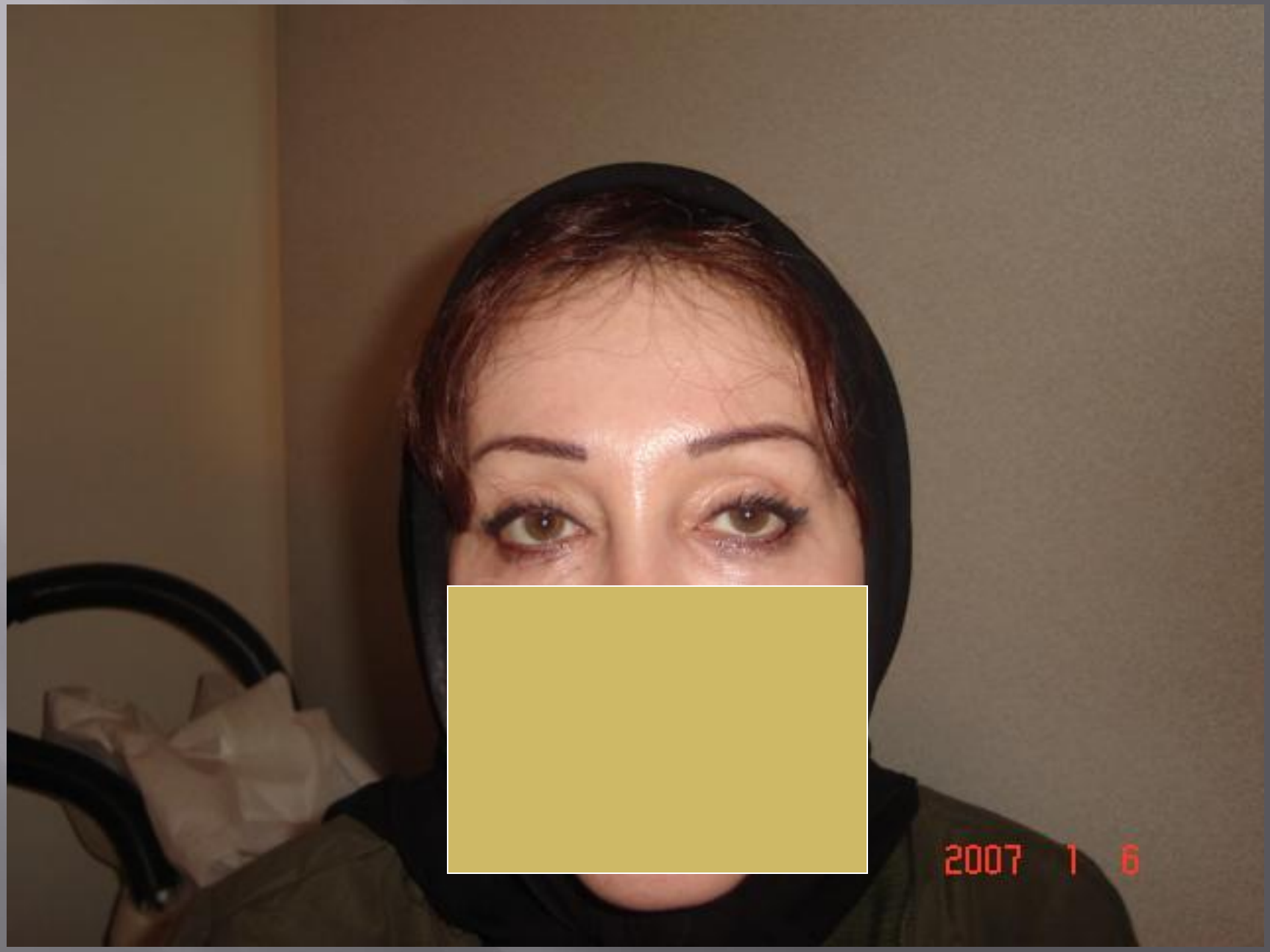



Vecta G



Age and beauty




2007 1 6

Laser phototherapy:

Non-thermal levels of coherent light, leading to cellular modifications

WYSIWUG?

Pioneers

- McGuff P E, Deterling R A Jr, Gottlieb L S. Tumoricidal effect of laser energy on experimental and human malignant tumors. N Engl J Med. 1965; 273 (9): 490-492.
- McGuff P E, Deterling R A Jr, Gottlieb L S, Fahimi H D, Bushnell D, Roeber F. Effects Of Laser Radiation On Tumor Transplants. Fed Proc. 1965; 24: Suppl 14: 150-154.
- McGuff P E, Gottlieb L S, Katayama I, Levy C K. Comparative study of effects of laser and/ or ionizing radiation therapy on experimental or human malignant tumors. Am J Roentgenol Radium Ther Nucl Med. 1966; 96 (3): 744-748.
- McGuff P E, Deterling R A Jr, Gottlieb L S. Laser radiation for metastatic malignant melanoma. JAMA. 1966; 31; 195 (5): 393-394.
- McGuff P E. Laser radiation for basal cell carcinoma. Dermatologica. 1966; 133 (5): 379-383.
- McGuff P E. Tumoricidal effect of laser radiation on malignant tumors. Int Ophthalmol Clin. 1966; 6 (2): 379-386.

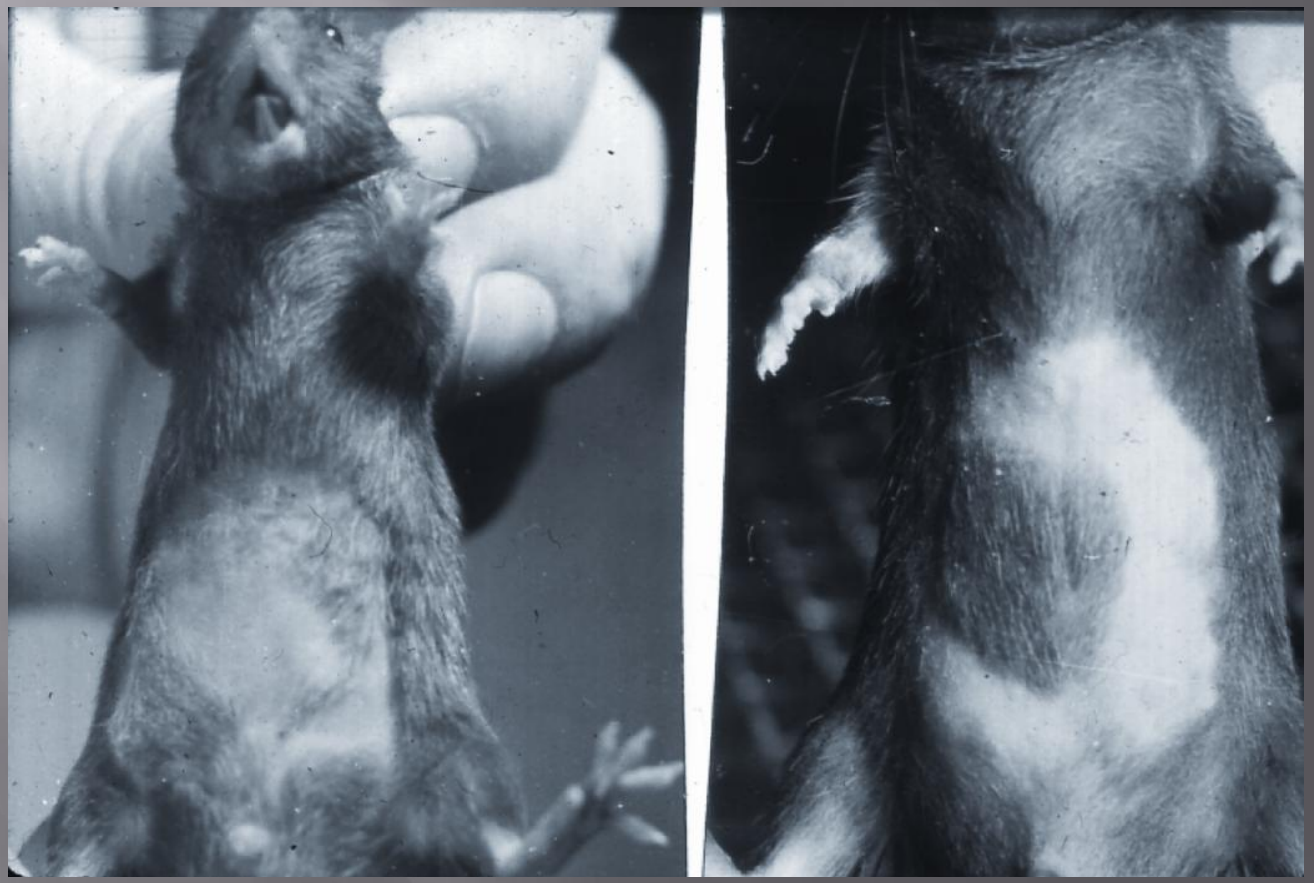
Endre Mester with Adam and Andrew



“The historic rats”



Regrowth of fur



Terminology confusion

- Low Level Laser
- Therapeutic Laser
- Biostimulative laser
- Soft laser
- Cold laser
- …and many more

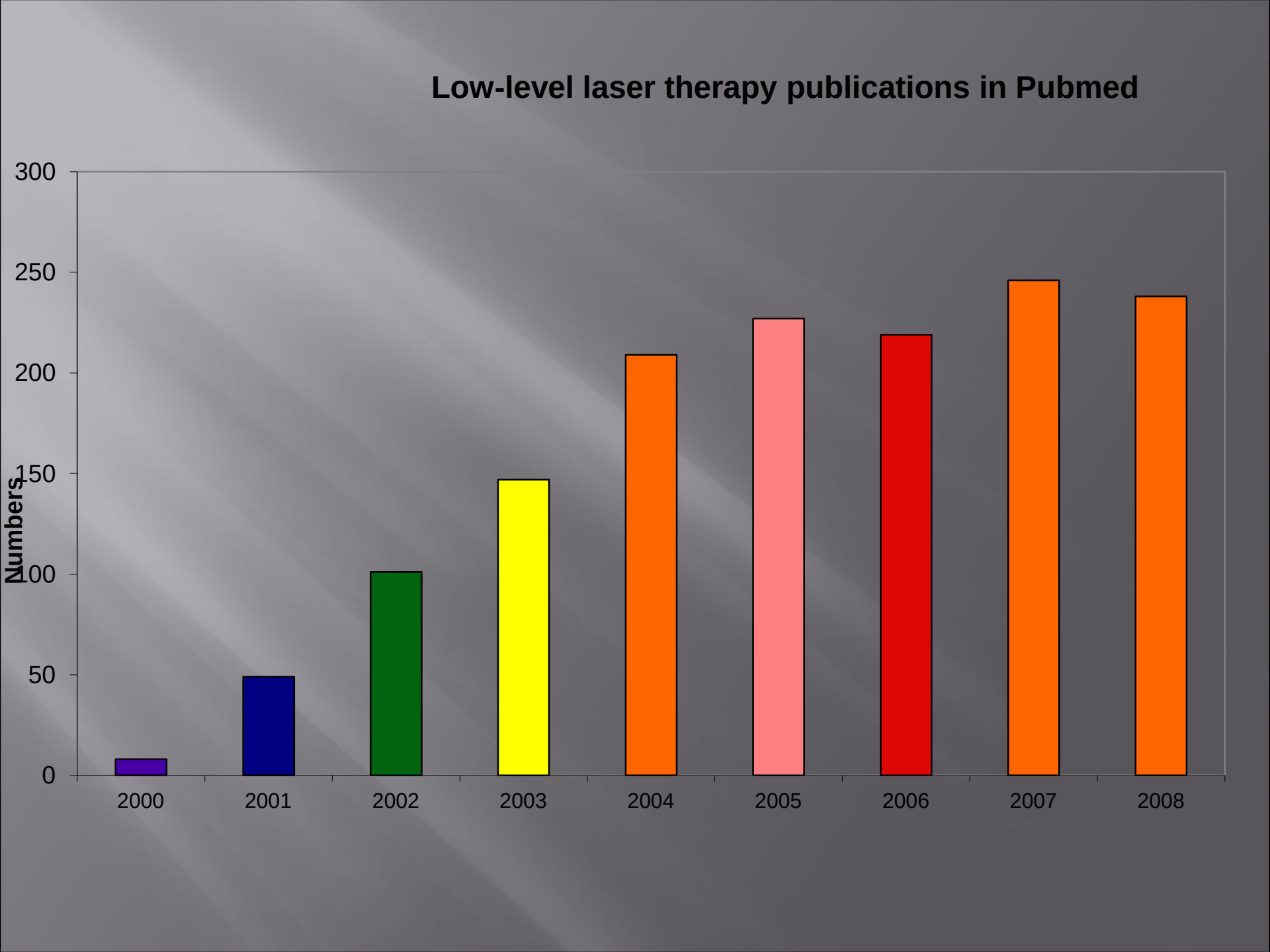
Most used types

- (Helium Neon 632.8 nm)
- InGaAlP 630-700 nm
- GaAlAs 700-980 nm
- GaAs 904 nm

Power: 10 – 500 mW

Energies used: 1-20 joules per point

Dose (fluence): 1-200 J/cm2


Low-level laser therapy publications in Pubmed
Numbers
300
250
200
150
100
50
0
2000
2001
2002
2003
2004
2005
2006
2007
2008

Double blind studies



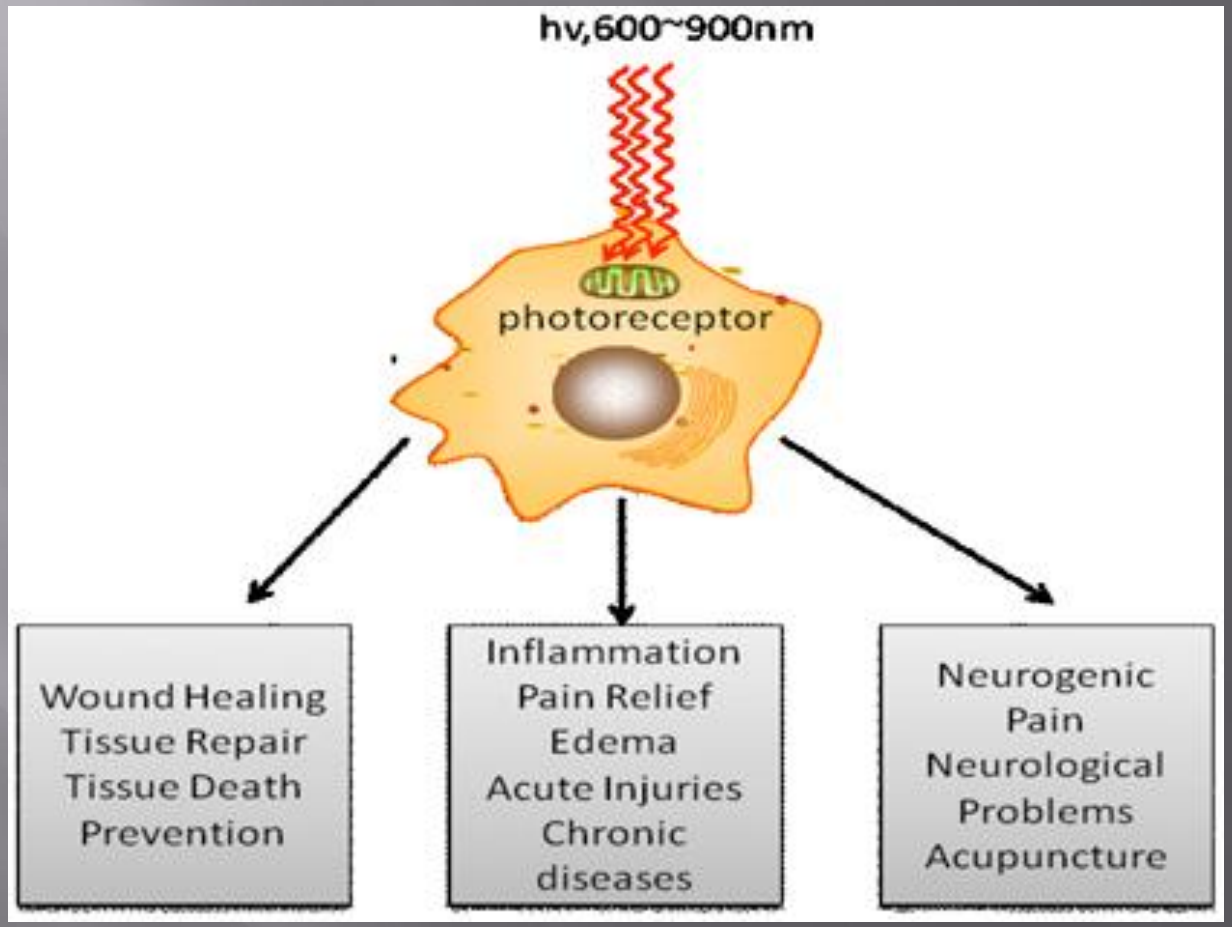
There are now at least 125 randomized controlled trials investigating the pain-relieving effects of LLLT

Some mechanisms

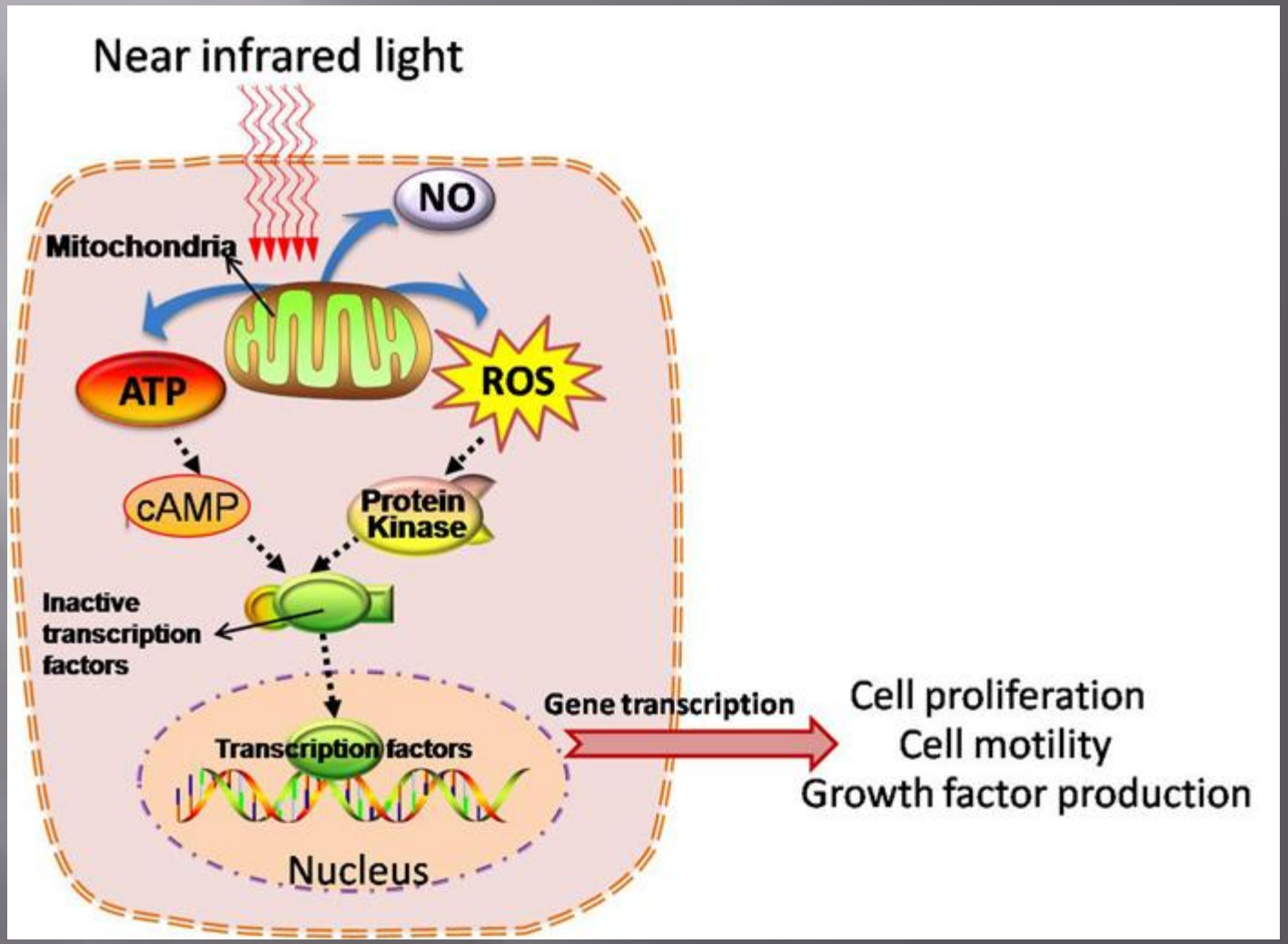


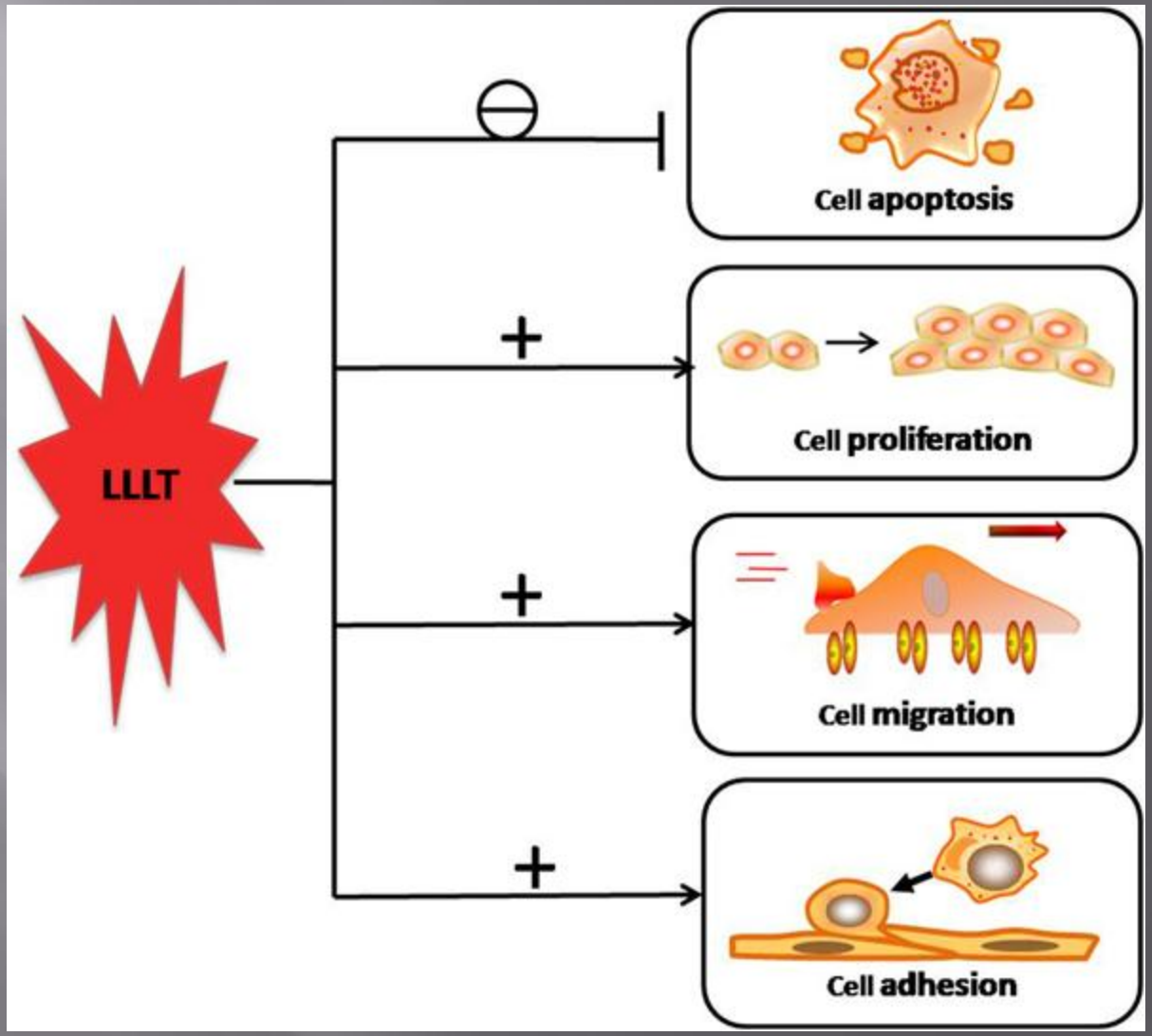
- ”We can talk to the cells, but we need to learn their language”

Tiina Karu


hv,600~900nm
photoreceptor
Wound Healing
Tissue Repair
Tissue Death
Prevention
Inflammation
Pain Relief
Edema
Acute Injuries
Chronic
diseases
Neurogenic
Pain
Neurological
Problems
Acupuncture

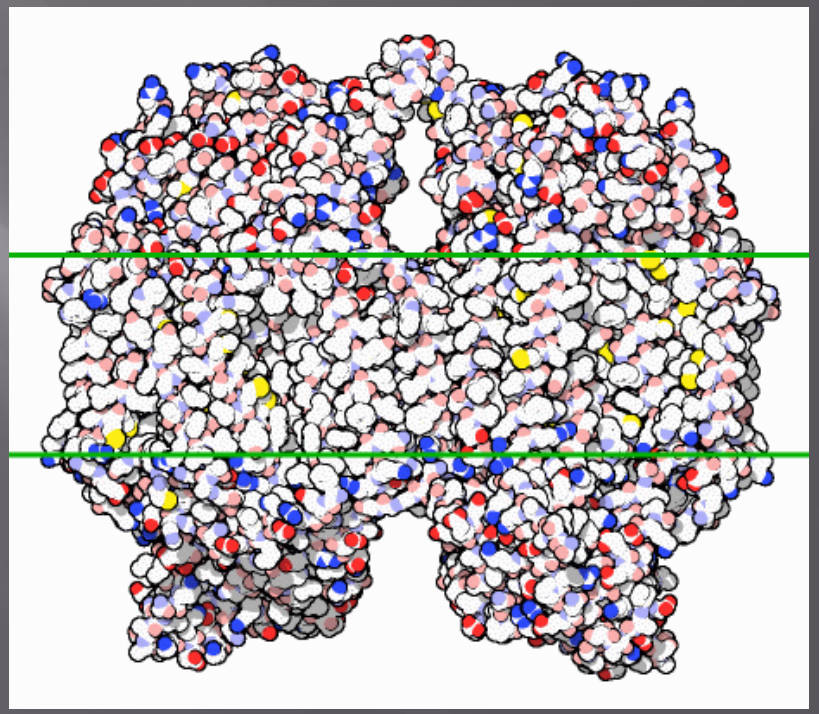
Proposed mechanism of LLLT. ATP: Adenosine triphosphate. cAMP: Cyclic adenosine monophosphate. NO: Nitric oxide. ROS: Reactive-oxygen species.




LLLT
Cell apoptosis
Cell proliferation
Cell migration
Cell adhesion

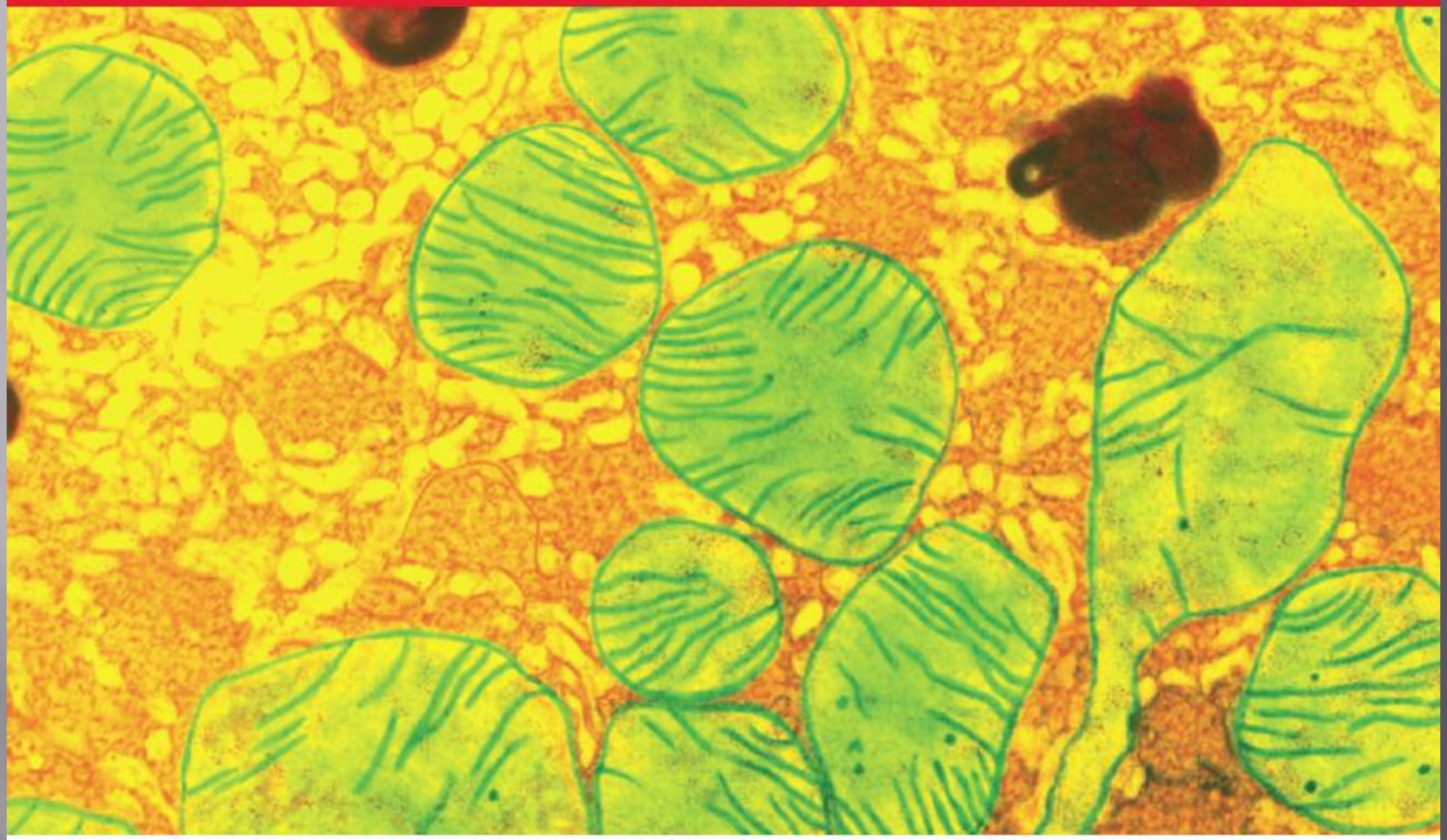
Photoreceptors (1)

- Cytochrome c Oxidase
- - terminal enzyme of the mitochondrial respiratory chain
- - ATP producer



Cytochrome c oxidase

- Salet C, Moreno G, Vinzens F. A study of beating frequency of a single myocardial cell. III. Laser micro-irradiation of mitochondria in the presence of KCN or ATP. Exp Cell Res. **1979**; 120 (1): 25-29.



POWER GAMES

There's a fight going on inside all our cells for each breath of air. **Nick Lane** sheds therapeutic light on the implications for cancer and degenerative diseases.

Photoreceptors (2)

- **Some human photochemically reactive proteins:**
- Encephalopsin in the brain
- Pinopsin in the pineal gland
- **Prokaryotic and eukaryotic cells:**
- More than 500

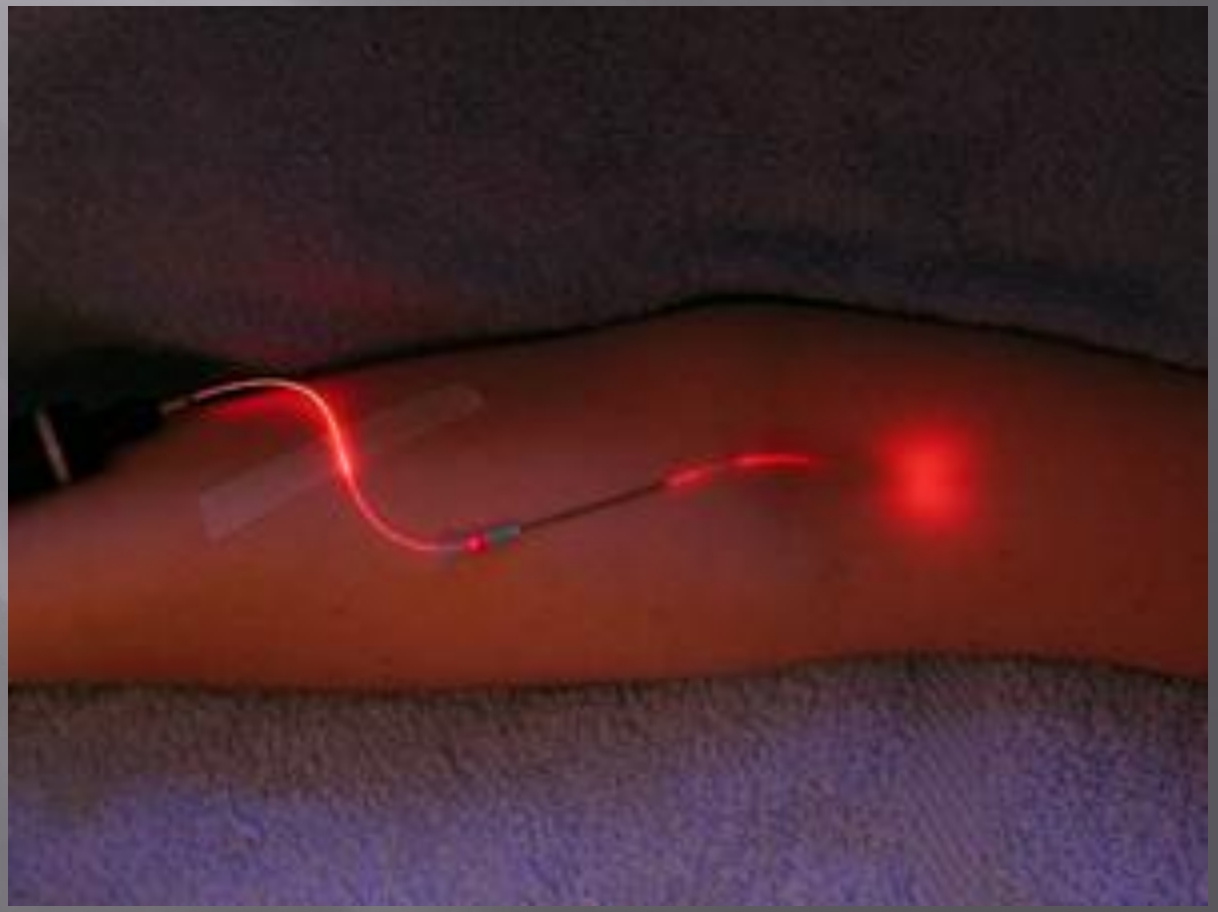
Photoreceptors (3)

- Endogenous porphyrines
- (compare PhotoDynamic Therapy)

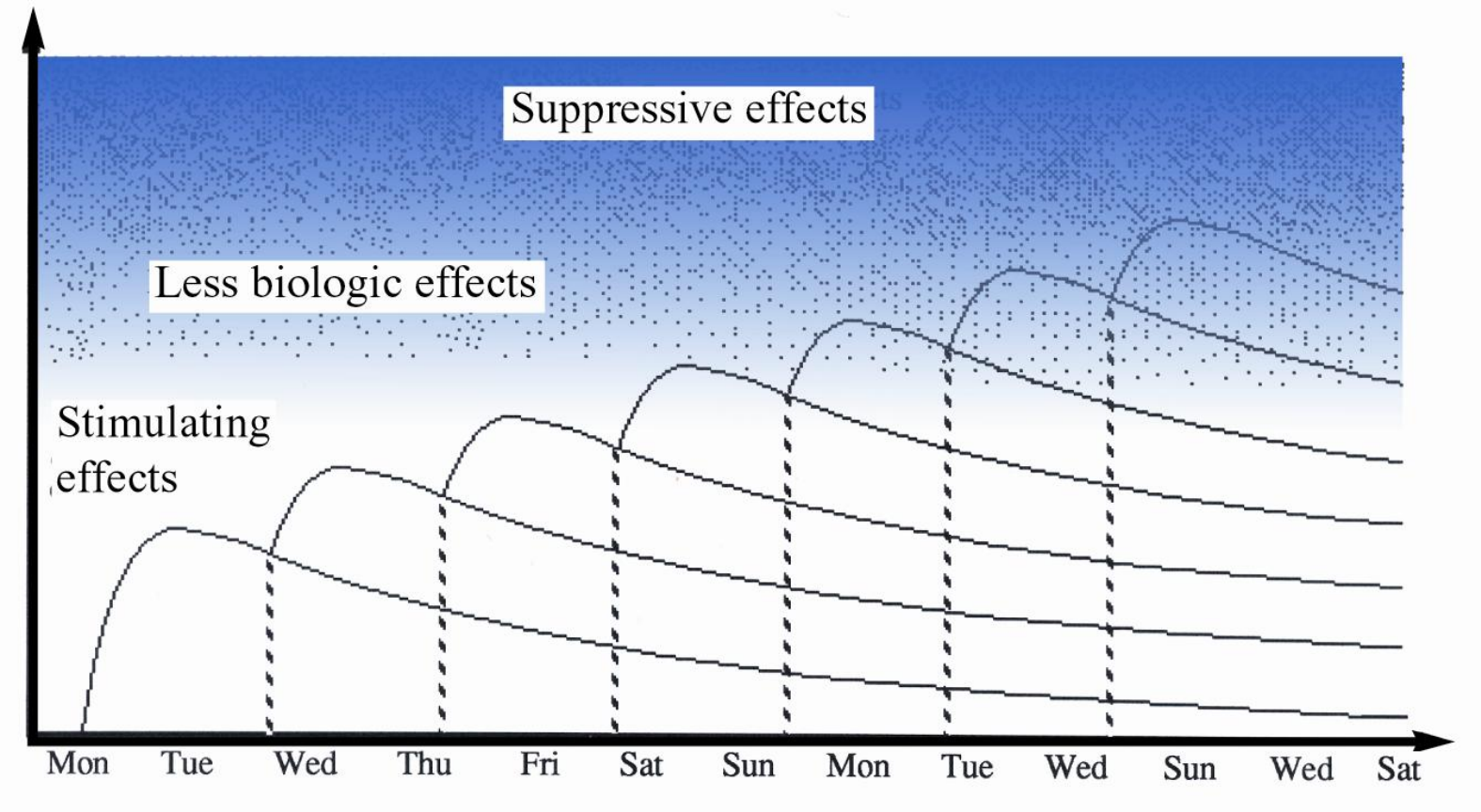
Blood irradiation

- Intravenous (HeNe) – extra corporis – over veins (IR)
- 5% of blood irradiated
- UV to IR seem to produce same results
- Septic conditions
- Combination with pharmaceuticals

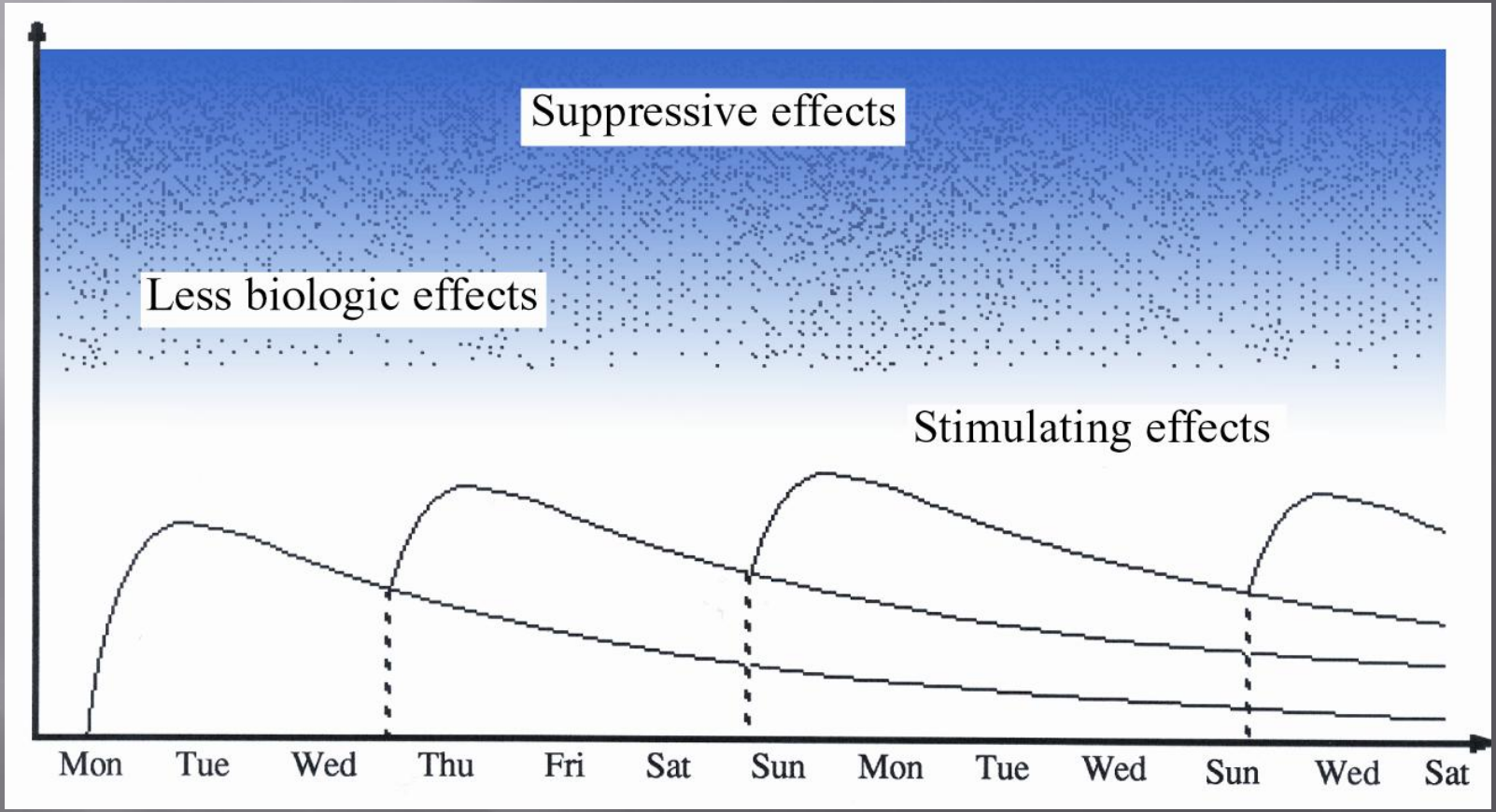
Blood irradiation



The doses are cumulative



Less frequent irradiation



40 years of use
No serious adverse effects discovered

Abiko Y et al. 2008
Nihon University, School of Dentistry at Matsudo.

LLLI significantly reduced swellings of foot paw and knee joint of rats and made it possible to walk by hind legs. LLLI altered many gene expressions of cytokines, chemokines, growth factors and signal transduction factors in IL-b induced MH-7. IPA revealed that LLLI as well as DEX kept the MH7A to the normal state to suppress mRNA levels of IL-8, IL-1b, CXC1, NFkB1, FGF13 which were enhanced by IL-1b treatment. However, certain gene expression of inflammatory factors were reduced by LLLI, but were enhanced by DEX.

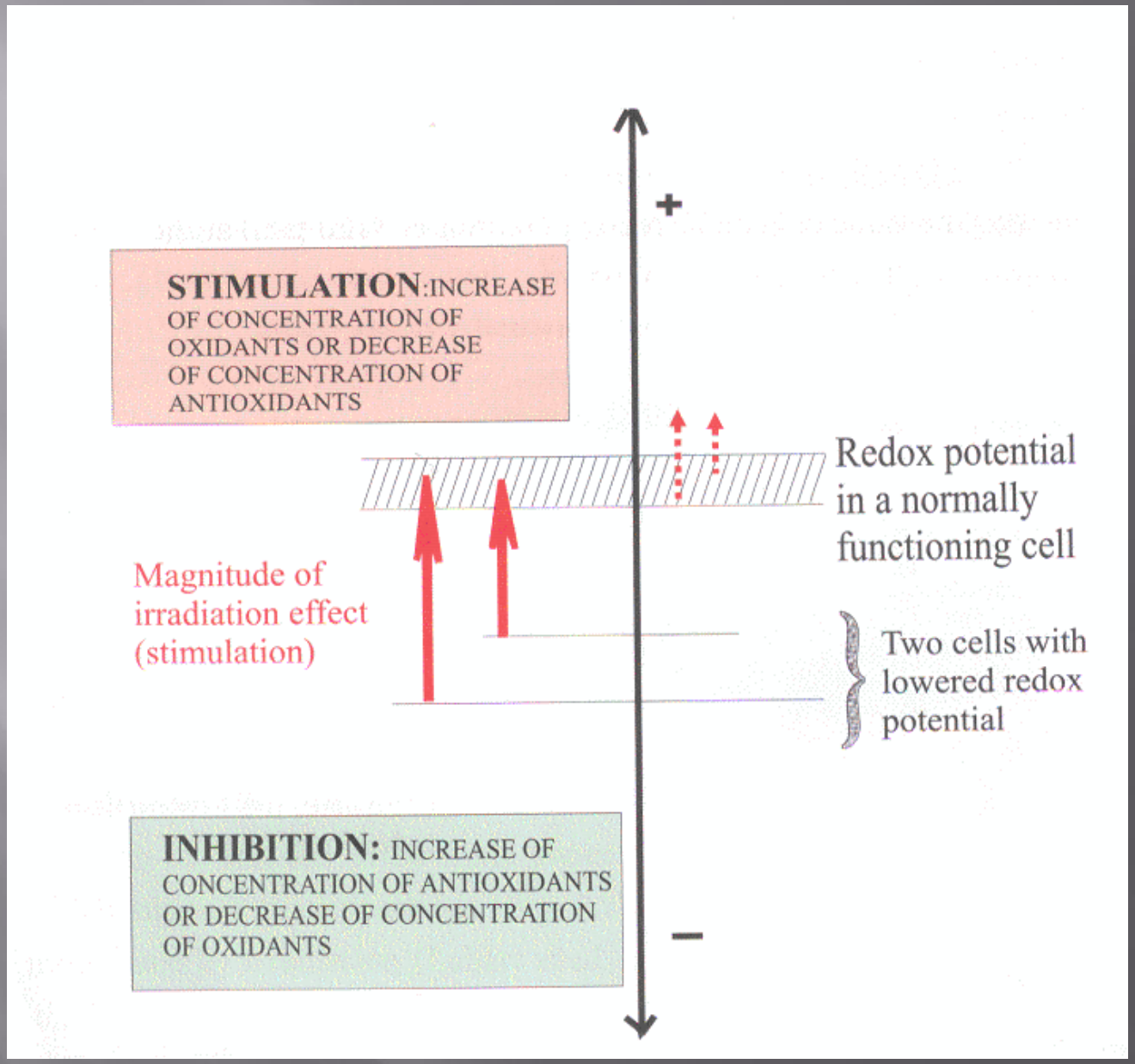
Conclusion: LLLI reduced inflammatory factors through altering signal pathways by gene expression levels. Interestingly, LLLI altered useful targeted gene expressions, whereas DEX randomly altered many gene expressions including the unwanted genes for anti-inflammation. Thus, genome based gene expression monitoring using Gene Chip system together with signal pathway based database provide unprecedented access to elucidate the mechanism of biostimulatory effects by LLLI.

Phototherapy works best on cells in a reduced redox situation

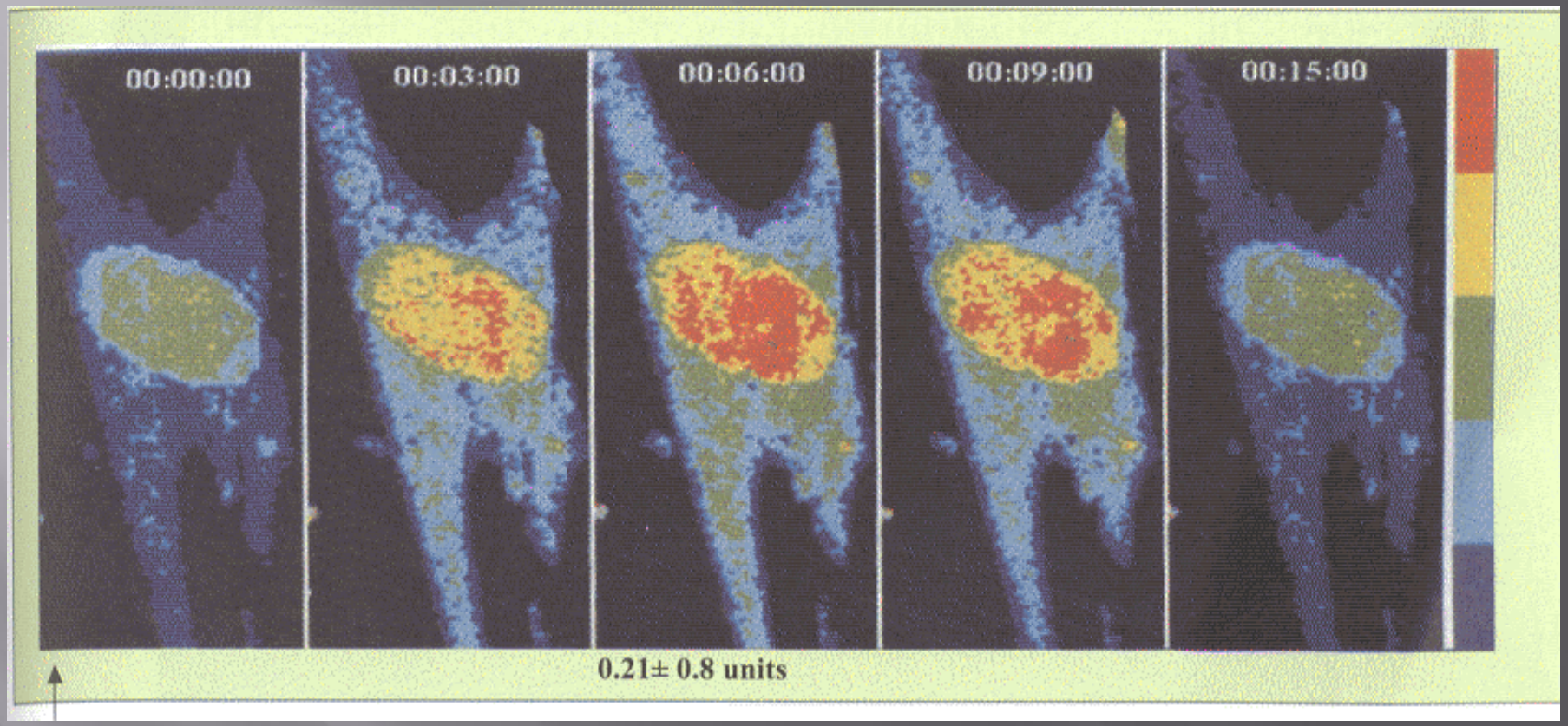
- Yamamoto Y, Kono T, Kotani H, Kasai S, Mito M. Effect of low-power laser irradiation on procollagen synthesis in human fibroblasts. J Clin Laser Med Surg. 1996; 14 (3): 129-132.

- Almeida-Lopes L, Rigau J, Zángaro R et al. Comparison of the low level laser therapy effects on cultured human gingival fibroblast proliferation using different irradiance and same fluency. Laser Surg Med. 2001; 29: 179-184.

- Al-Watban FA, Andres BL. Polychromatic LED in oval full-thickness wound healing in non-diabetic and diabetic rats. Photomed Laser Surg. 2006; 24 (1): 10-16.


STIMULATION: INCREASE OF CONCENTRATION OF OXIDANTS OR DECREASE OF CONCENTRATION OF ANTIOXIDANTS
+
Redox potential in a normally functioning cell
Magnitude of irradiation effect (stimulation)
Two cells with lowered redox potential
INHIBITION: INCREASE OF CONCENTRATION OF ANTIOXIDANTS OR DECREASE OF CONCENTRATION OF OXIDANTS
–

Karu T, 2007



Alexandratou et al 2002
pH change in single fibroblast

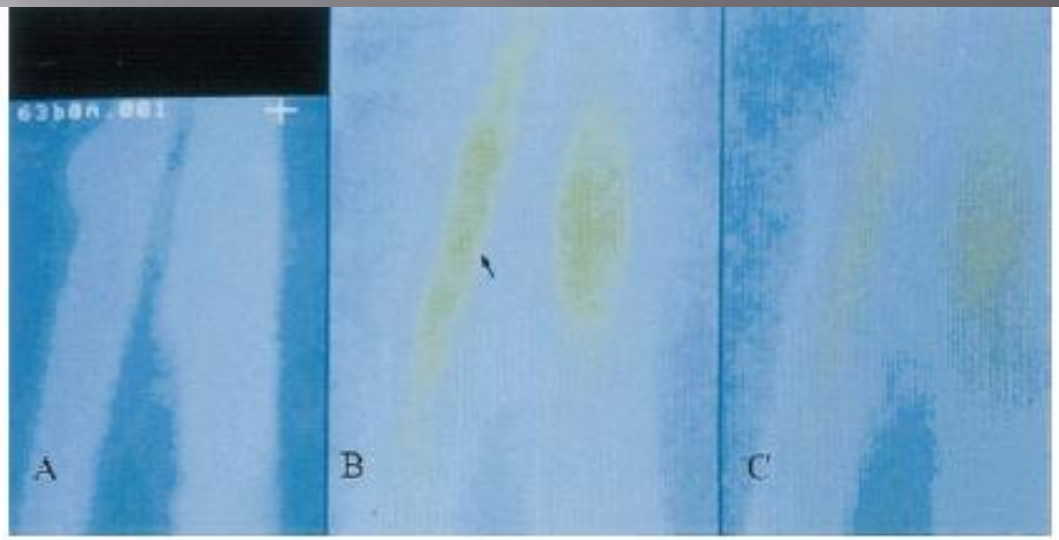


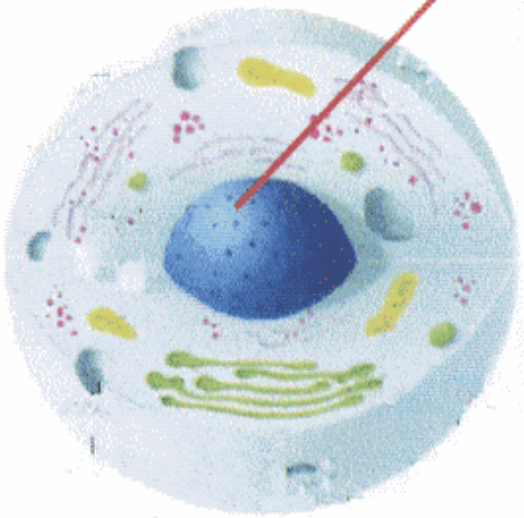
Fig. 6. Effect of light irradiation with He/Ne 3 J/cm^2 on intracellular calcium in rat skeletal muscle myotubes, preincubated with 1 μg/ml hematoporphyrin for 2 h. Calcium was determined with fluo-3/AM with photo imaging system. Picture A represents the basal fluorescence in the myotubes. Picture B represents myotubes immediately after irradiation and picture C represents the myotubes at 420 s post-irradiation. The pseudo yellow color represents calcium level elevation.

Shin D H, Lee E, Hyun J K, Lee S J et al. Growth-associated protein-43 is elevated in the injured rat sciatic nerve after low power laser irradiation. Neurosci Lett. 2003; 344 (2): 71-74.

cDNA microarray analysis of gene expression profiles in human fibroblasts HS27

(Zhang et al., J. Invest. Dermatol. 120:849, 2003)

hν=628 nm
0.88 J/cm^2

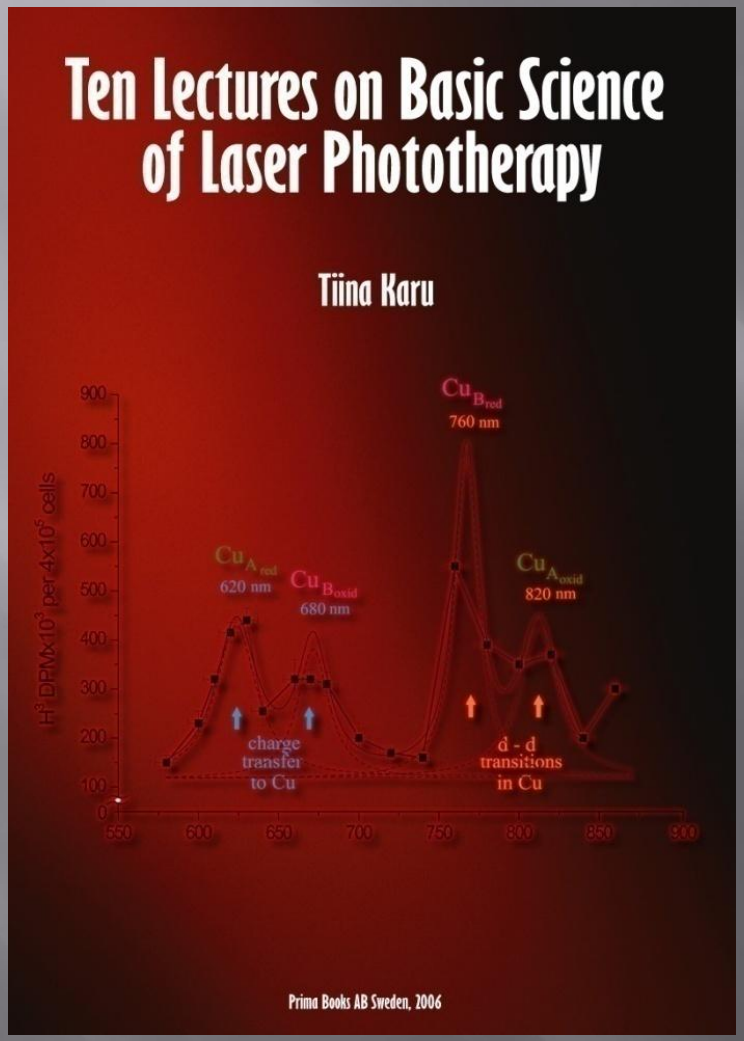


9982 genes studied:

111 genes of 10 categories were affected by irradiation

- **proliferation**
- antioxidant
- metabolism
- membrane potential
- **cytosceleton**
- DNA synthesis
- transcription factors
- **immune/inflammation**
- cytokines

Recommended reading

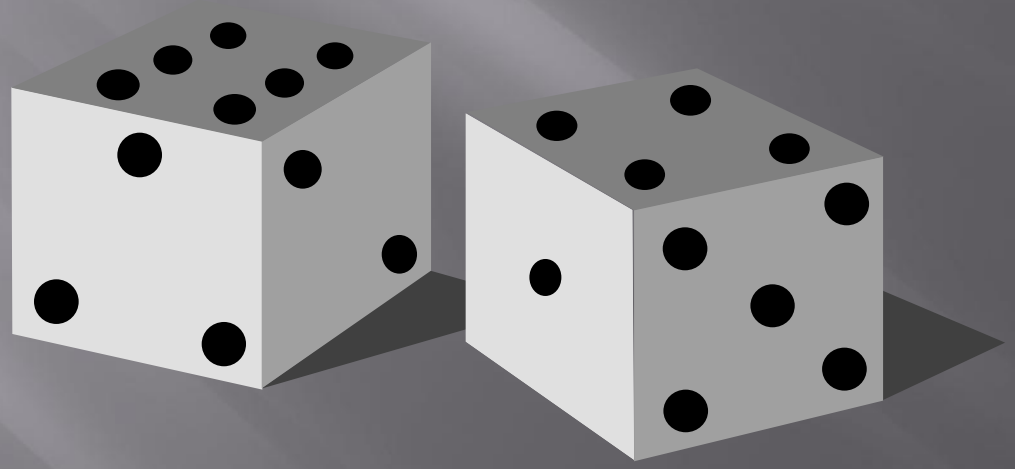


www.prima-books.com

Is it only a heat effect?

- Lanzafame R J, Stadler I, Coleman J, Haerum B, Oskoui P, Whittaker M, Zhang R Y. Temperature-controlled 830-nm low-level laser therapy of experimental pressure ulcers. Photomedicine and Laser Surgery. 2004; 22 (6): 483-488.

Does laser light cause cancer?



The visible spectrum

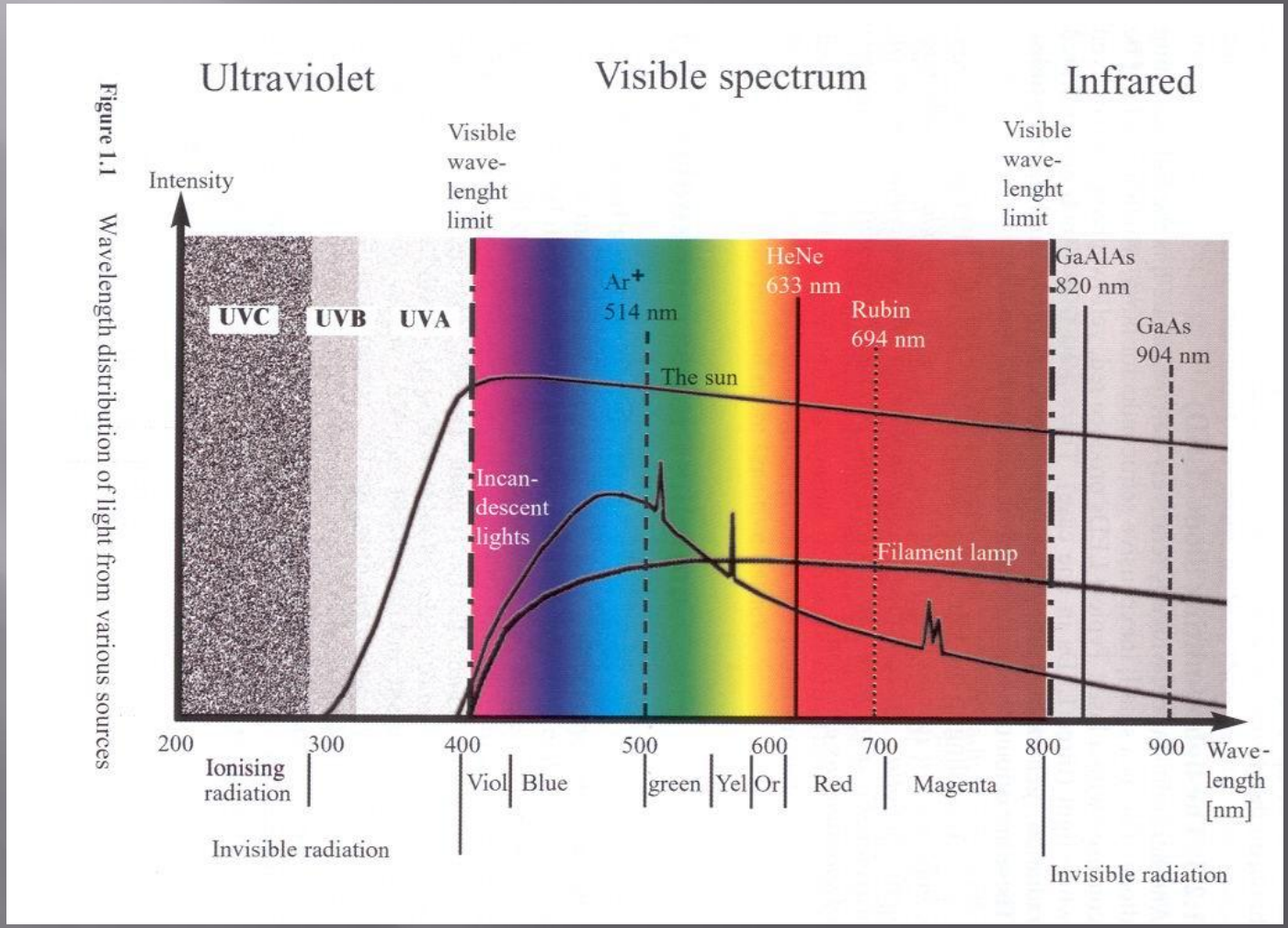


Figure 1.1 Wavelength distribution of light from various sources

Protection against radiation injury

- Podolskaya E et al. Radiation damage of lips and its treatment by low-intensity laser irradiation. Proc SPIE. 1995; Vol 1984: 245-246.
- Popova M et al. [Effect of Helium-Neon laser beam in regeneration of irradiated transplanted skeletal muscle]. Biull Exp Biol Med. 1978; 80: 333. (Russian with English abstract.)
- Karu T I, Pyatibrat L, Kalendo G. Irradiation with HeNe laser can influence the cytotoxic response of HeLa cells to ionizing radiation. Int. J Radiation Biology. 1994; 65 (6): 691-697.

Prevention of apoptosis

- Carnevalli CM, Soares CP, Zangaro RA, Pinheiro AL, Silva NS. Laser light prevents apoptosis in Cho K-1 cell line. J Clin Laser Med Surg. 2003 Aug;21(4):193-6.

Cells held in conditions of nutritional deficiency and then irradiated at 830 nm had both their membrane and genetic material more preserved than in the controls.

- LLLT can stimulate some cancer cells *in vitro*

- LLLT stimulates the immune system *in vivo*. This stimulation is normally higher than the stimulation of the cancerous cells

However, the treatment of cancer is always the privilege of the specialist!

LLLT is recommended as a palliative therapy in terminal patients

DO HIGH DOSES DAMAGE TISSUE?

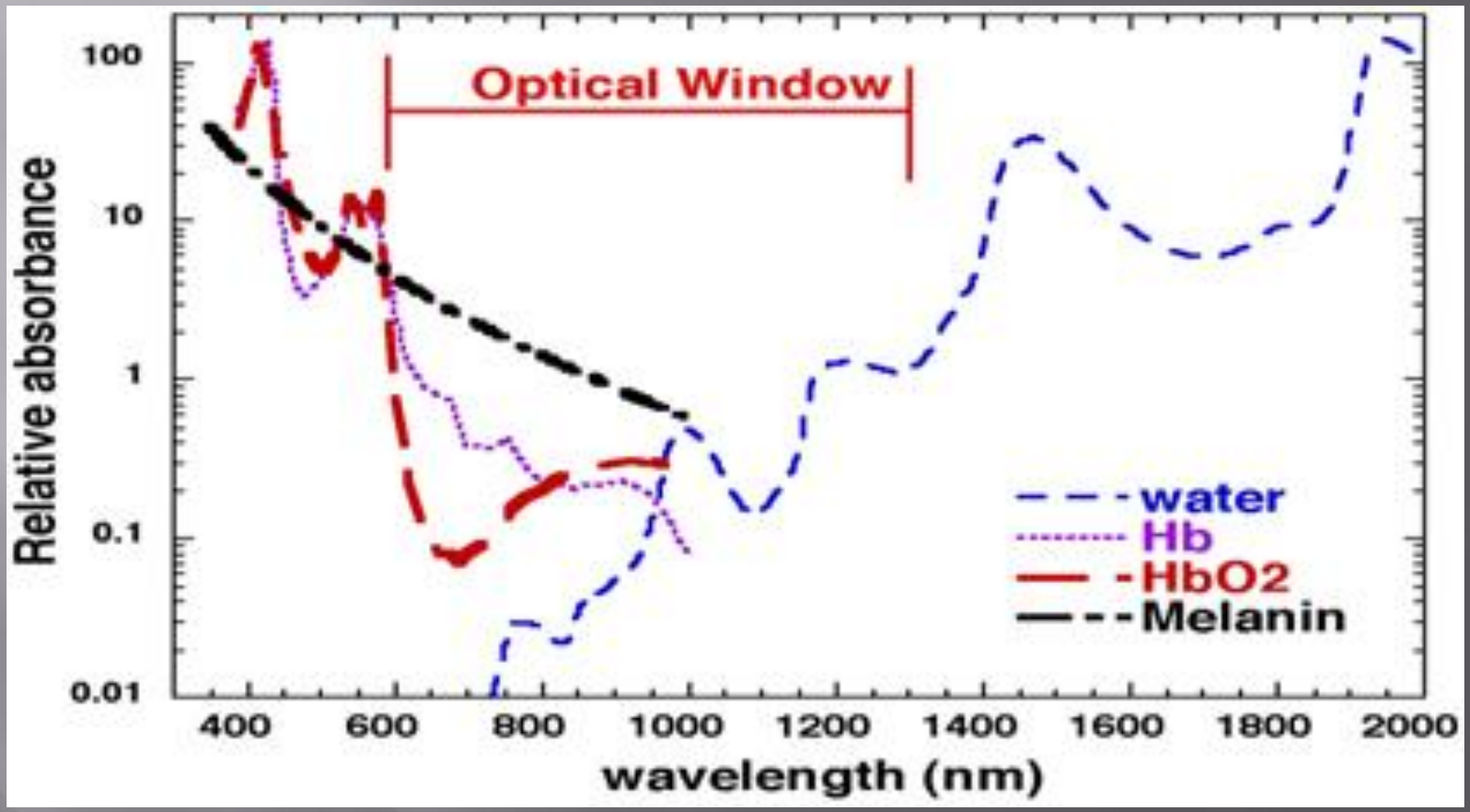
Sasaki K, Calderhead R G, Chin I, Inomata K. To examine the adverse photothermal effects of extended dosage laser therapy in vivo on the skin and subcutaneous tissue in the rat model. Laser Therapy. 1992; 4 (2): 69-74.

Calderhead R G, Inomata K. A study of the possible haemorrhagic effects of extended infrared diode laser irradiation on encapsulated and exposed synovial membrane articular tissue in the rat. Laser Therapy. 1992; 4 (2): 65-74.

Ilic S, Leichliter S, Streeter J, DeTaboada L, Oron U. Effects of Dose, Mode and Frequency of Low Level Laser Therapy on the Rat Brain. Photomedicine and Laser Surgery. 2006; 24 (4): 458-466.

Steroids reduce the anti-inflammatory effects of laser

Penetration


Optical Window
Relative absorbance
100
10
1
0.1
0.01
400
600
800
1000
1200
1400
1600
1800
2000
wavelength (nm)
water
Hb
HbO2
Melanin





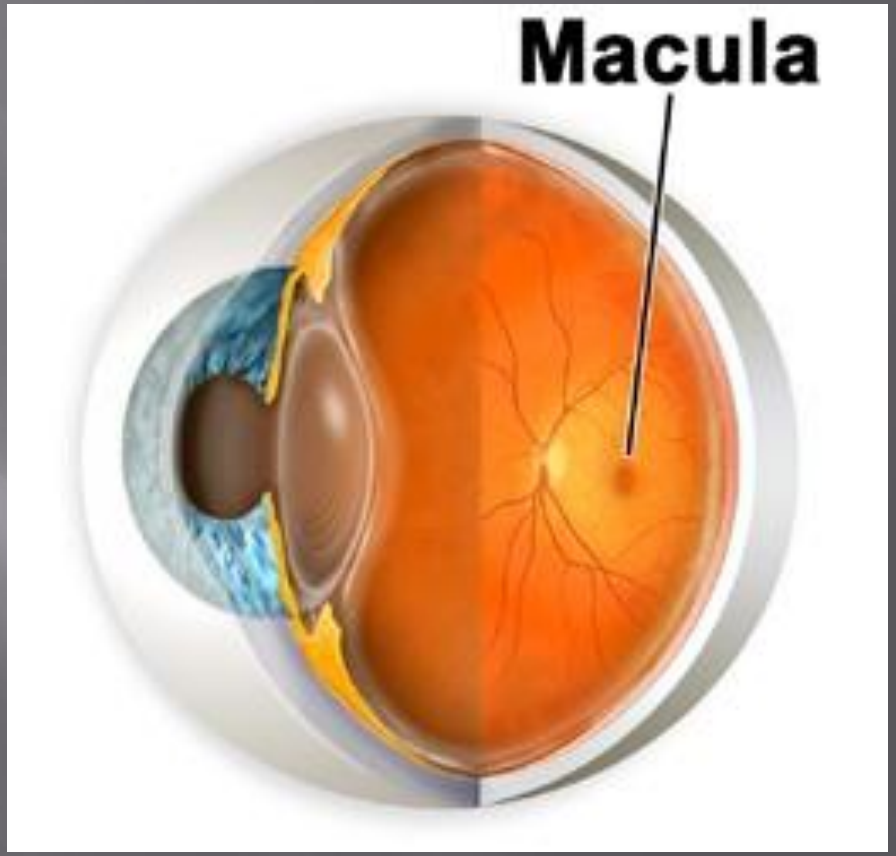
Courtesy: Aldo Brugnera Jr



Eye protection



Ivandic B T, Ivandic T. Low-Level Laser Therapy Improves Vision in Patients with Age-Related Macular Degeneration. Photomed Laser Surg. 2008; 2 (3): 241-245.



Macular degeneration

Stye on day of treatment with HeNe laser



The following day

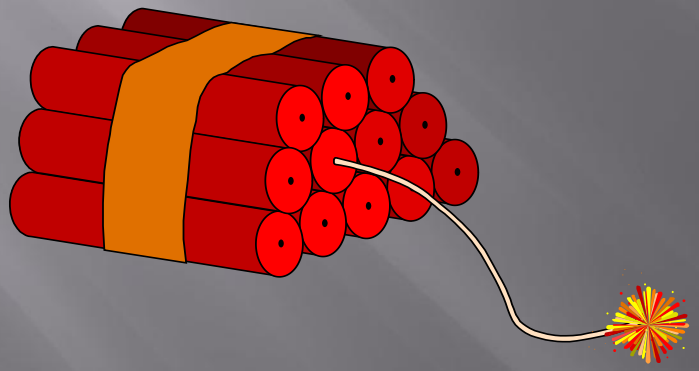


Contra indications?



Absolute contra indications of Low Level Laser Therapy

None!



Relative contra indications for Low Level Laser Therapy

- **Epilepsy (visible pulsing beam)**
- **Cancer (for legal reasons only)**
- **Light sensitivity**
- **Pregnant women (commons sense/legal issues /"forbidden acupuncture points")**
- **Patients with coagulation disorders (until we know more)**

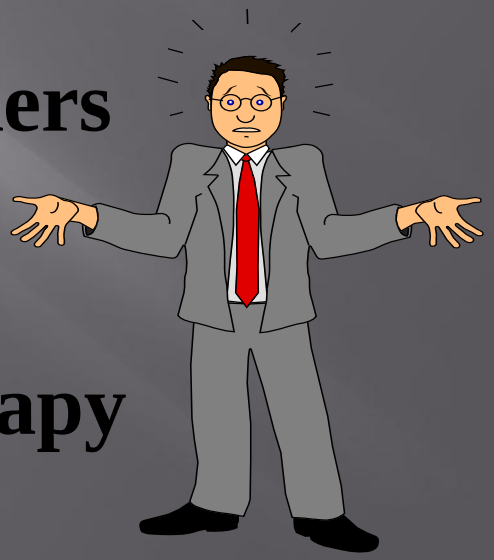
Other *relative* contra indications

- **St Johns Wort (Hypericum) and Chinese herbs (which often contain photosensitisers**

Steroids

Nonsense contraindications of Low Level Laser Therapy

- **patients with pacemakers**
- **diabetes**
- **prior to radiation therapy**



Some indications



Kazemi-Khoo N. Successful treatment of diabetic foot ulcers with low-level laser therapy. The Foot. 2006; 16 (4): 184-187.



10 months of therapy

Venous ulcer since 1991

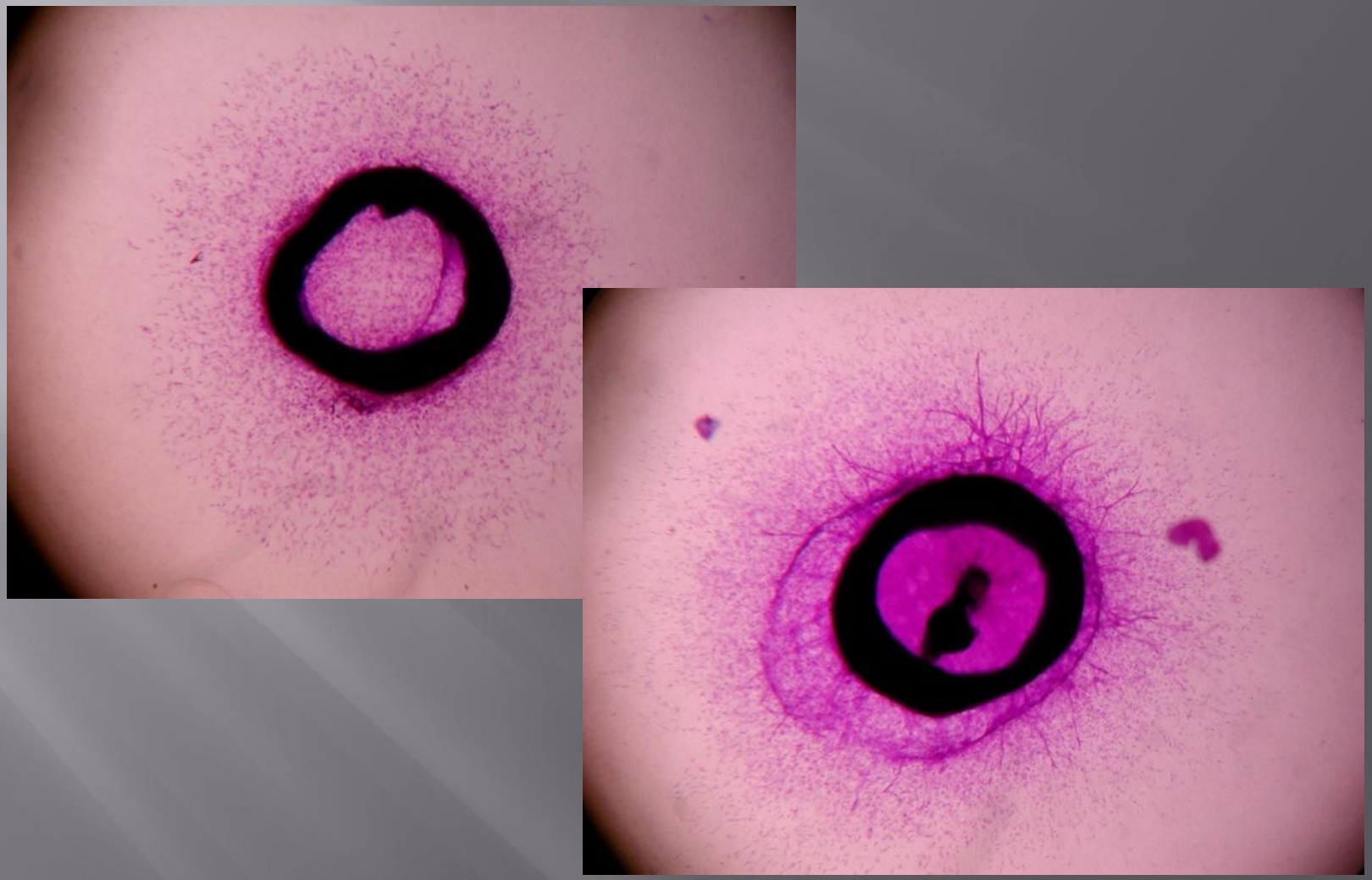


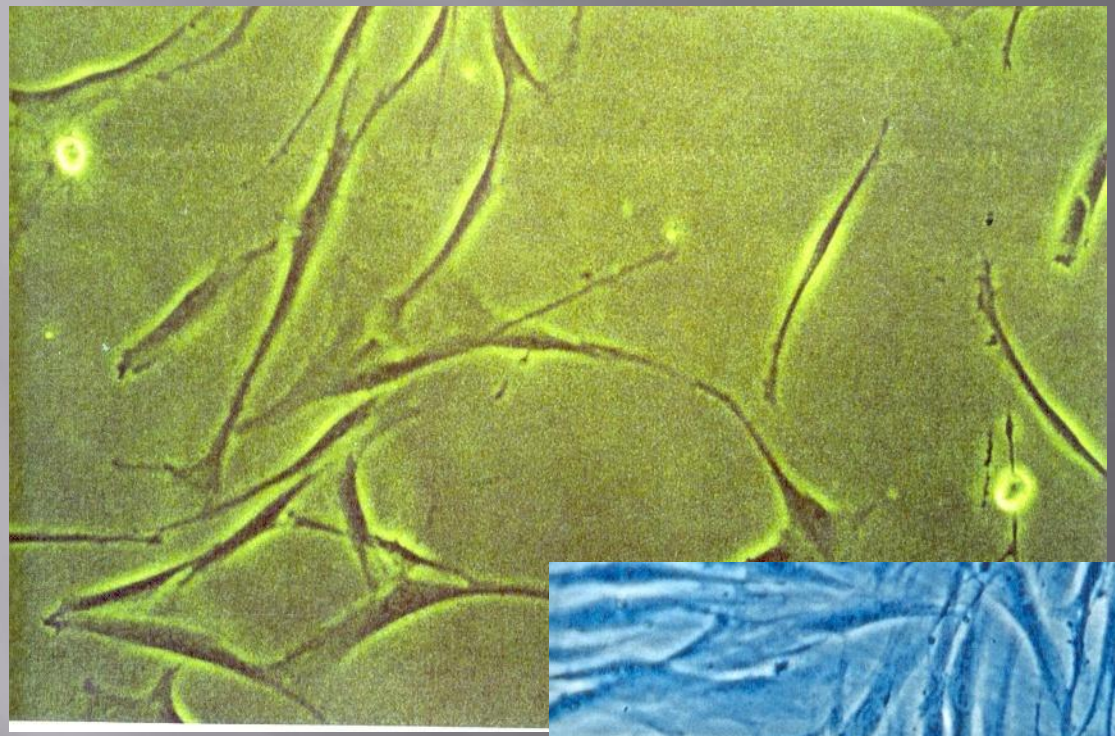
May **2010**

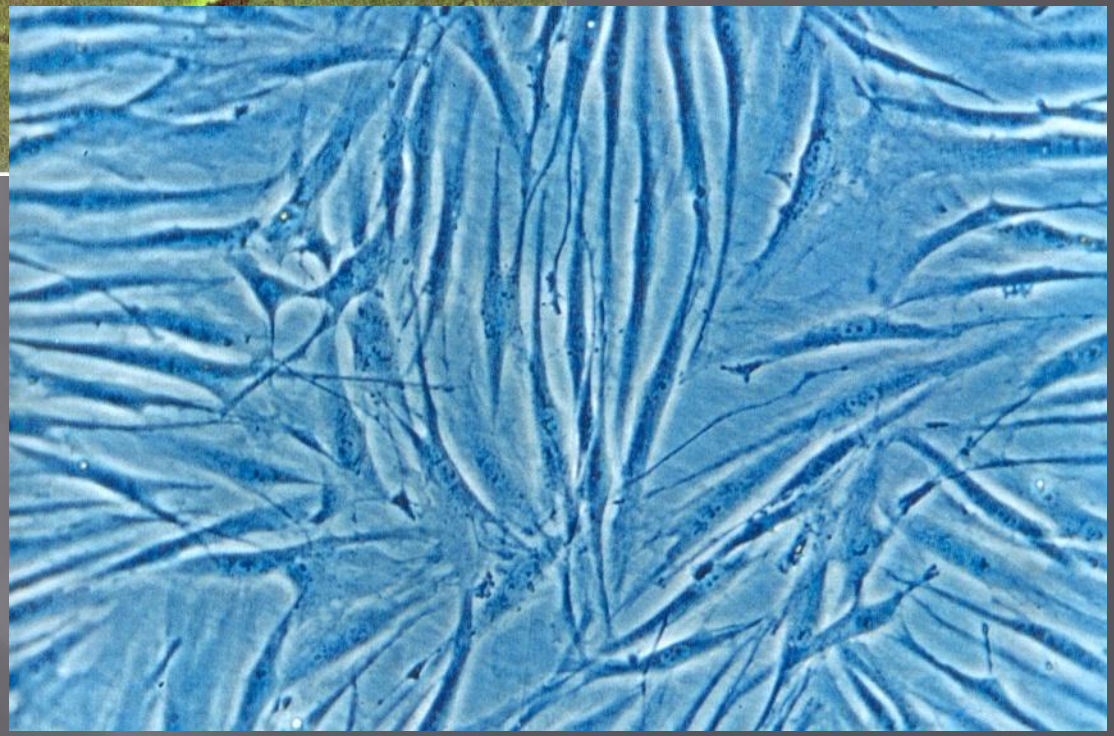


August 2010

Angiogenesis

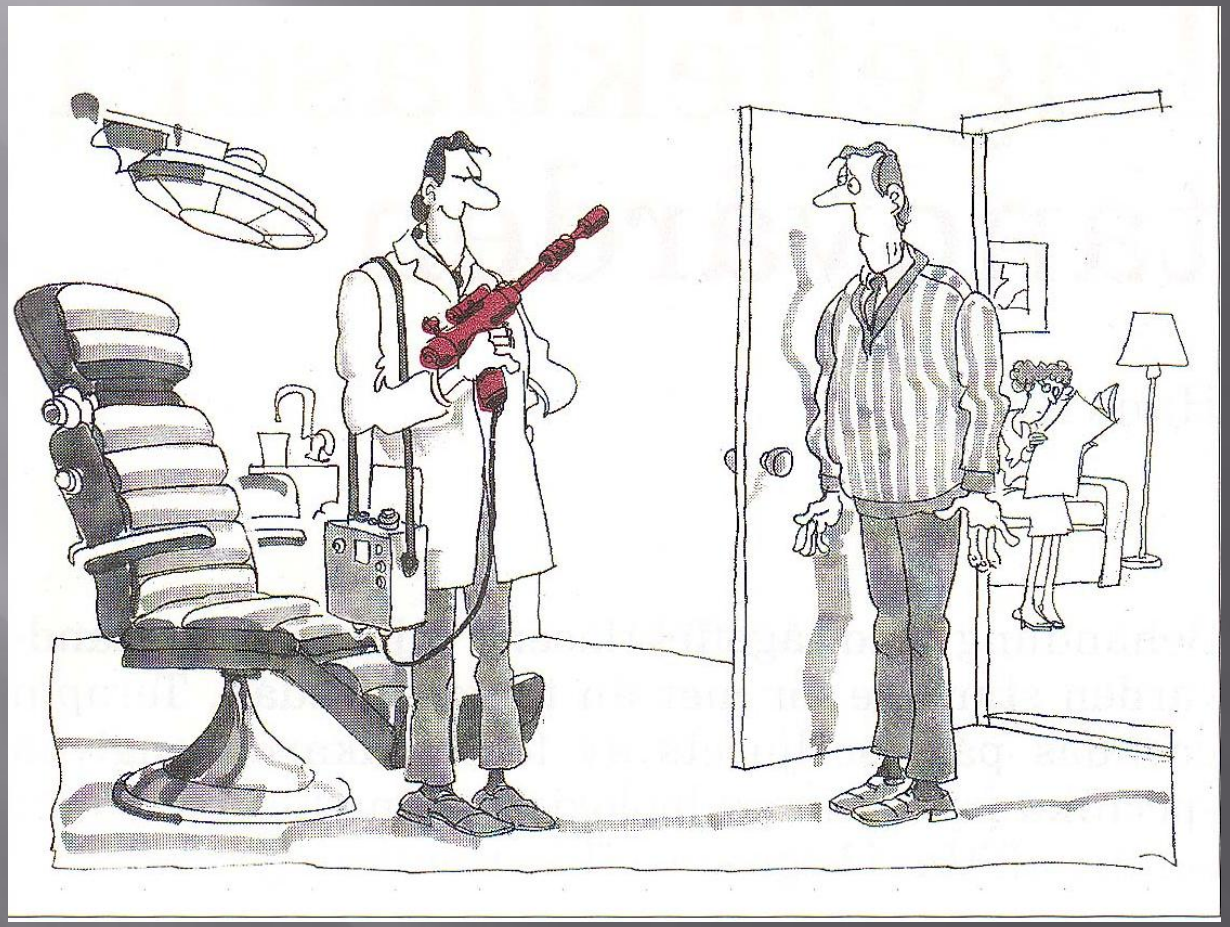






Almeida Lopes, L, 1999

Some dental indications



The good old days…

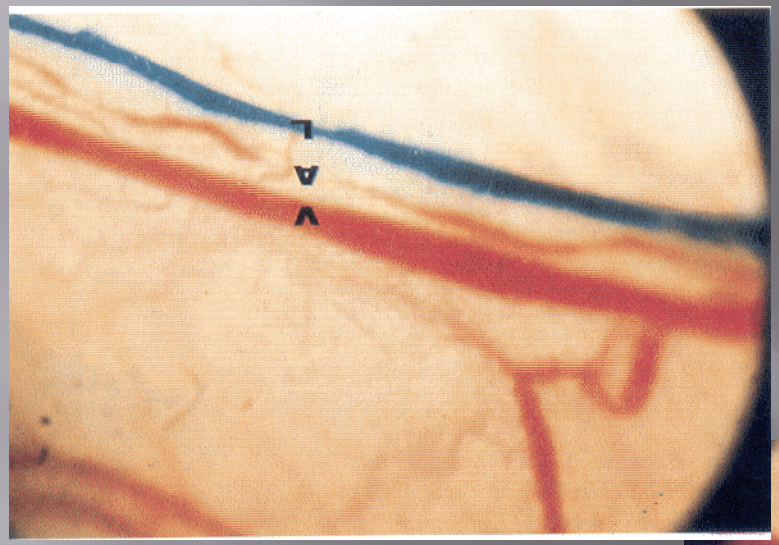


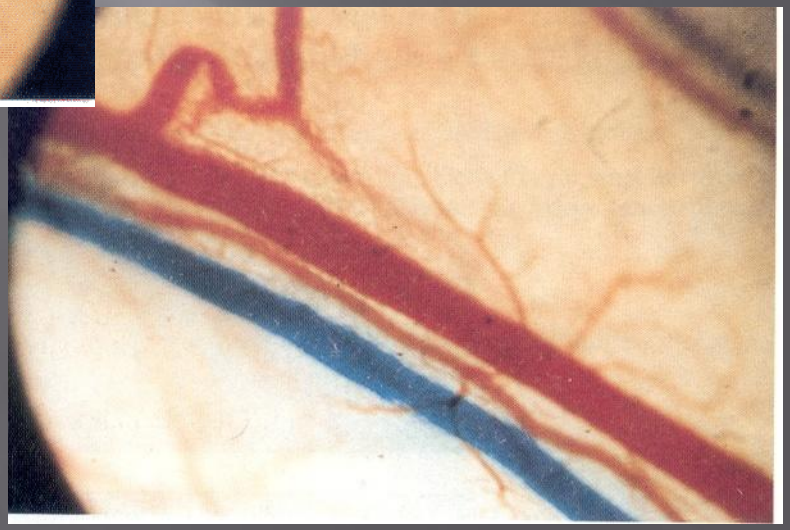
…had some advantages



Oedema


LASER APERTURE
Pack
Dual Purpose
Drugless Pain Relief
Flexible Ice or Soothing Heat
3M

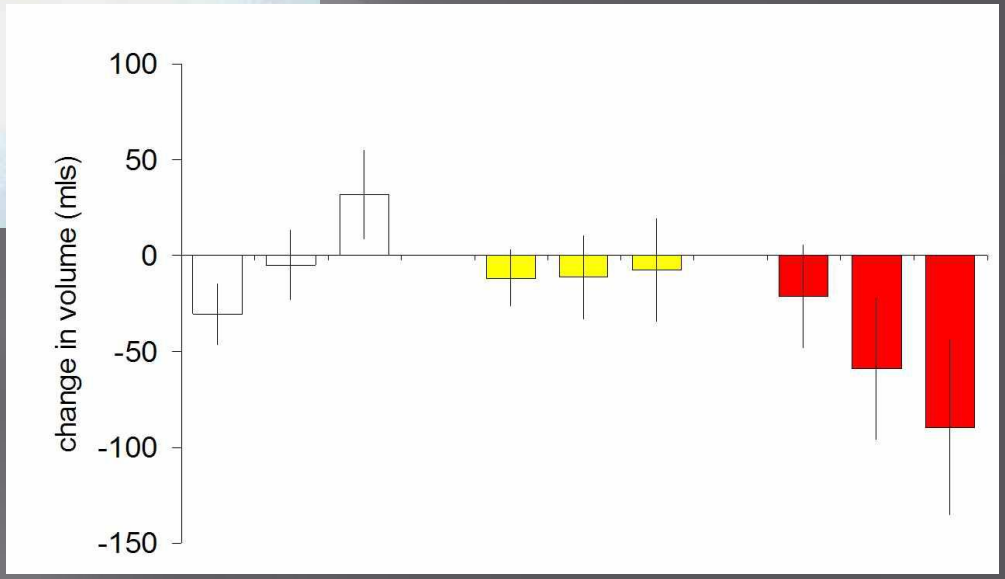




- Lievens, 1991

Postmastectomy oedema





Nerve regeneration

Nerve regeneration



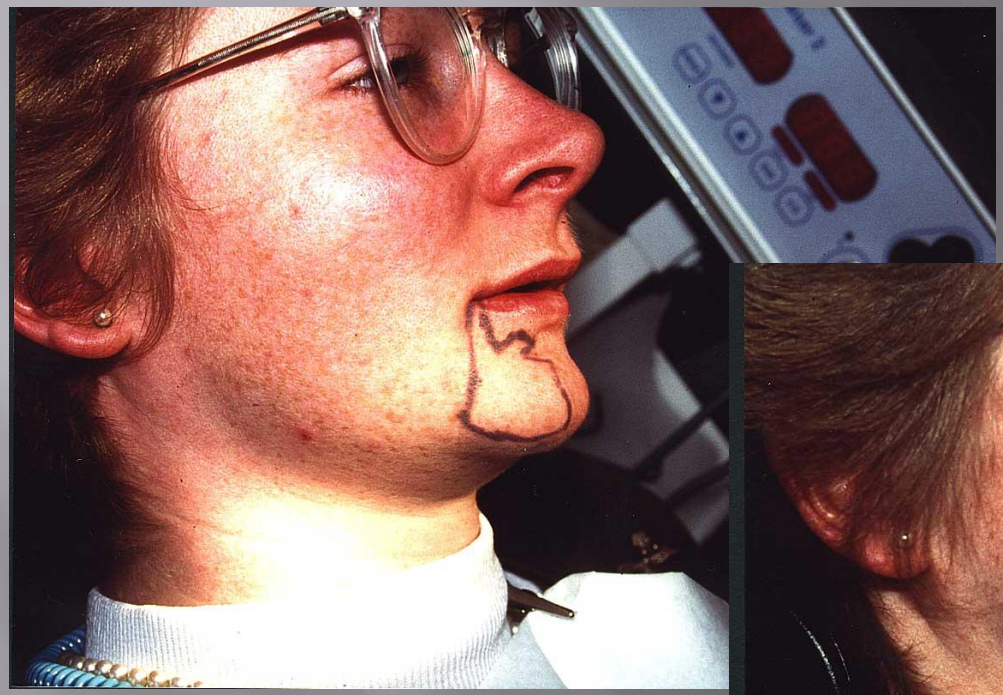
Per Hugo Beck Kristiansen

Paresthesia at delivery



Per Hugo Beck Kristiansen

Inferior alveolar nerve



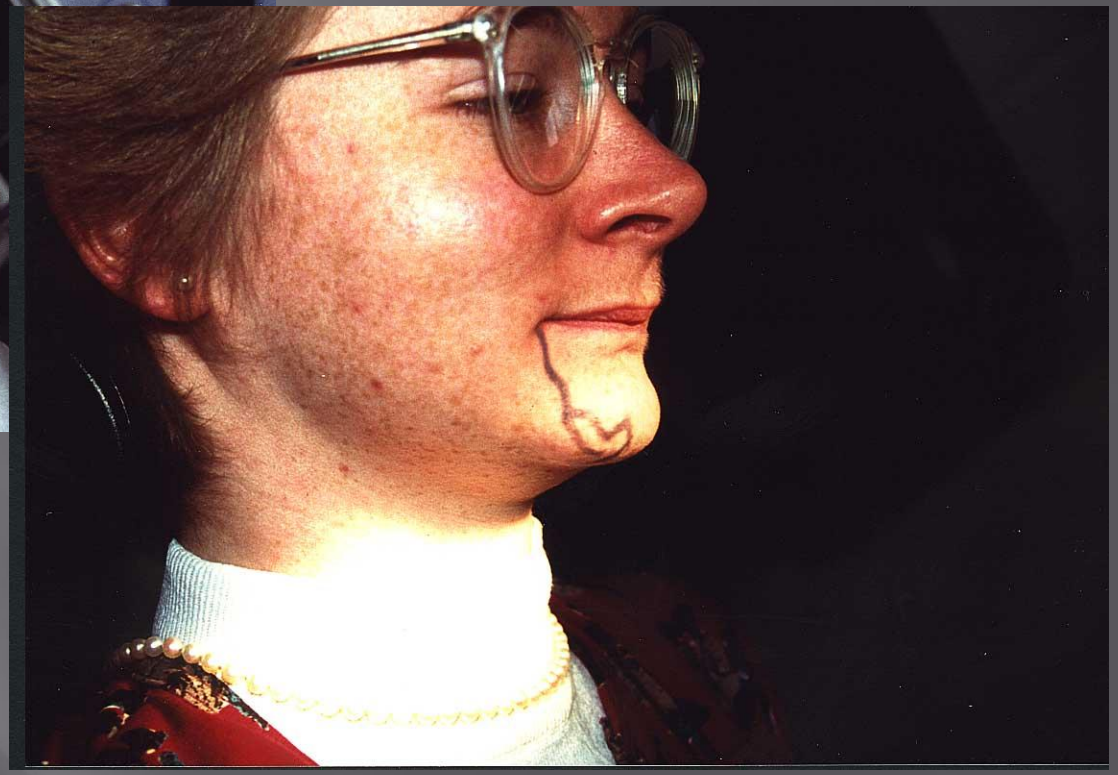
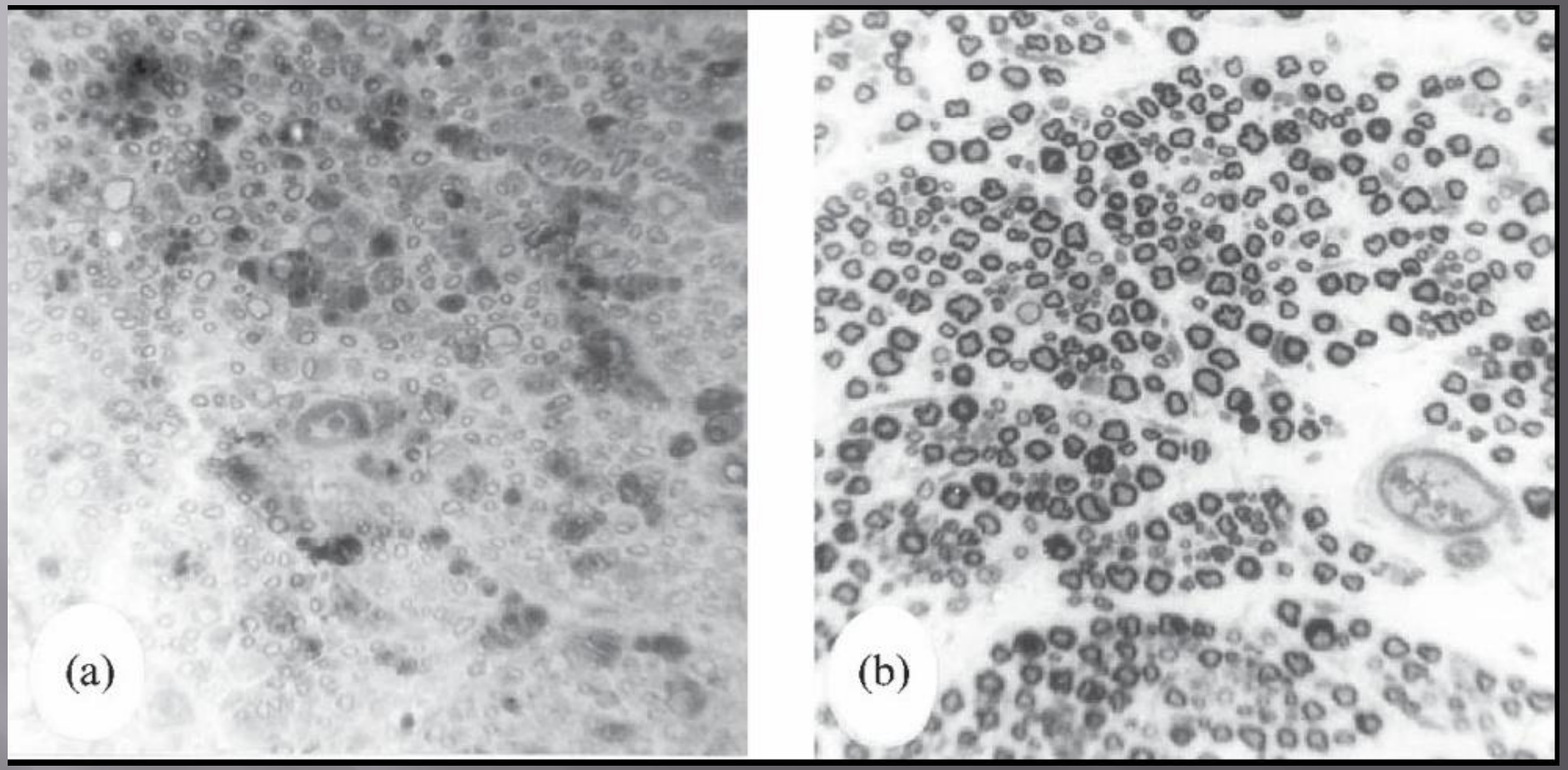


Photo: Per Hugo Christensen

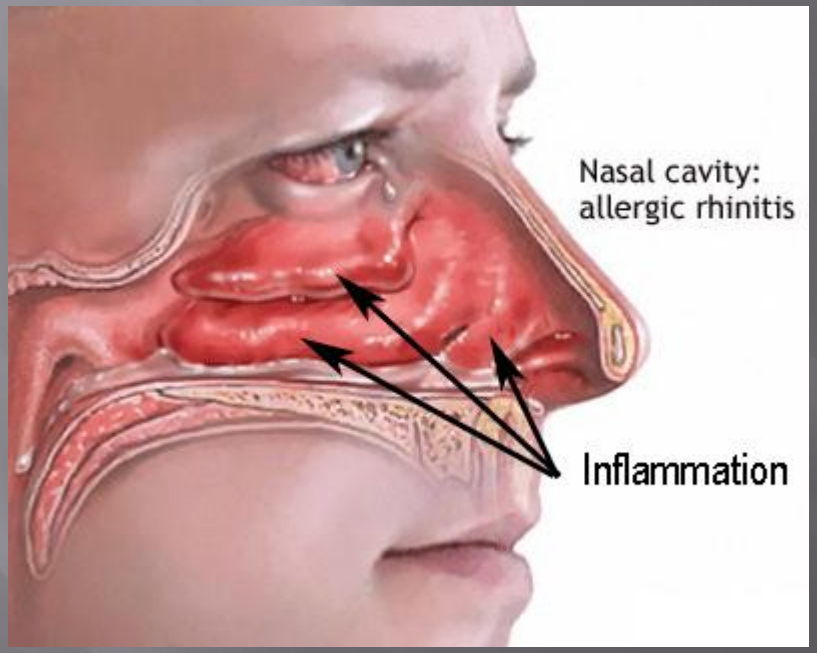


Increase in rate of axonal growth and myelination: (a) without treatment; (b) laser treated nerve. Neurological Research 1992; 14: 2–11.

Sinuitis



- **Pollinosis**



Bisphosphonate-associated necrosis

Romeo U, Galanakis A, Marias C, Vecchio AD, Tenore G, Palaia G, Vescovi P, Polimeni A. Observation of Pain Control in Patients with Bisphosphonate-Induced Osteonecrosis Using Low Level Laser Therapy: Preliminary Results. Photomed Laser Surg. 2011 Jan 16. [Epub ahead of print]

Scoletta M, Arduino PG, Reggio L, Dalmasso P, Mozzati M. Effect of low-level laser irradiation on bisphosphonate-induced osteonecrosis of the jaws: preliminary results of a prospective study. Photomed Laser Surg. 2010 Apr;28(2):179-84.

Diniz JS, Nicolau RA, de Melo Ocarino N, do Carmo Magalhães F, de Oliveira Pereira RD, Serakides R. Effect of low-power gallium-aluminum-arsenium laser therapy (830 nm) in combination with bisphosphonate treatment on osteopenic bone structure: an experimental animal study. Lasers Med Sci. 2009 May;24(3):347-52.

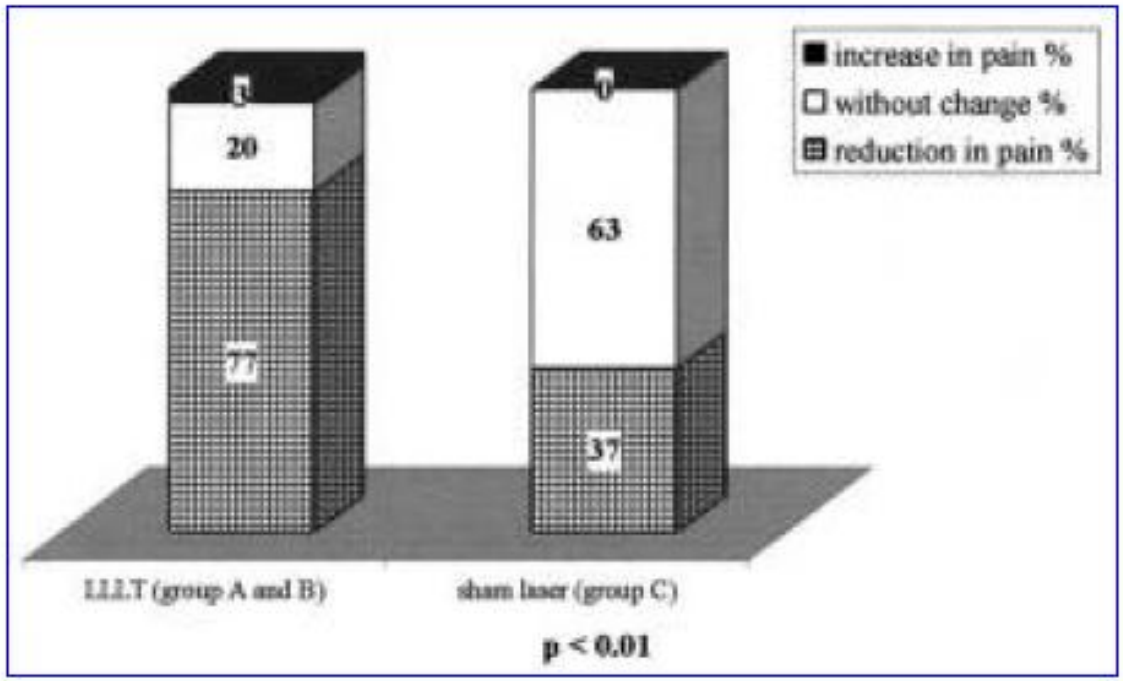
Vescovi P, Merigo E, Manfredi M, Meleti M, Fornaini C, Bonanini M, Rocca JP, Nammour S. Nd:YAG laser biostimulation in the treatment of bisphosphonate-associated osteonecrosis of the jaw: clinical experience in 28 cases. Photomed Laser Surg. 2008 Feb;26(1):37-46.

Vescovi P, Merigo E, Meleti M, Fornaini C, Nammour S, Manfredi M. Nd:YAG laser biostimulation of bisphosphonate-associated necrosis of the jawbone with and without surgical treatment. Br J Oral Maxillofac Surg. 2007 Dec;45(8):628-32.

Burning mouth syndrome

Kato IT, Pellegrini VD, Prates RA, Ribeiro MS, Wetter NU, Sugaya NN. Low-level laser therapy in burning mouth syndrome patients: a pilot study. Photomed Laser Surg. 2010;28(6):835-9.

Yang HW, Huang YF. Treatment of Burning Mouth Syndrome with a Low-Level Energy Diode Laser. Photomed Laser Surg. 2010 Oct 22. [Epub ahead of print]



The effect the LLLT and the sham laser on reduction in pain in patients with TMD (percentage analysis).

Fikackova H, Dostalova T, Navratil L, Klaschka J. Effectiveness of Low-Level Laser Therapy in Temporomandibular Joint Disorders: A Placebo-Controlled Study. Photomed Laser Surg. 2007; 25 (4): 297-303.

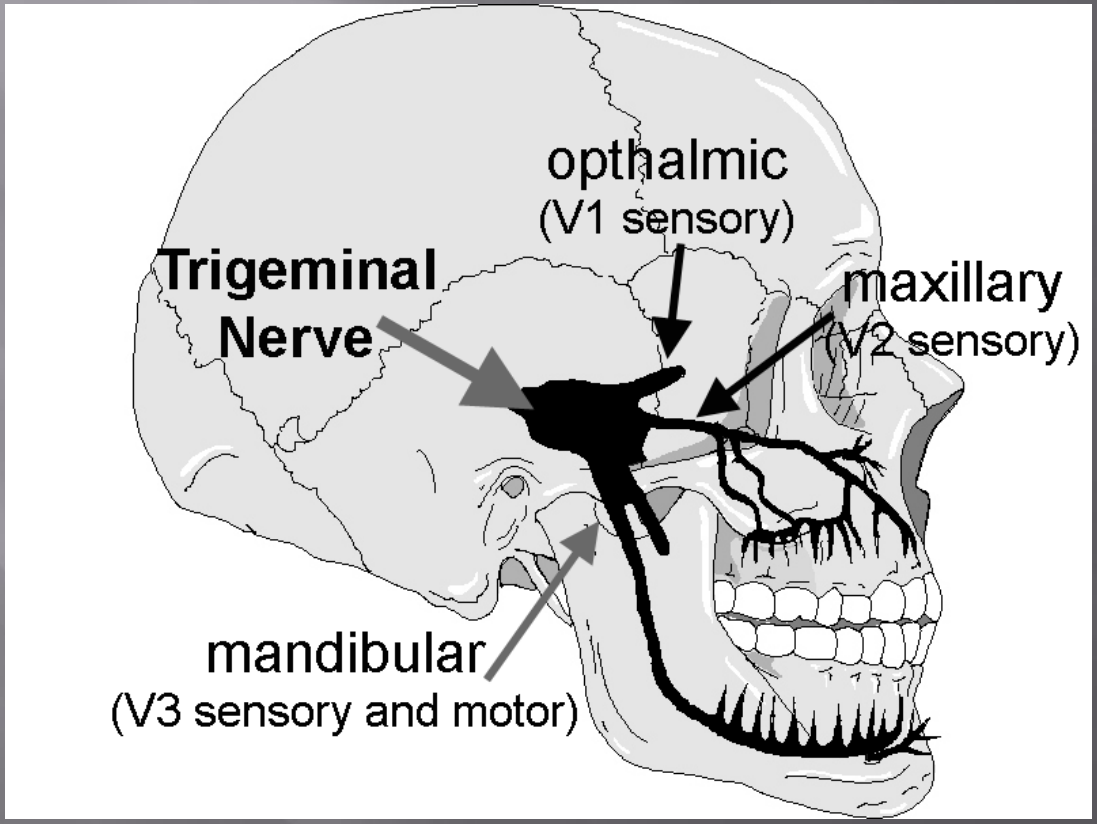
Trismus



FIGURE 2- Infiltration of the anesthetic solution

Photomed Laser Surg. 2009 Feb;27(1):21-4. The effect of low-level laser therapy on trismus and facial swelling following surgical extraction of a lower third molar. Aras MH, Güngörmüş M.

Trigeminal neuralgia



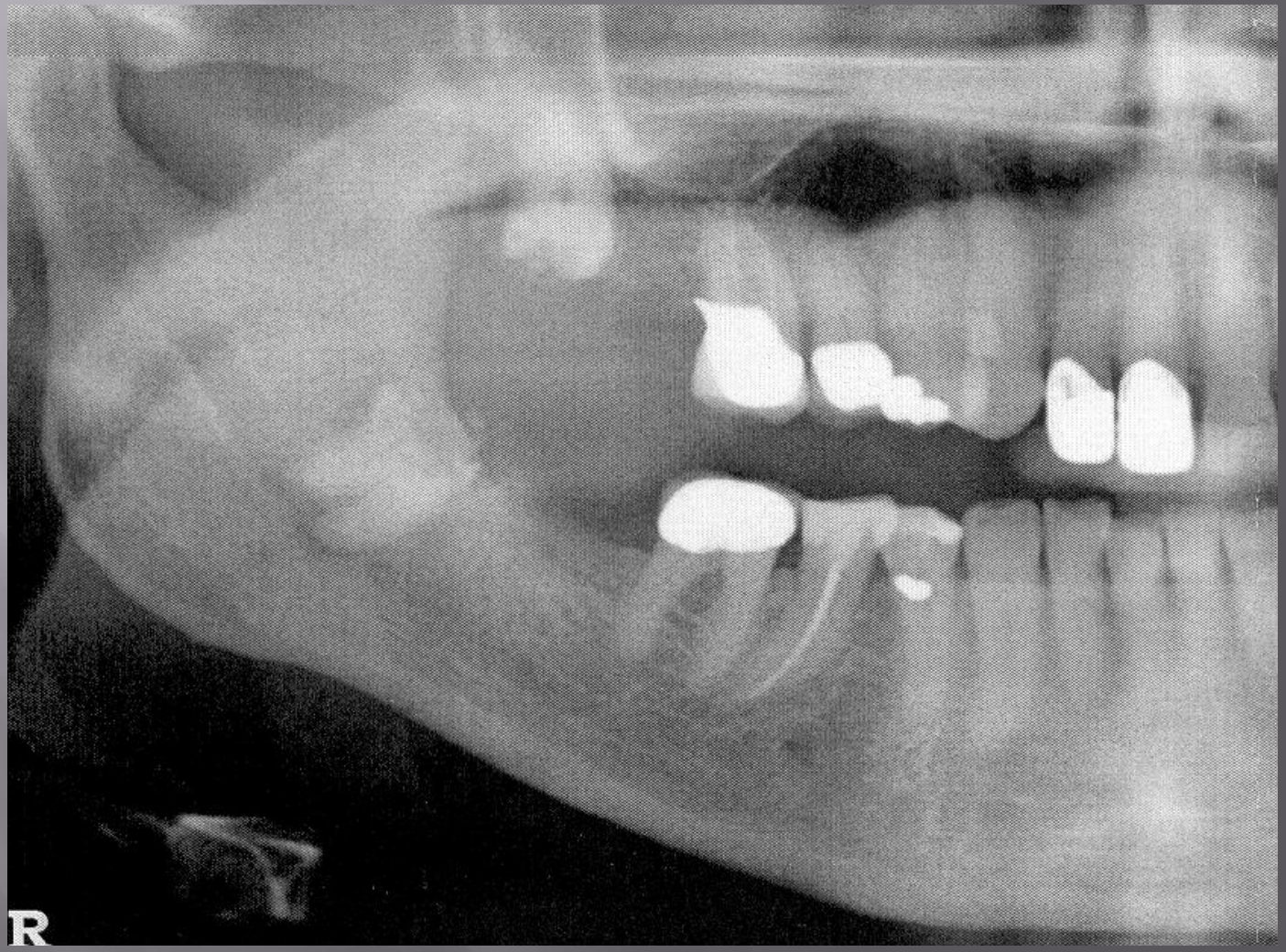
Trigeminal neuralgia

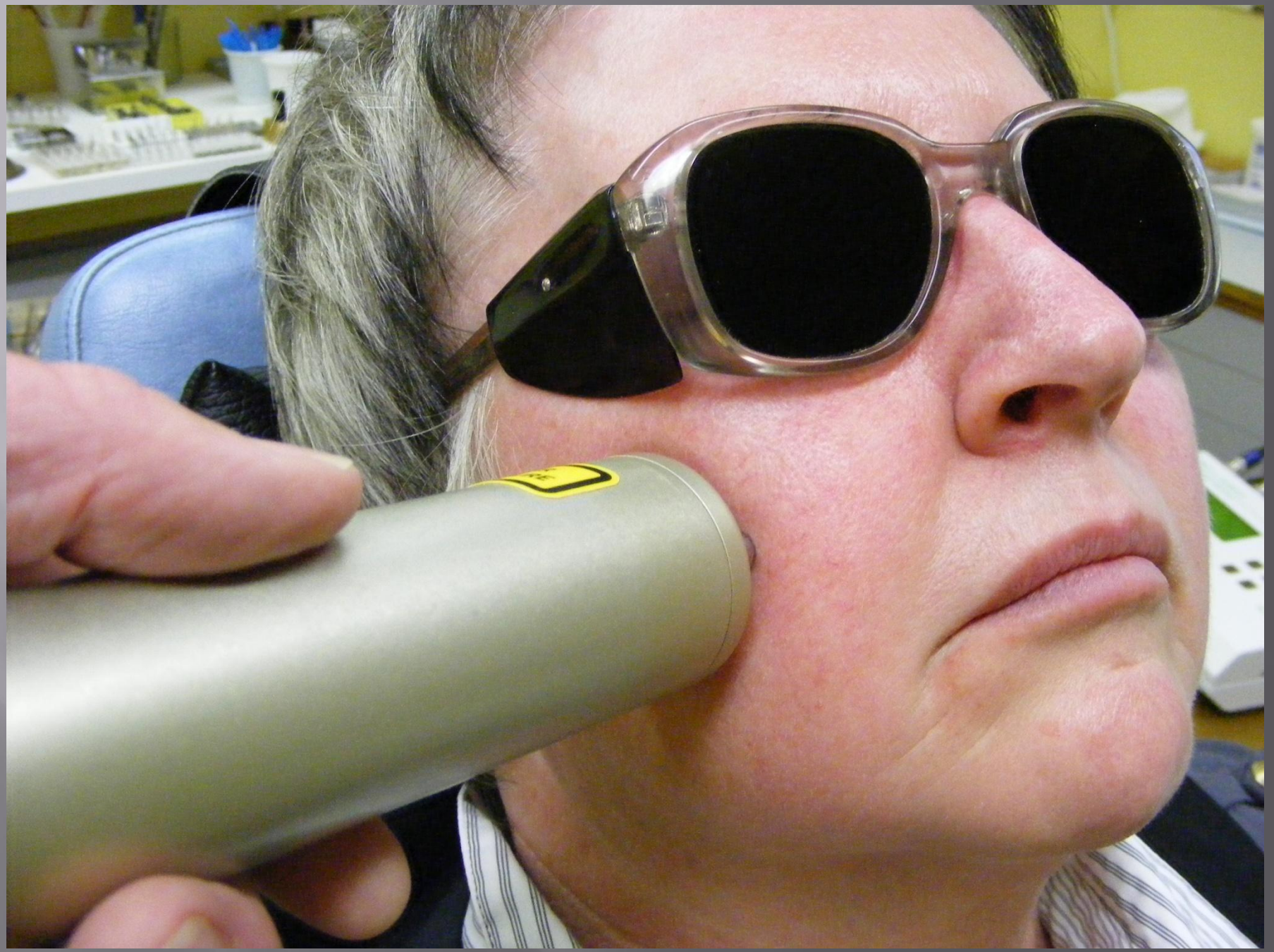
- Eckerdal A, Lehmann Bastian H. Can low reactive-level laser therapy be used in the treatment of neurogenic facial pain? A double-blind, placebo controlled investigation of patients with trigeminal neuralgia. Laser Therapy. 1996; 8 (4): 247-252.

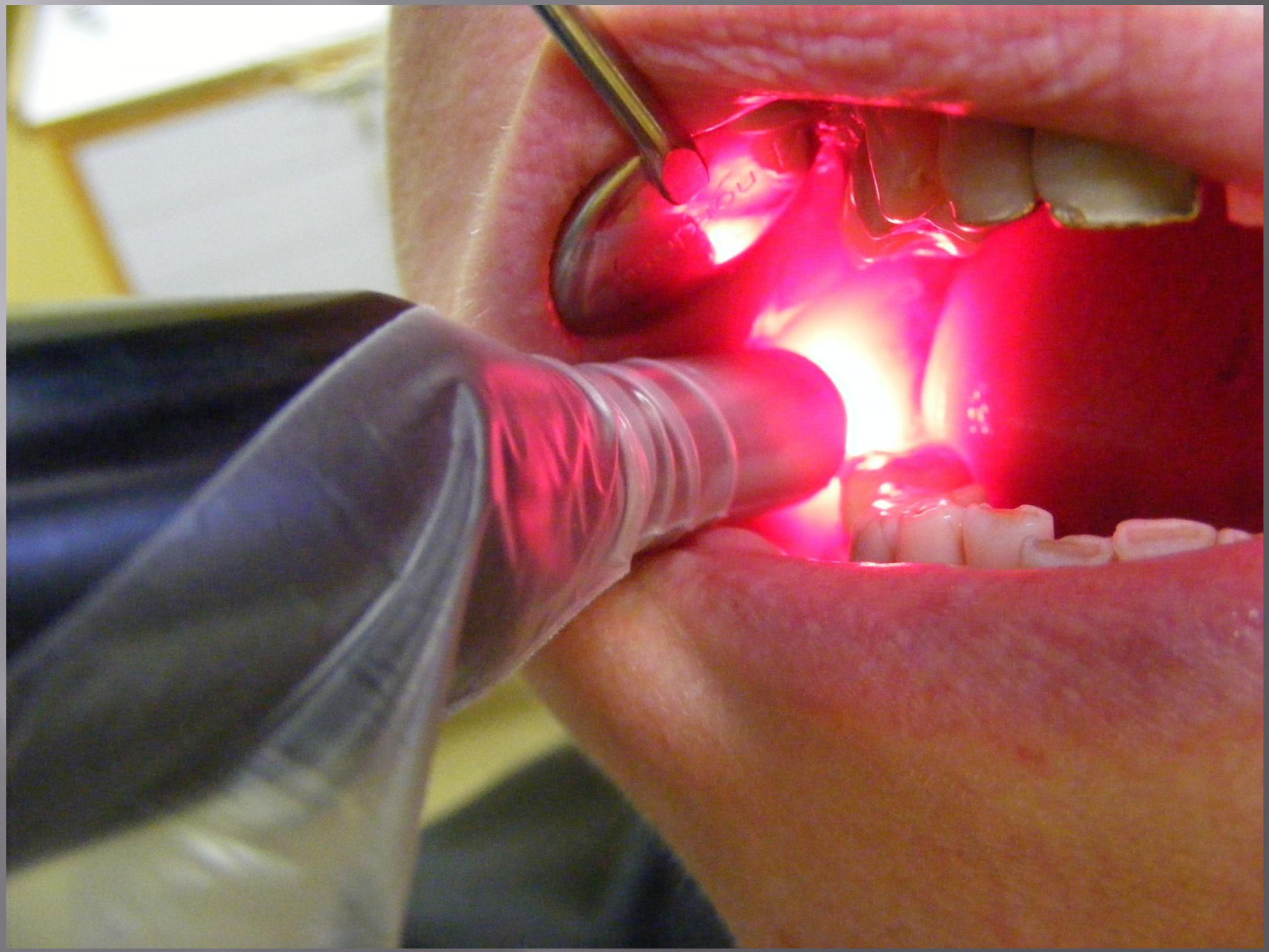
- Hansen H, Thorøe U. Low power laser biostimulation of chronic orofacial pain. A double-blind placebo controlled cross-over study in 40 patients. Pain. 1990; 43: 169-179.

- Takamoto M, Magalhães Da Cruz F, Ladalardo T C; Tarso Mugnai Marraccini; Brugnera Júnior A, De Carvalho Campos R A. Evaluation of the effect of Laser Therapy in the treatment of trigeminal neuralgia. Photomedicine and Laser Surgery. 2005; 23 (1). Abstracts from the 5th Congress of the World Association for Laser Therapy, São Paulo, Brazil, November 2004. Poster no 28, page 121.

After surgery









Orthodontics

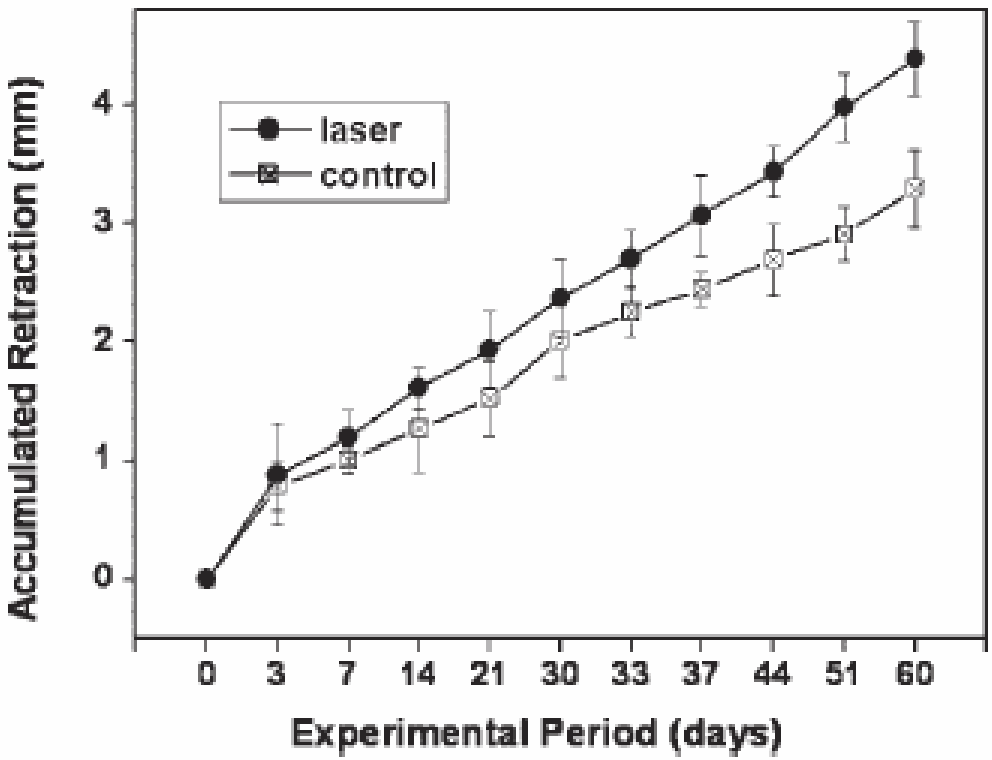
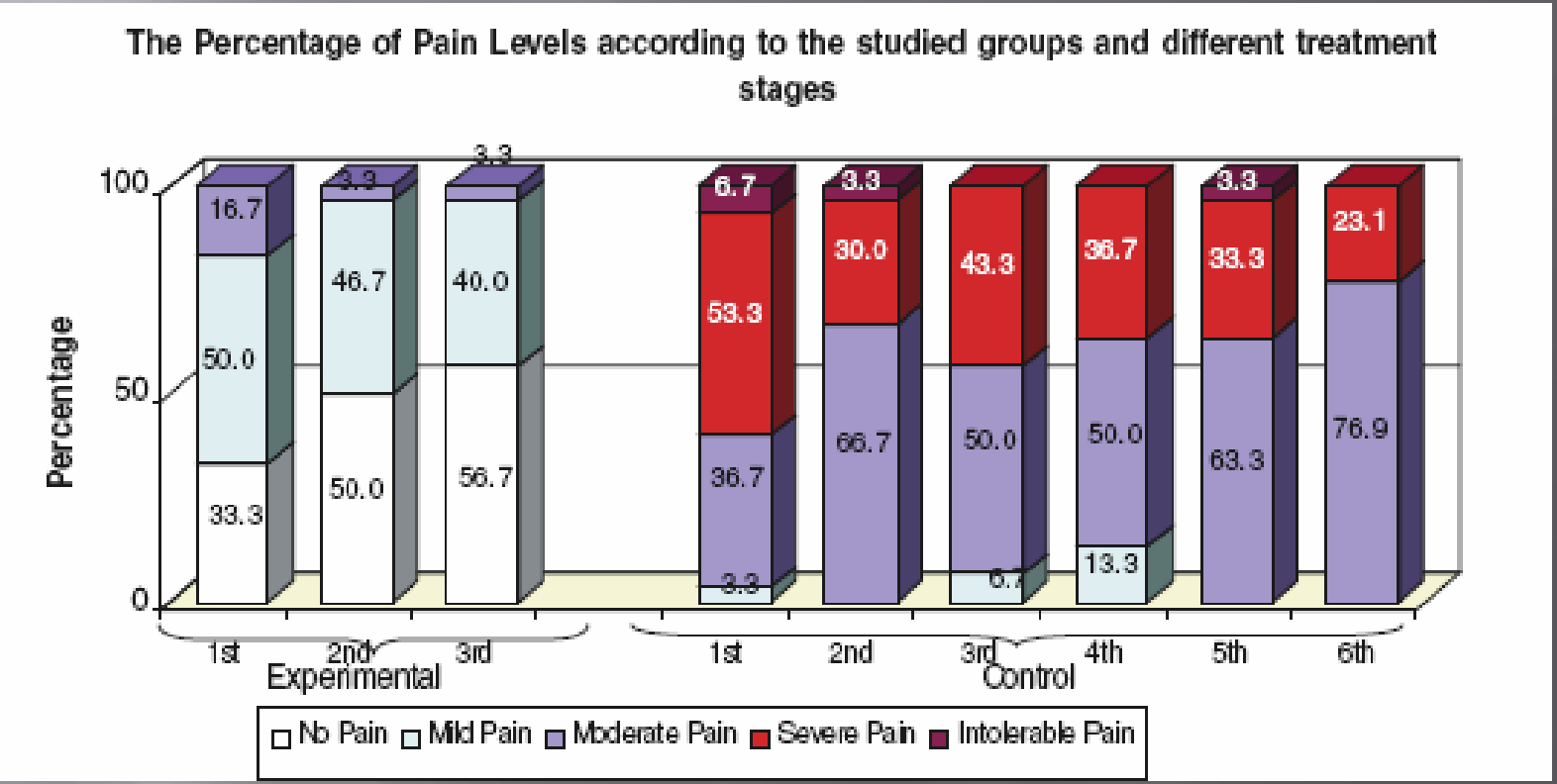


Fig. 1. Mean values ± SD of the accumulated retraction during the experimental period.

Cruz D R, Kohara E K, Ribeiro M S, Wetter N U. Effects of low-intensity laser therapy on the orthodontic movement velocity of human teeth: a preliminary study. Laser Surg Med. 2004; 35 (2): 117-120.

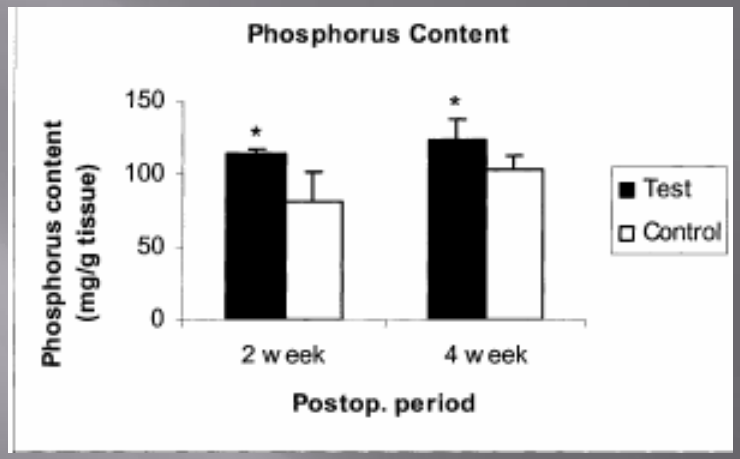


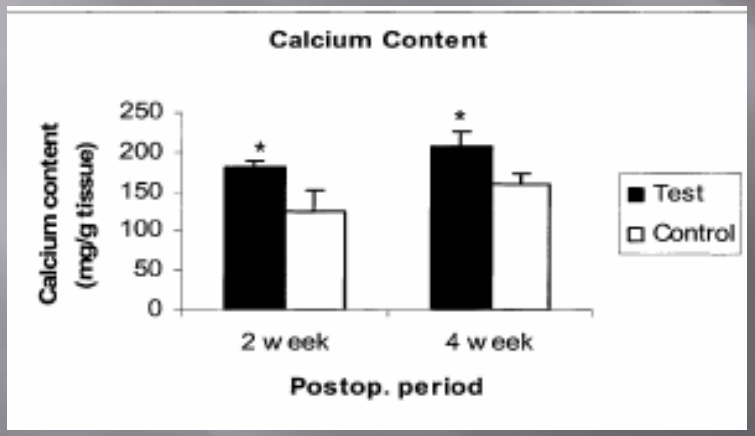
Youssef M, Ashkar S, Hamade E, Gutknecht N, Lampert F, Mir M. The effect of low-level laser therapy during orthodontic movement: a preliminary study. Lasers Med Sci. 2008; 23 (1): 27-33.

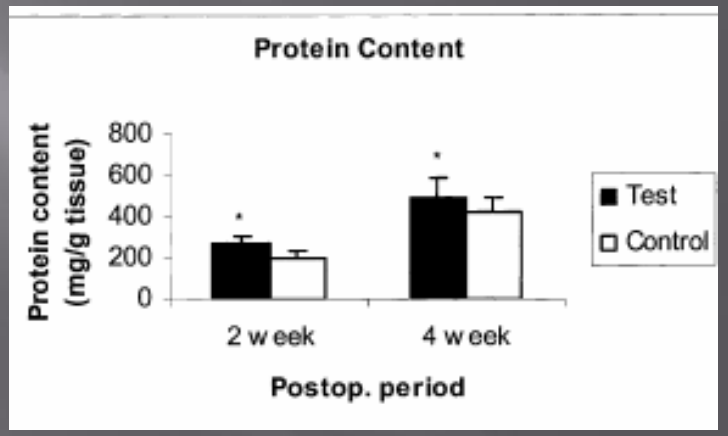
IMPLANTOLOGY



PHK







Khadra M, Kassem N, Haanaes H R, Ellingsen J E, Lyngstadaas S P. Enhancement of bone formation in rat calvarial bone defects using low-level laser therapy. Oral Surg Oral Med Oral Pathol Oral Endod. 2004; 97: 693-700.

Cariology



Godoy et al. A r c h i v e s of Ora l B i o logy. 5 2 (2 0 0 7) 8 99 – 9 03.

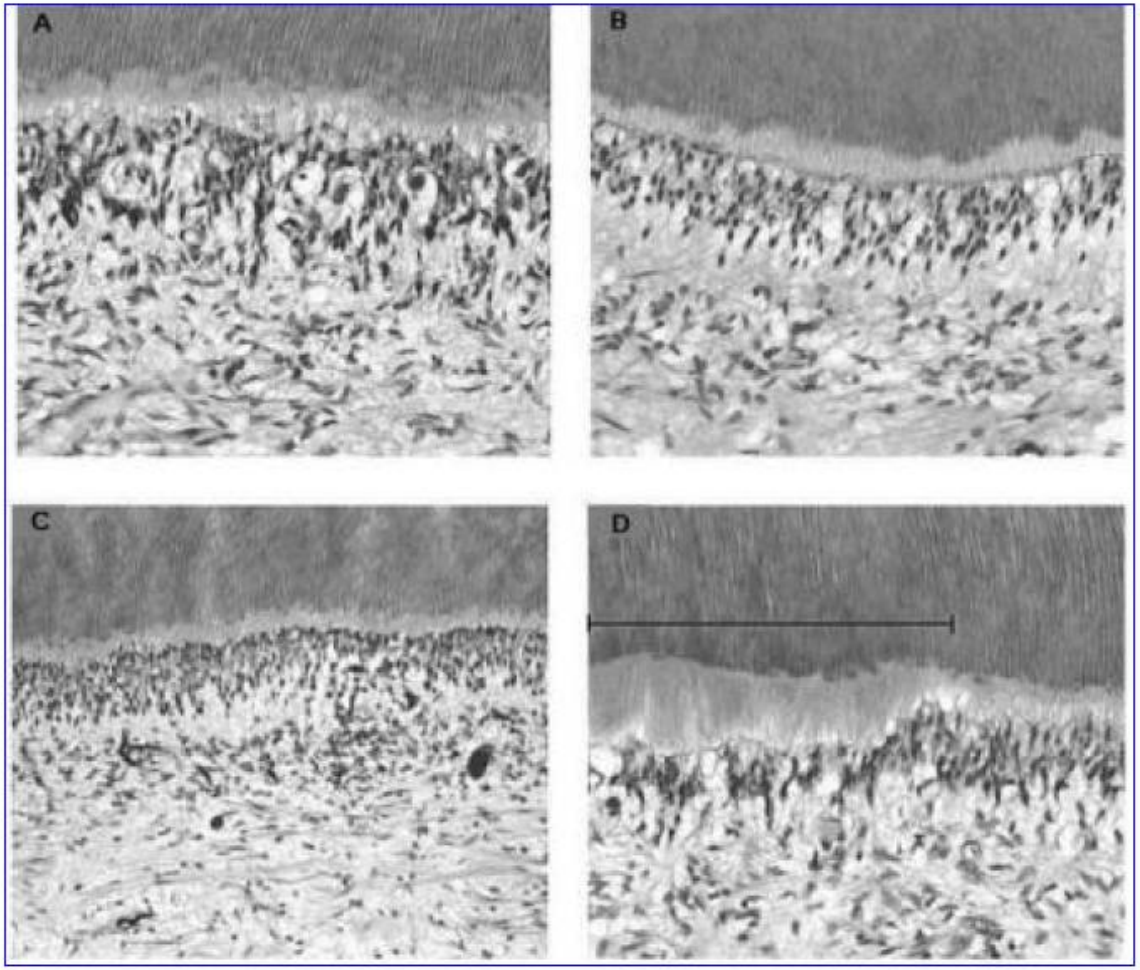
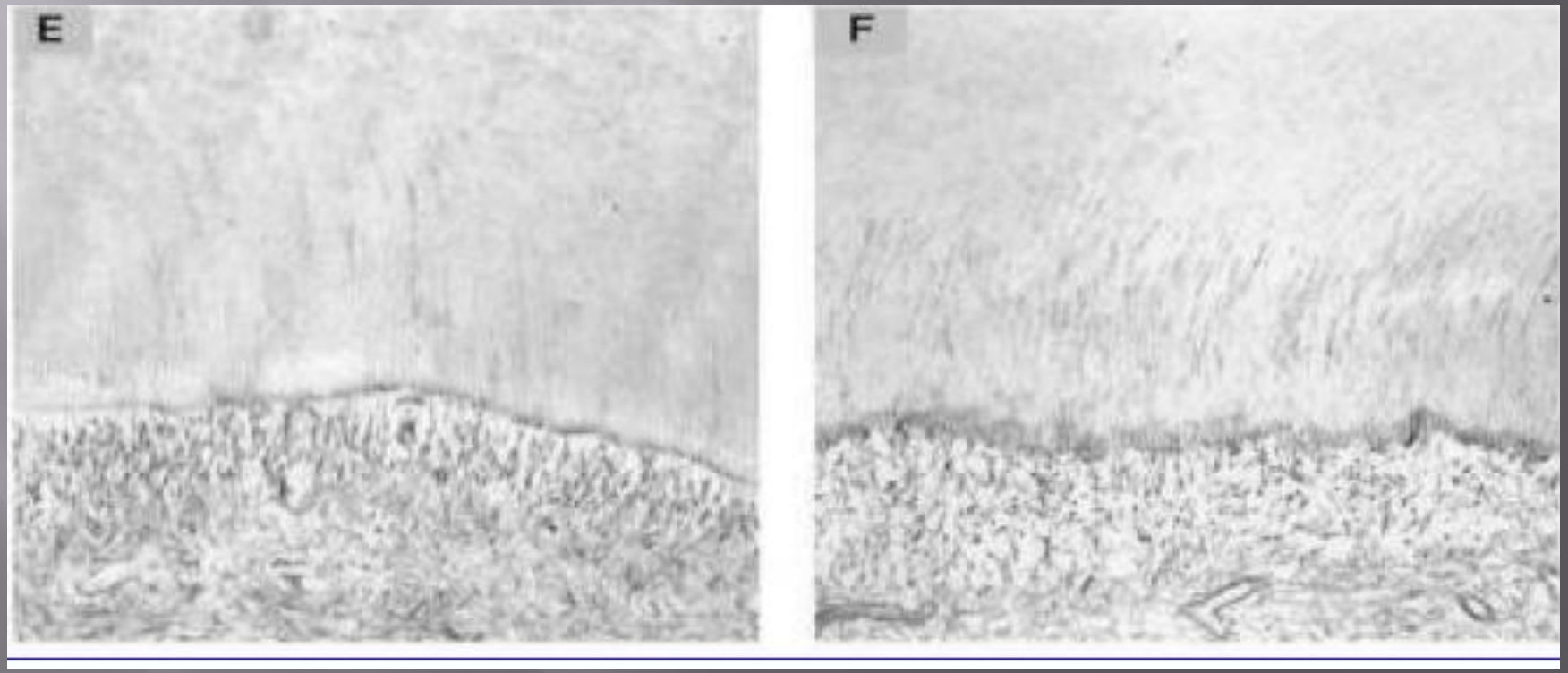


FIG. 1. Photomicrography of histological sections of human premolar teeth stained by hematoxylin and eosin (H&E). *14 days*: (**A**) Pulp conjunctive tissue of the control group showing a moderate inflammatory process and odontoblast layer disorganization (original magnification, ×320). (**B**) Absence of inflammatory morphologic signs in the irradiated pulp tissue. The most regular disposition is found in the odontoblast layer (original magnification, ×320). *42 days*: (**C**) Presence of mononuclear cells close to the surface of the preparation and discrete odontoblast disorganization of control group (original magnification, ×200). (**D**) Irradiated pulp tissue with normal appearance. Odontoblastic cells associated with reactional dentinogenesis areas are found (original magnification, ×320).

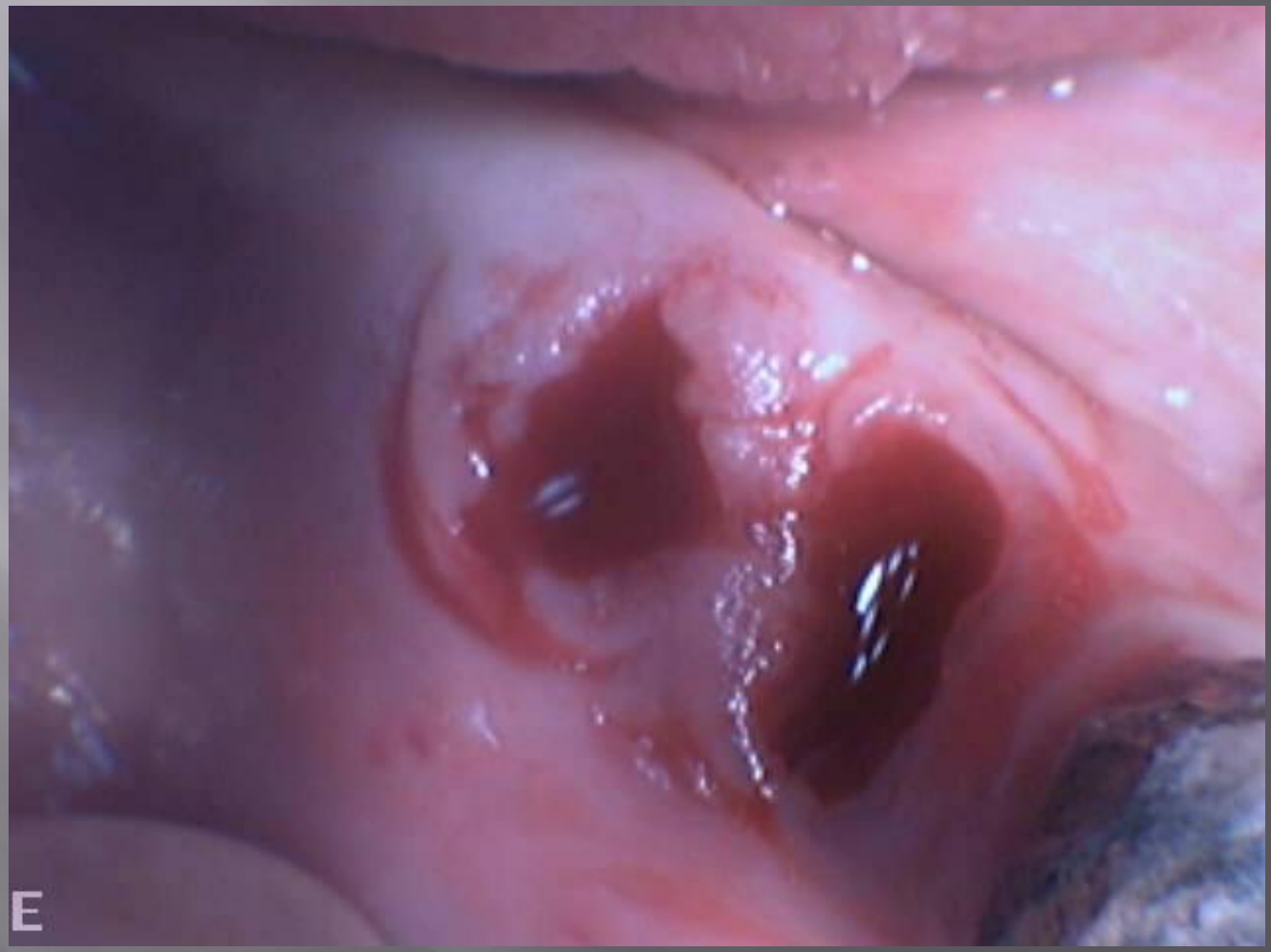
Ferreira A N S, Silveira L B, Genovese W J, Cavalcante de Araujo V, Frigo L et al. Effect of GaAlAs Laser on Reactional Dentinogenesis Induction in Human Teeth. Photomed Laser Surg. 2006; 24 (3): 358-365.

42 days
Collagene staining



Extractions

Directly post extraction



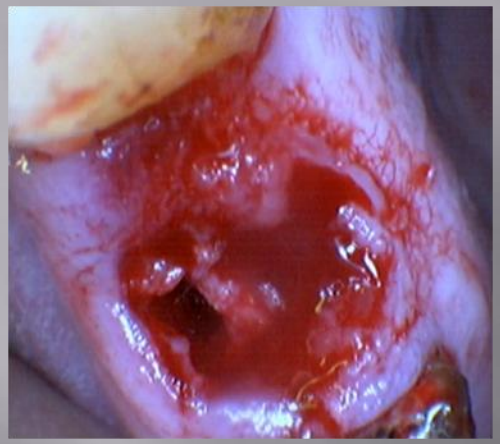
660 nm, 30 mW, 3 minutes



The following day



Same patient
Upper: No laser, day 0, 15, 30
Lower: with laser, day 0, 15, 30








Talat Qadri

Photomed Laser Surg. 2011;29(5):333-8.
Blue-violet light emitting diode (LED) irradiation immediately controls socket bleeding following tooth extraction: clinical and electron microscopic observations.
Ishikawa I, Okamoto T, Morita S, Shiramizu F, Fuma Y, Ichinose S, Okano T, Ando

Herpes simplex

Pedro José Muñoz Sanchez, José Luis Capote Femenías, Alejandro Díaz Tejeda, Jan Tunér. The effect of 670 nm low laser therapy on herpes simplex type 1. Photomedicine and Laser Surgery. 2012; 30 (1): 37-40.

Herpes simplex (HSV1)









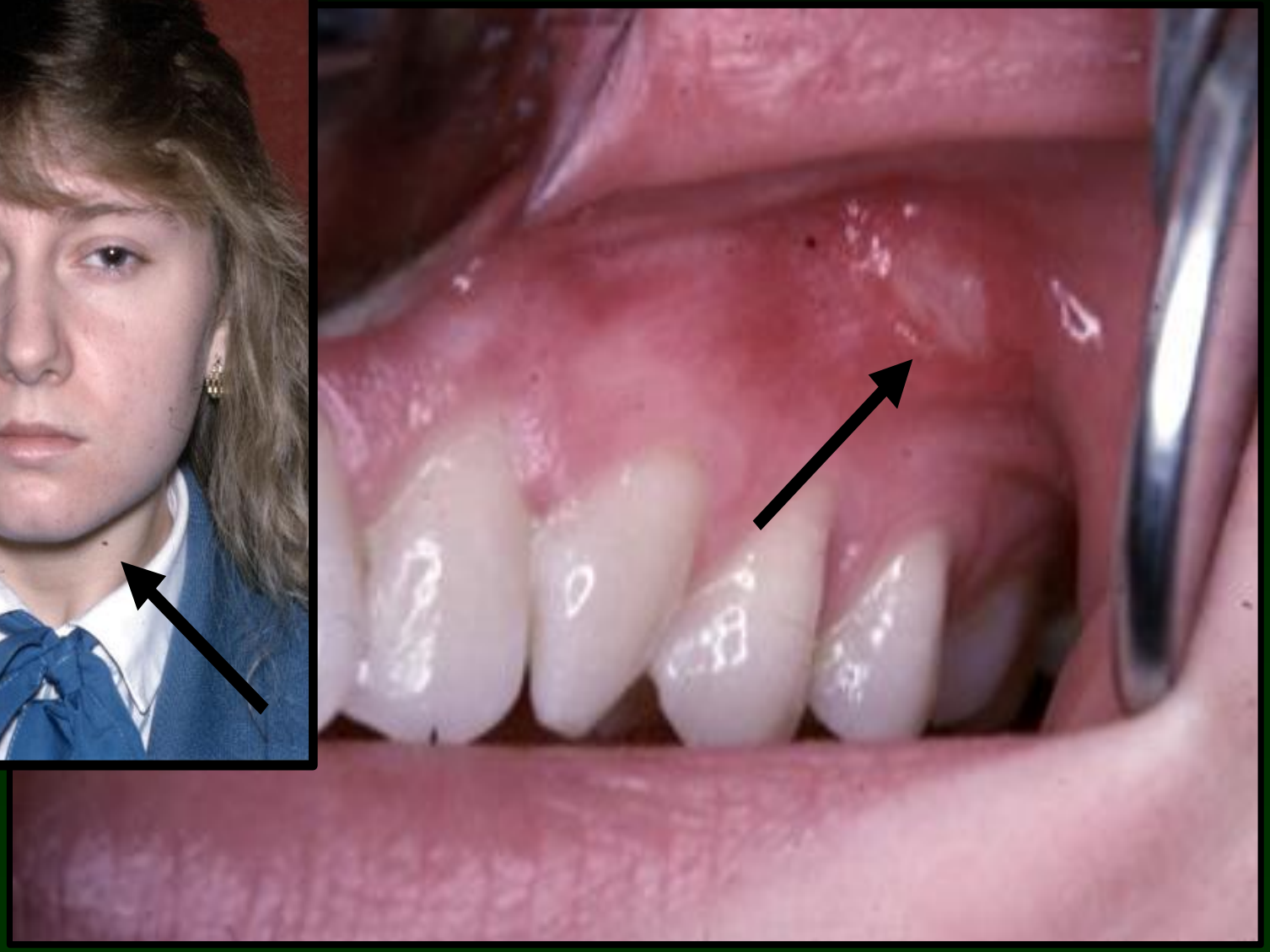
One week later

- **Treatment of Giant Aphthous Ulcer**

820 nm / 60 mw / 2 Joules per point / 16 J per sq cm / CW.

NB : spot 1/8th sq cm.








RAPID RESOLUTION
1 – 2 TREATMENTS

•Treatment of aphthous stomatitis using Low Level Laser Therapy (LLLT)

Pedro J. Muñoz Sánchez[1], José Luis Capote Feminias[1], Jan Tunér[2]

Leonardo Fernández Sánchez Dental Clinic, Cienfuegos, Cuba
Private dental clinic, Grängesberg, Sweden

•**Table 6**

Distribution in the LLLT group according to the clinical category and the time of total scaring.

Clinical cathegories	Total scaring time				
	< 48 hours	≥ 48 hours to 4 days	≥ 5 to 7 days	> 7 days	Total
Smaller ulcers	68	24	-	-	92
Large ulcers	-	4	4	-	8
Herpetiform ulcers	-	4	-	-	4
Total	68	32	4	-	104

Table 7

Distribution in the control group according to the clinical category and the time of total scaring.

Clinical cathegories	Total scaring				
	< 48 hours	≥ 48 hours a 4 days	≥ 5 a 7 days	> 7 days	Total
Smaller ulcers	-	-	84	8	92
Large ulcers	-	-	-	12	12
Total	-	-	84	20	104


FACULTAD DE
CIENCIAS MEDICAS
Dr. Raúl Dorticós
CIENFUEGO

Mucositis

Bensadoun R-J, Franqiun J C, Ciais C et al. Low energy He/Ne laser inthe prevention of radiation-induced mucositis: A multicenter phase III randomized study in patients with head and neck cancer. Support Care Cancer. 1999; 7 (4): 244-252.

Plus 14 additional studies

•Support Care Cancer. 2011 Aug;19(8):1069-77.
A systematic review with meta-analysis of the effect of low-level laser therapy (LLLT) in cancer therapy-induced oral mucositis.
Bjordal JM, Bensadoun RJ, Tunèr J, Frigo L, Gjerde K, Lopes-Martins RA.

Mucositis



Mucositis





Alyne Simoes

Photomed Laser Surg. 2011 Jan;29(1):67-9.

Laser phototherapy for Stevens-Johnson syndrome: a case report.

Simões A, de Freitas PM, Bello-Silva MS, Tunér J, de Paula Eduardo C.

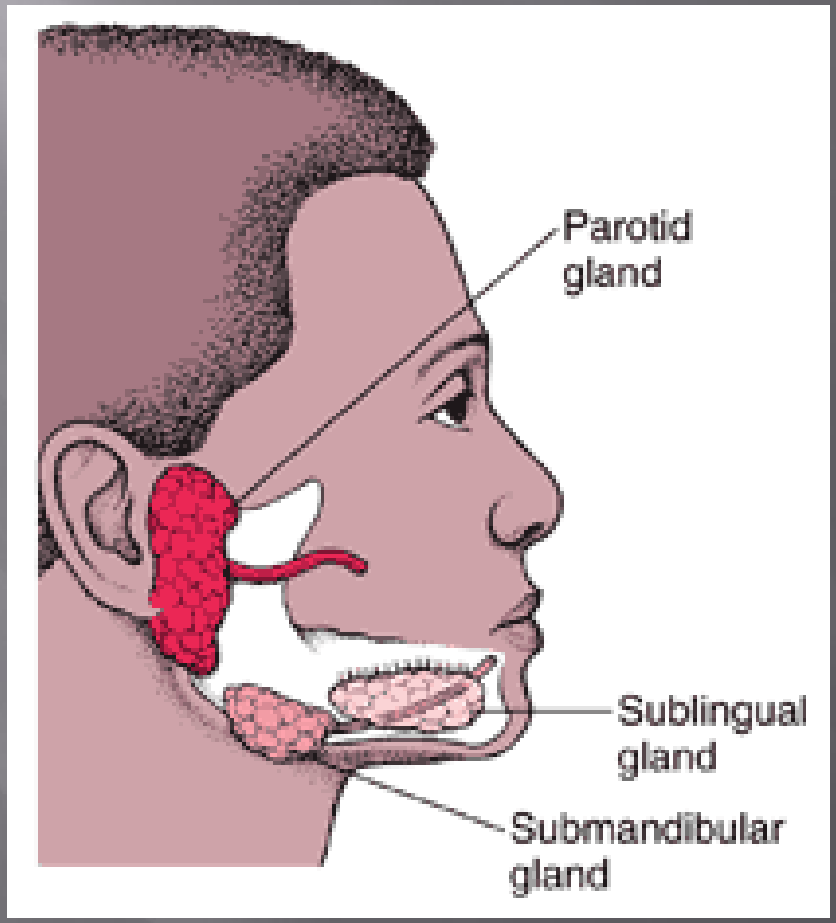






Simoes A 2009

Salivary glands



Xerostomia

Vidović Juras D, Lukac J, Cekić-Arambasin A, Vidović A, Canjuga I, Sikora M, Carek A, Ledinsky M. Effects of low-level laser treatment on mouth dryness. Coll Antropol. 2010 Sep;34(3):1039-43.

Lončar B, Mravak Stipetić M, Baričević M, Risović D. The Effect of Low-Level Laser Therapy on Salivary Glands in Patients With Xerostomia. Photomed Laser Surg. 2010 Nov 6.

Simões A, de Campos L, de Souza DN, de Matos JA, Freitas PM, Nicolau J. Laser phototherapy as topical prophylaxis against radiation-induced xerostomia. Photomed Laser Surg. 2010 Jun;28(3):357-63.

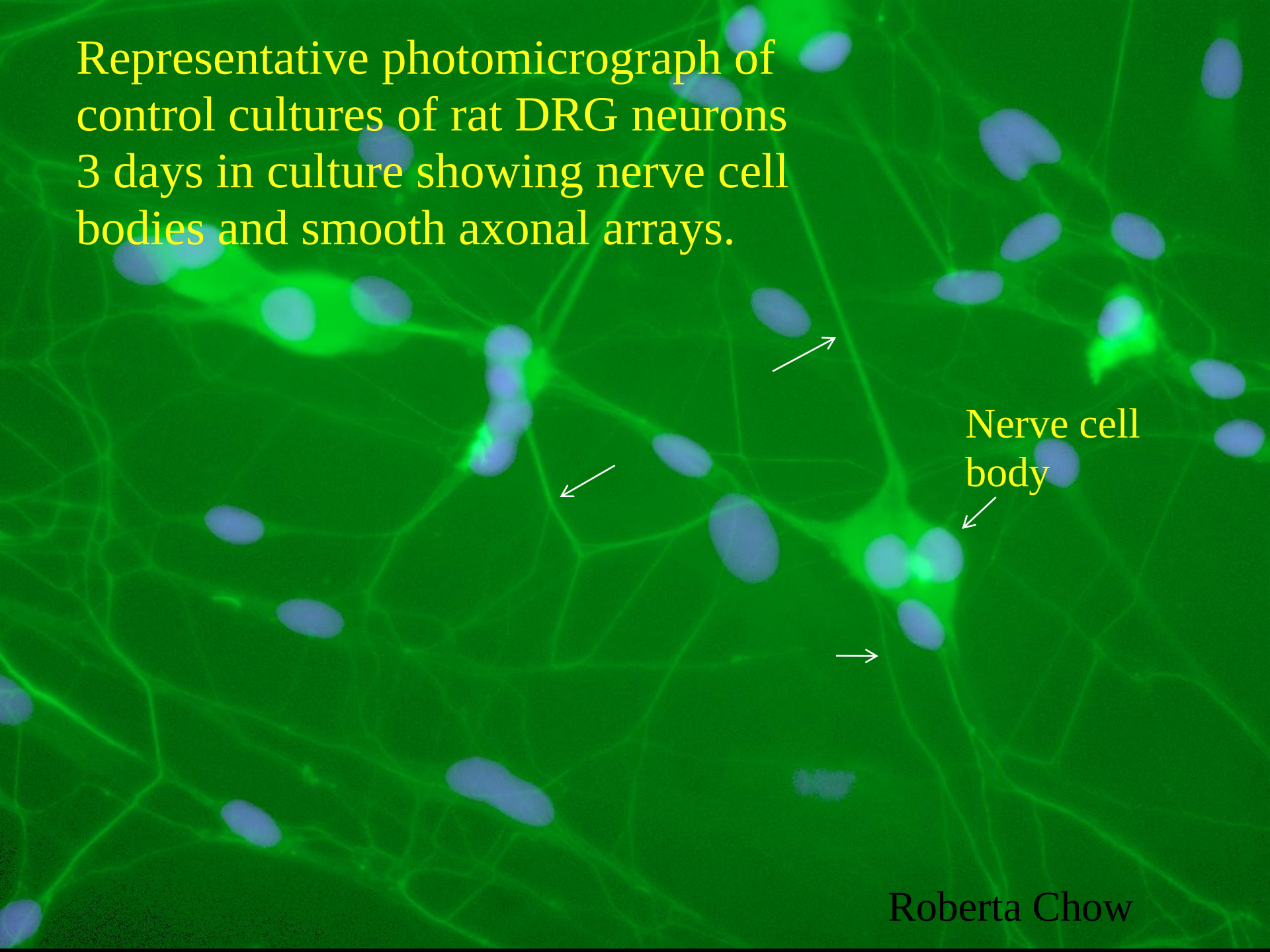
Simões A, Ganzerla E, Yamaguti PM, de Paula Eduardo C, Nicolau J. Effect of diode laser on enzymatic activity of parotid glands of diabetic rats. Lasers Med Sci. 2009 Jul;24(4):591-6.

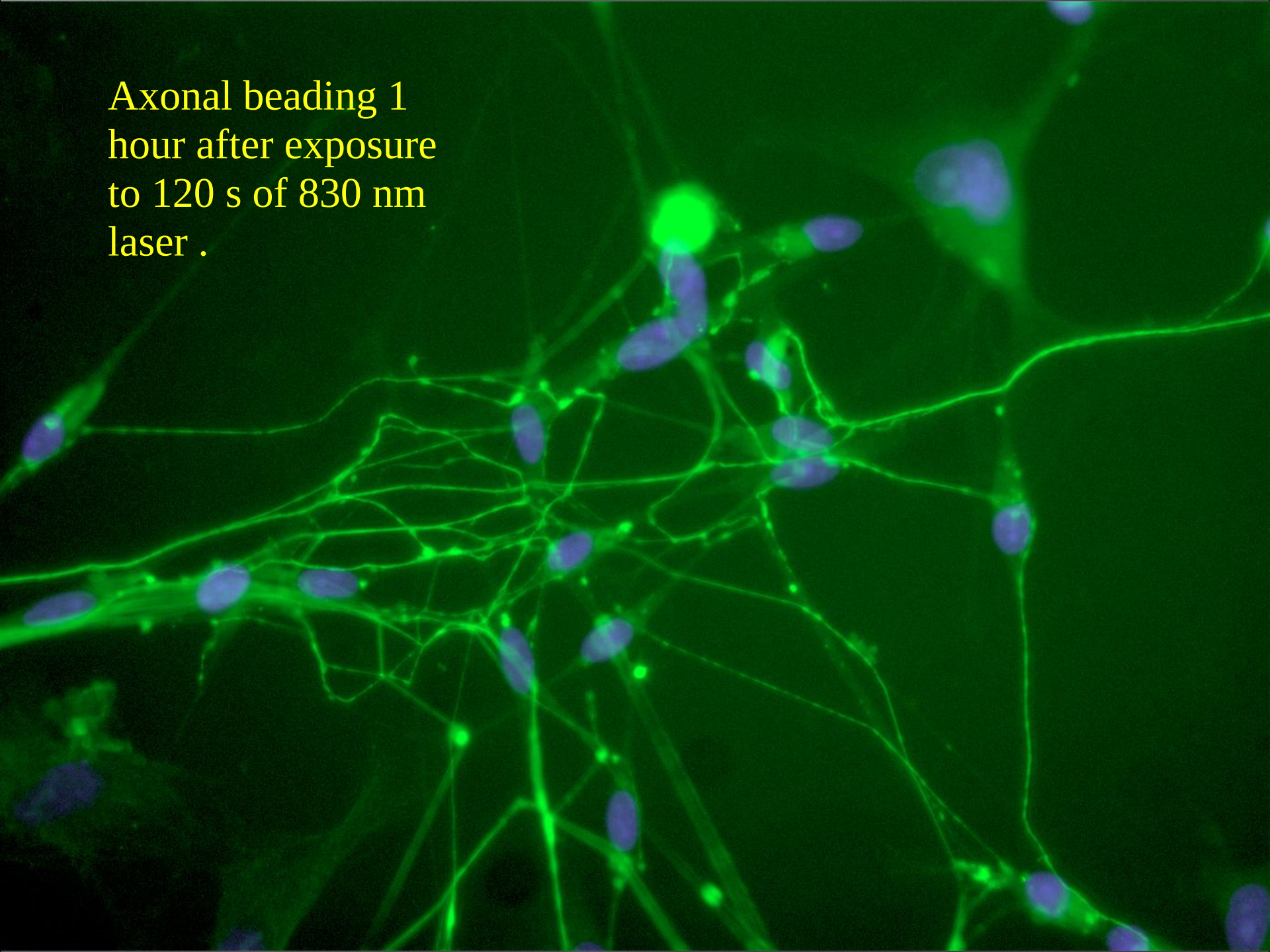
Pain



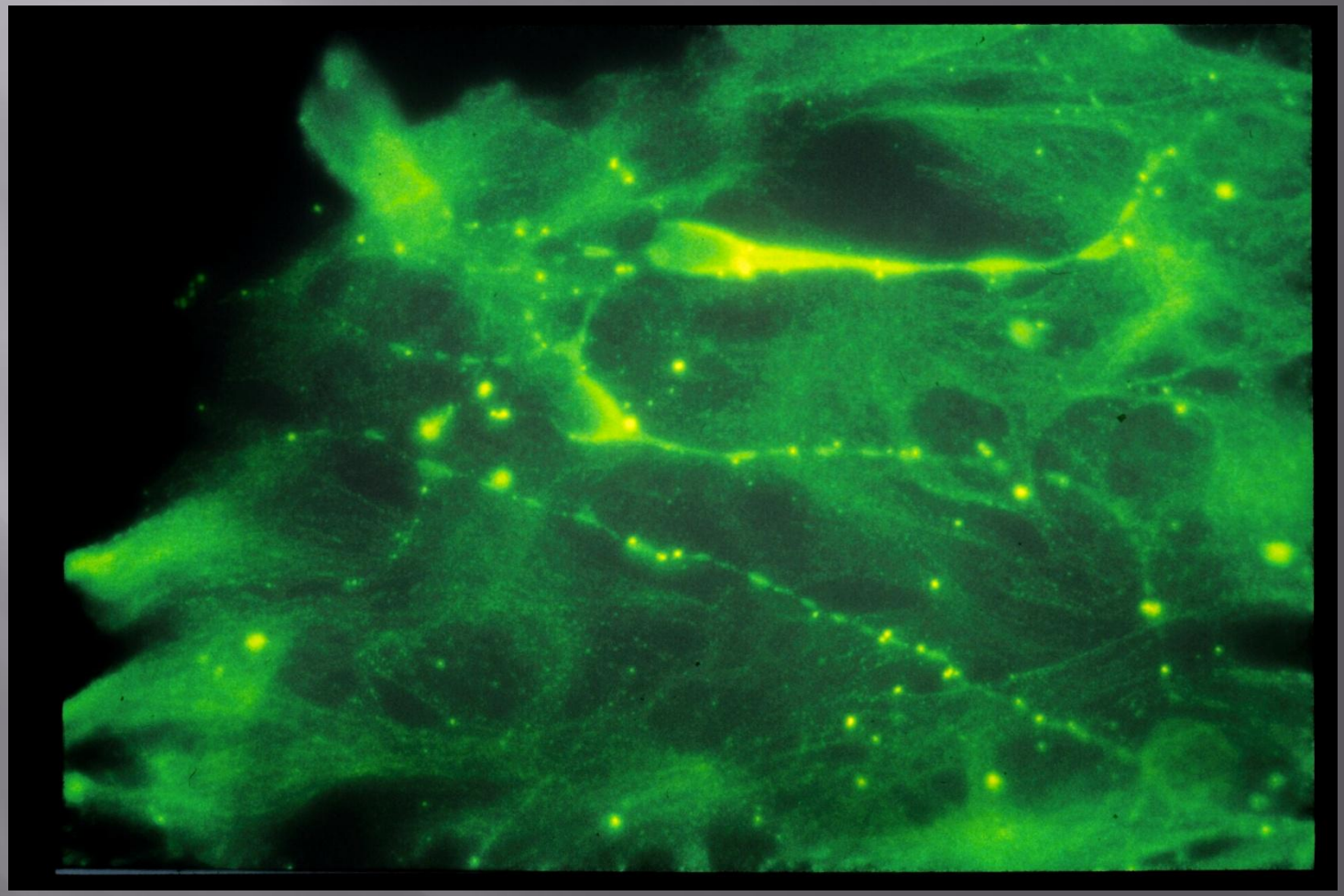
Lancet. 2009 Nov 12. [Epub ahead of print]
Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials.

Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM.


Representative photomicrograph of control cultures of rat DRG neurons 3 days in culture showing nerve cell bodies and smooth axonal arrays.
Nerve cell body
Roberta Chow

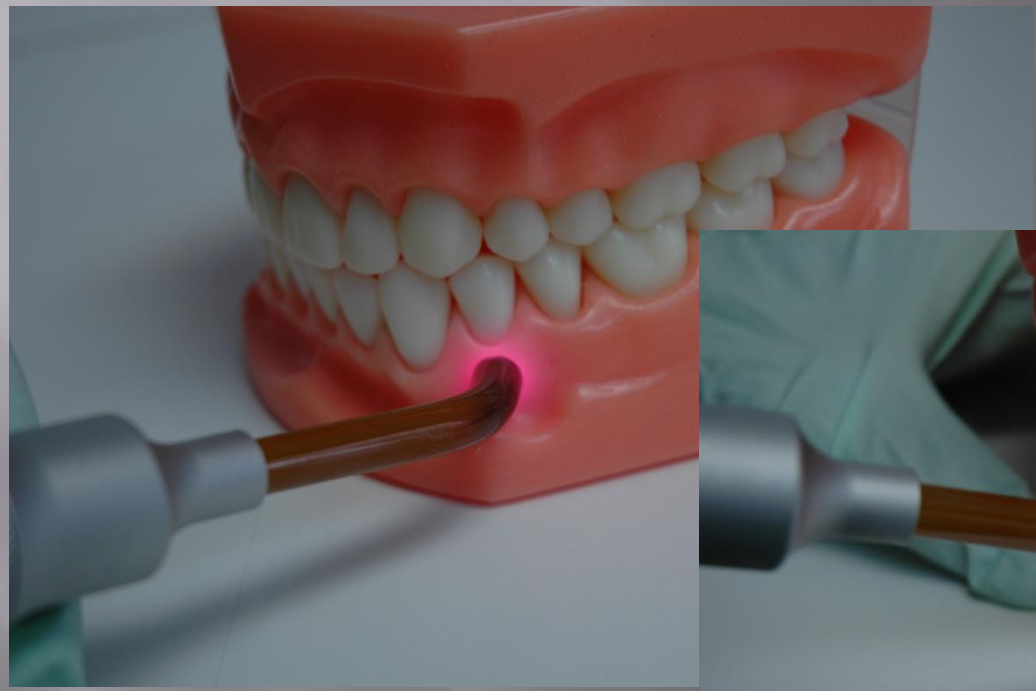

Axonal beading 1
hour after exposure
to 120 s of 830 nm
laser .

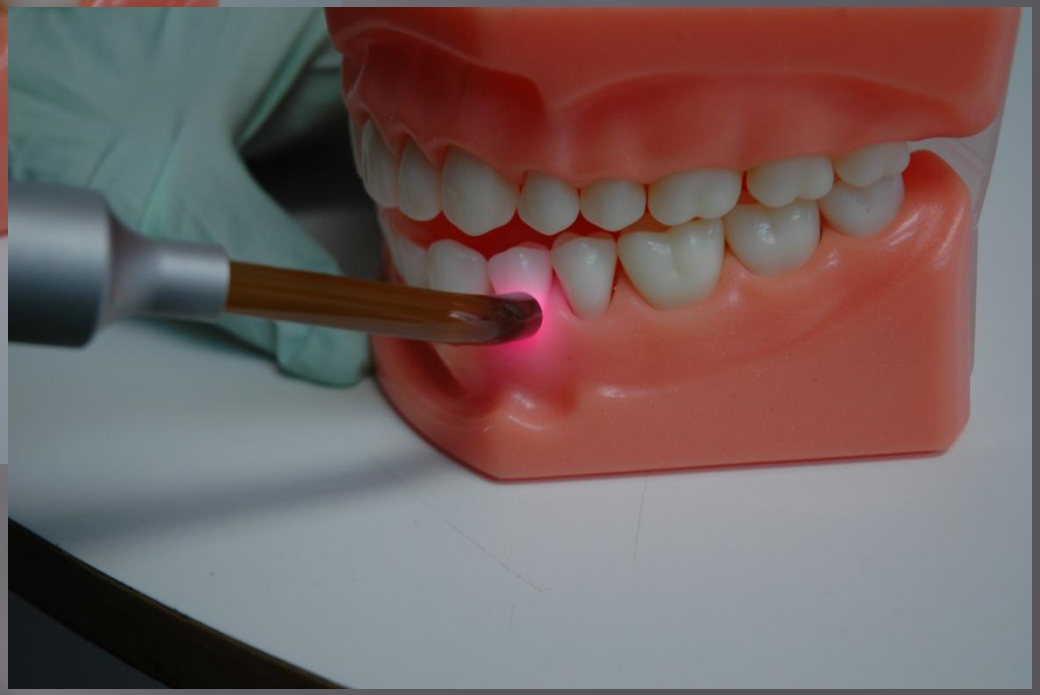
VARICOSITY FORMATION WITH ND:YAG



Ambrose Chan

Pedodontic therapy





Periodontics


H P ESTERHUYSE
KRAAIRIVIER
DANGER AHEAD
FASTEN SAFETY BELTS
AND REMOVE DENTURES
GEVAAR VOOR
MAAK GORDELS VAS
EN VERWYDER KUNSTANDE

Qadri T, Bohdanecka P, Miranda L, Tunér J, Altamash M, Gustafsson A. The importance of coherence length in laser phototherapy of gingival inflammation - a pilot study. Lasers Med Sci. 2007; 22 (4): 245-251.

Qadri T, Bohdanecka P, Miranda L, Tunér J, Altamash M, Gustafsson A. The importance of coherence length in laser phototherapy of gingival inflammation - a pilot study. Lasers in Med Sci. 2007; 22 (4): 245-251.


لم نشعر
بالتغيير
فعدنا للتحرير
الشعب يريد
تطهير الفساد
في
الداخلية والشرطة
النقابات
والجامعات
والتعليم
مسلم مسيحي
يد واحدة

Photomed Laser Surg. 2012 Mar;30(3):160-166.

Effect of Adjunctive Low Level Laser Therapy (LLLT) on Nonsurgical Treatment of Chronic Periodontitis.

Makhlouf M, Dahaba MM, Tunér J, Eissa SA, Harhash TA.

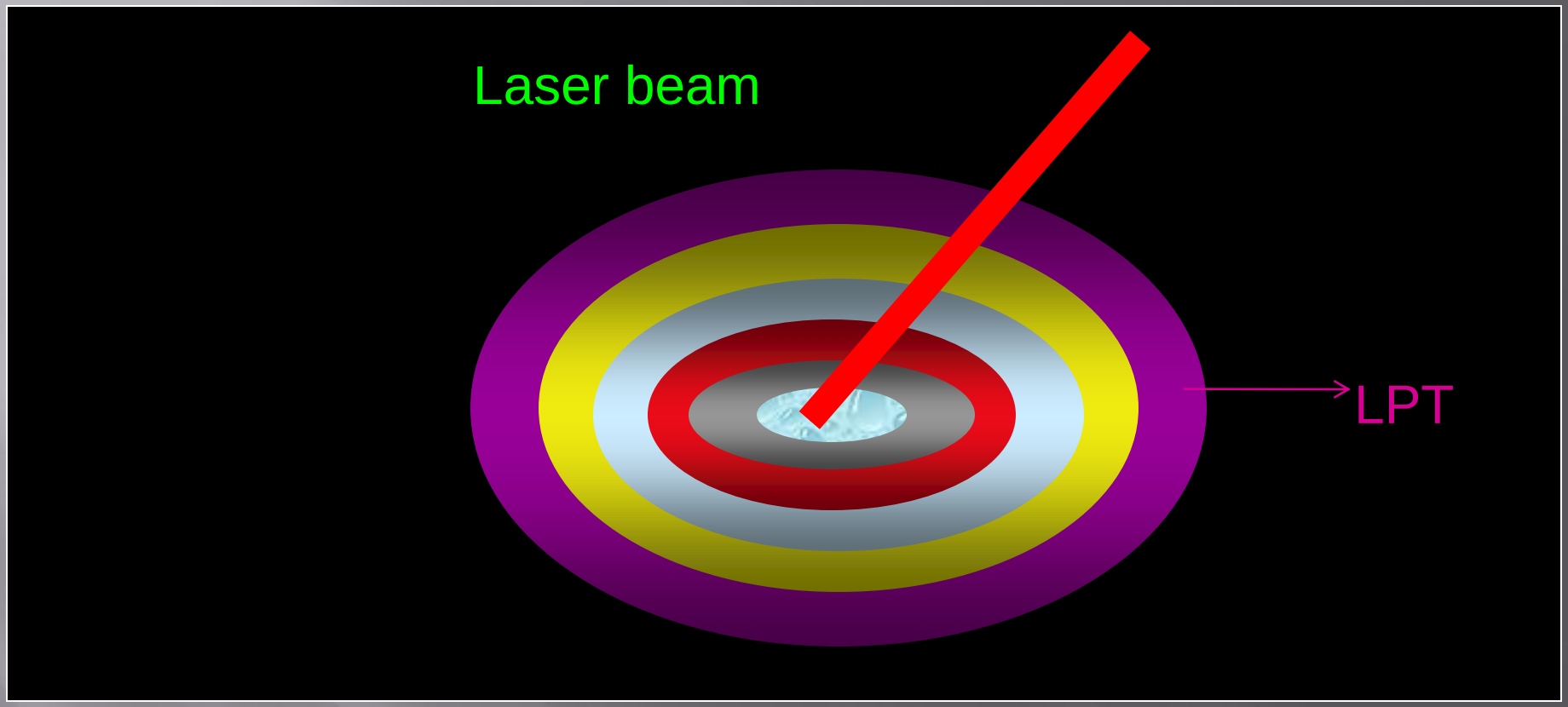
Lasers Med Sci. 2010 Nov;25(6):781-92.

Laser phototherapy in the treatment of periodontal disease. A review.

de Paula Eduardo C, de Freitas PM, Esteves-Oliveira M, Aranha AC, Ramalho KM, Simões A, Bello-Silva MS, Tunér J.

Laser – tissue interaction

HLLT



Vaporisation

Coagulation

Photothermic effect

Carbonisation

Denaturation

Photostimulating effe









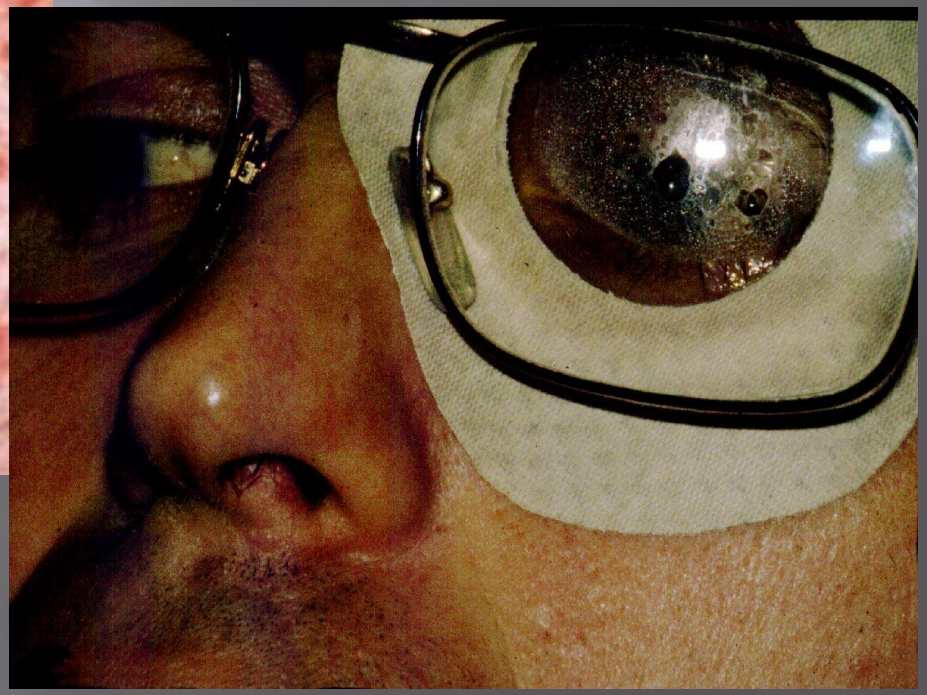
Toothbrush grip?





Zoster







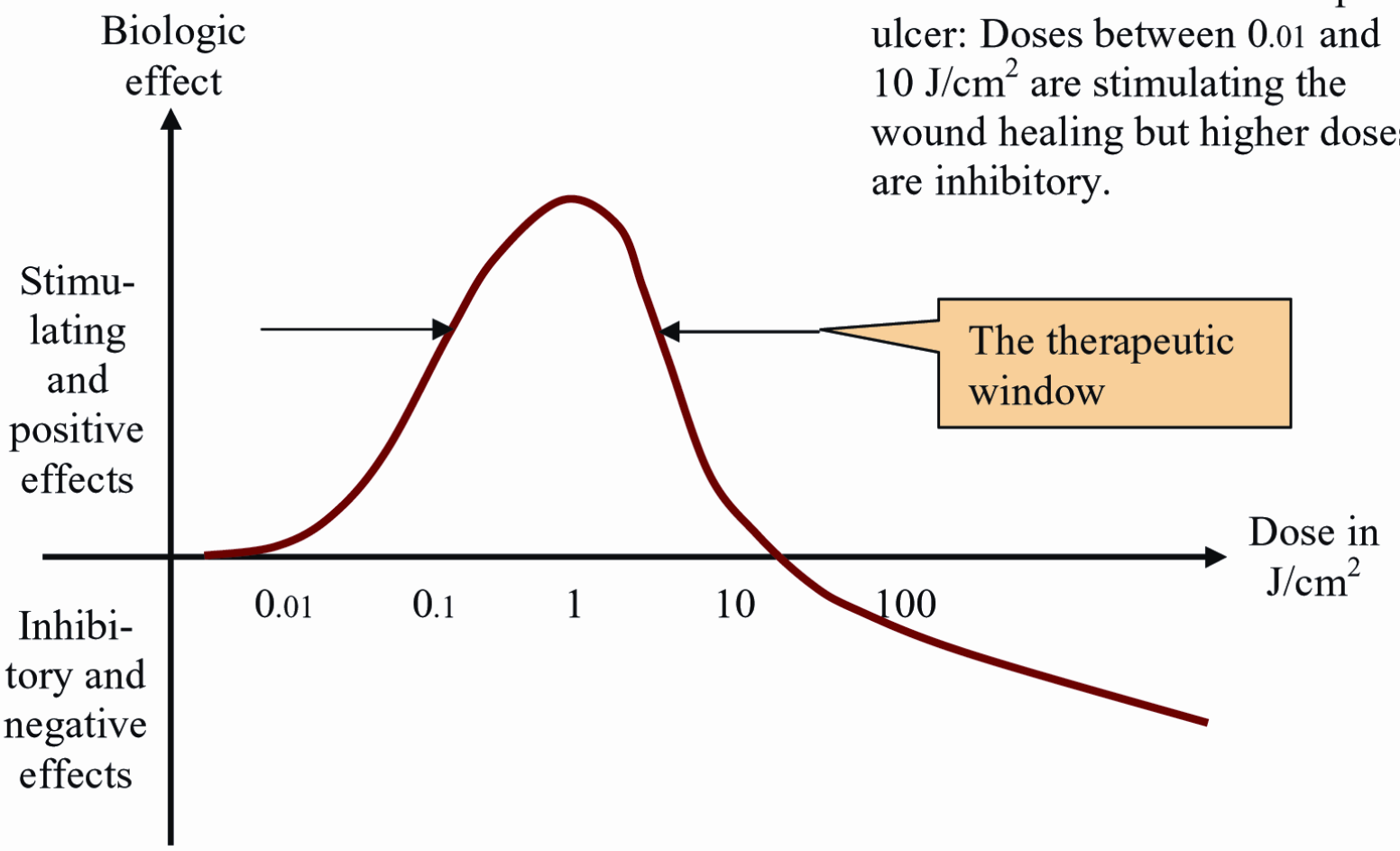




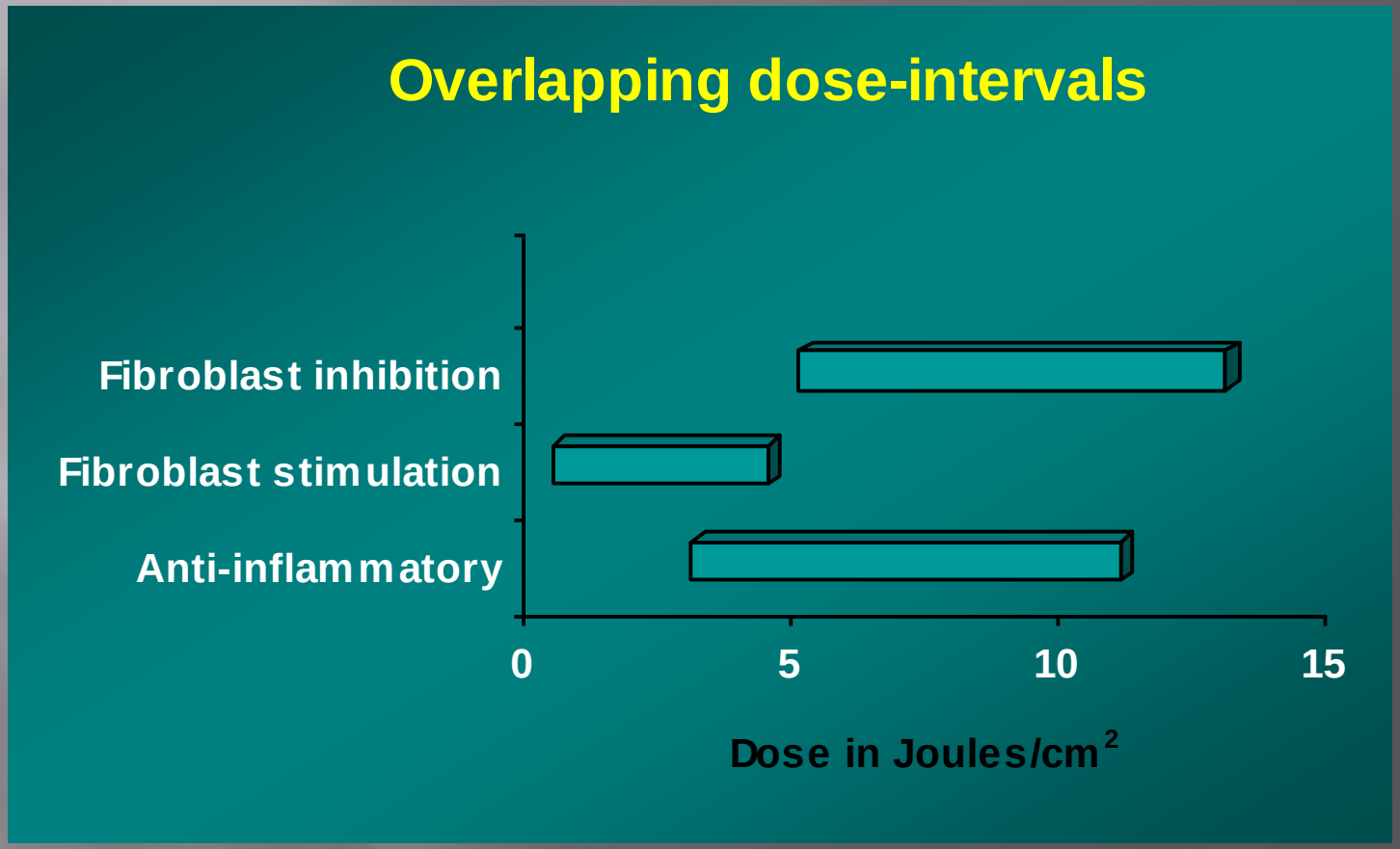



Lost in the dosage jungle?

Arndt-Schulz law for an open ulcer: Doses between 0.01 and 10 J/cm^2 are stimulating the wound healing but higher doses are inhibitory.



Therapeutic windows



Bjordal 2009

Dose

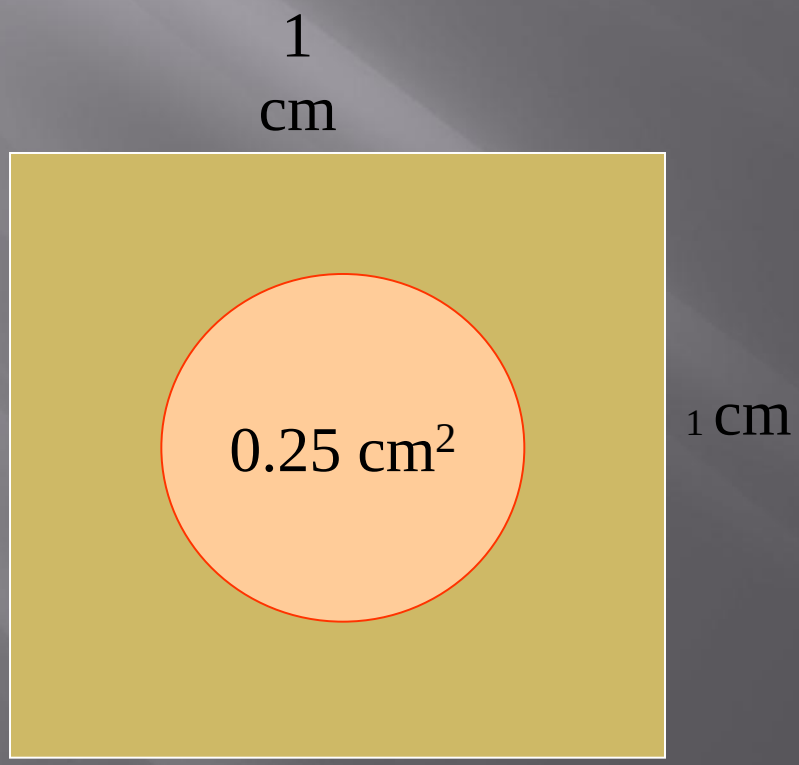
- Joule = energy – not dose!
- Joule/cm^2 = dose

Energy per ”point”…

- ..is not a ”dose”! But…
- ..is a practical and easily understood clinical expression of the energy
- Not to be used in scientific studies
- A ”point” is approximatively 5 mm^2

Joule and dose

Light green = 1 cm^2

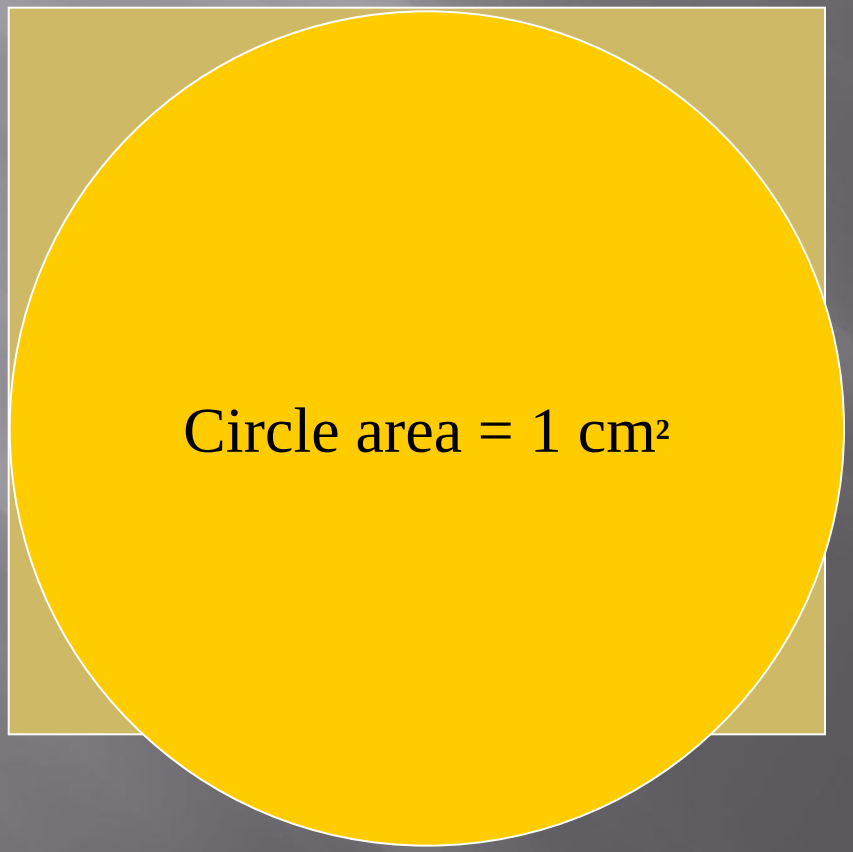


Applied energy = 1 Joule

- Size of the laser aperture (in contact with tissue) = 0.25 cm^2

- Dose: $\frac{1 \text{ Joule}}{\text{area } 0.25\ cm^2} = \frac{1}{0.25} = 4\ J/cm^2$

Irradiation from slight distance



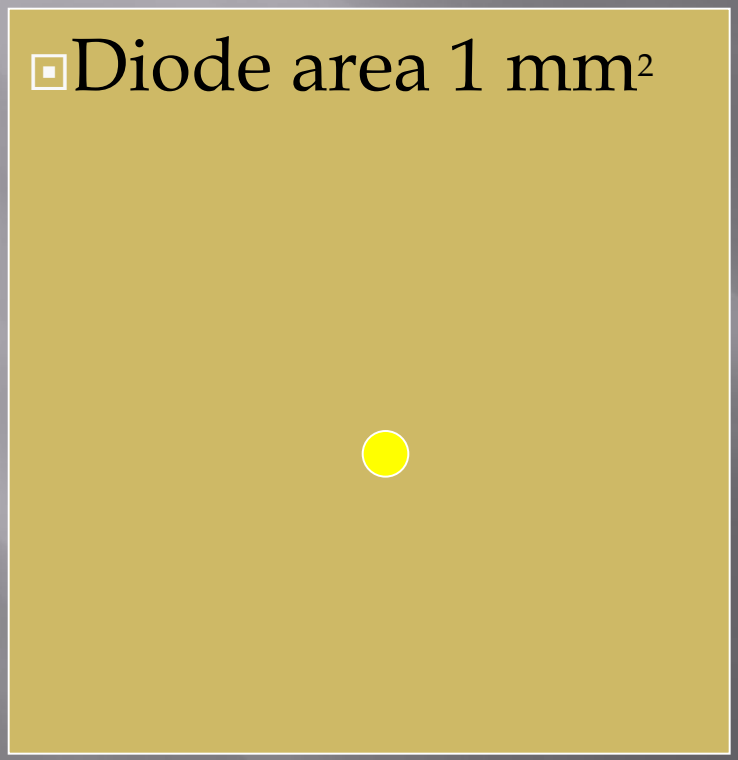
Applied energy = 1 Joule

- Dose:

- 1 Joule / Area: 1 cm² = 1 / 1 = 1 J/cm²

Typical GaAs diode size

- Diode area 1 mm^2



Dose: 100 J/cm^2
Energy: J Joule

1 mW x 1000 s = 1 J
10 mW x 100 s = 1 J
100 mW x 10 s = 1 J
1000 mW x 1 s = 1 J

Sizes of the laser eye





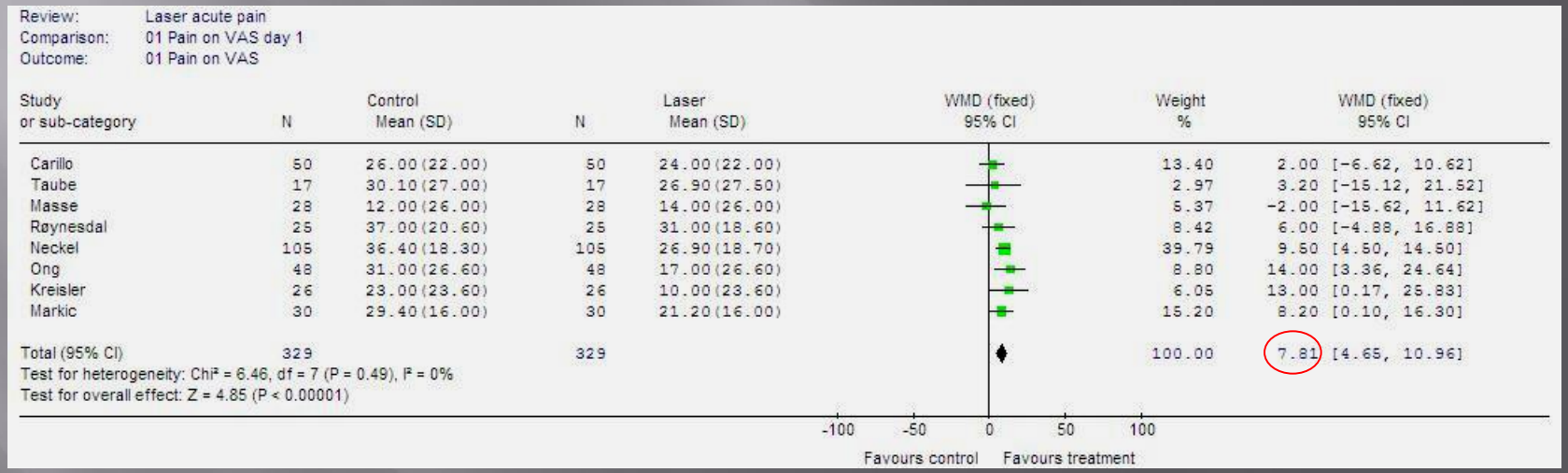
The Cochrane collaboration

Statens Beredning För Medicinsk Utvärdering

Nationella riktlinjer

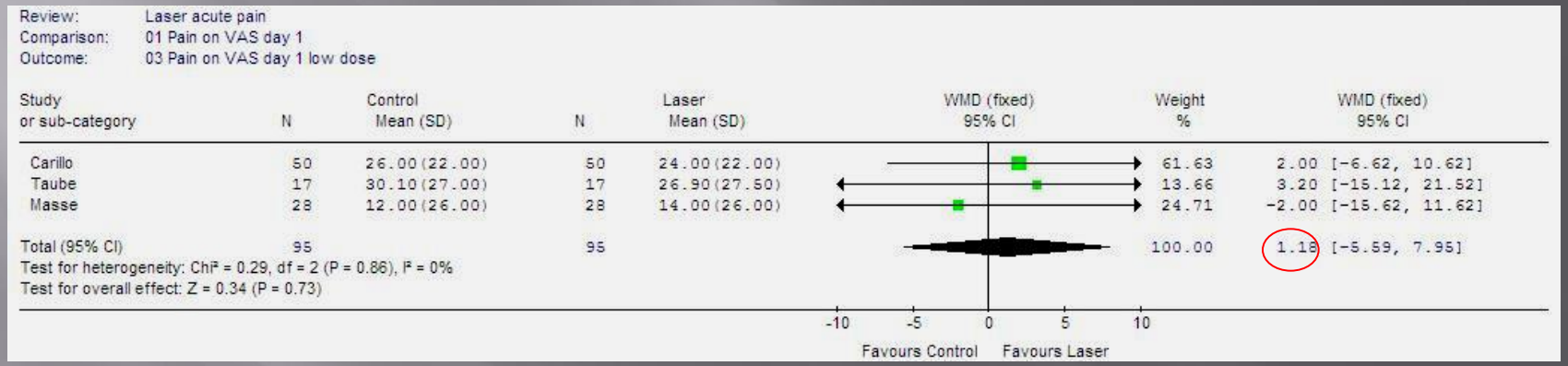
Randomized placebo-controlled LLLT trials in acute post-operative dental pain

Pain on VAS all included trials



Randomized placebo-controlled LLLT trials in acute post-operative dental pain

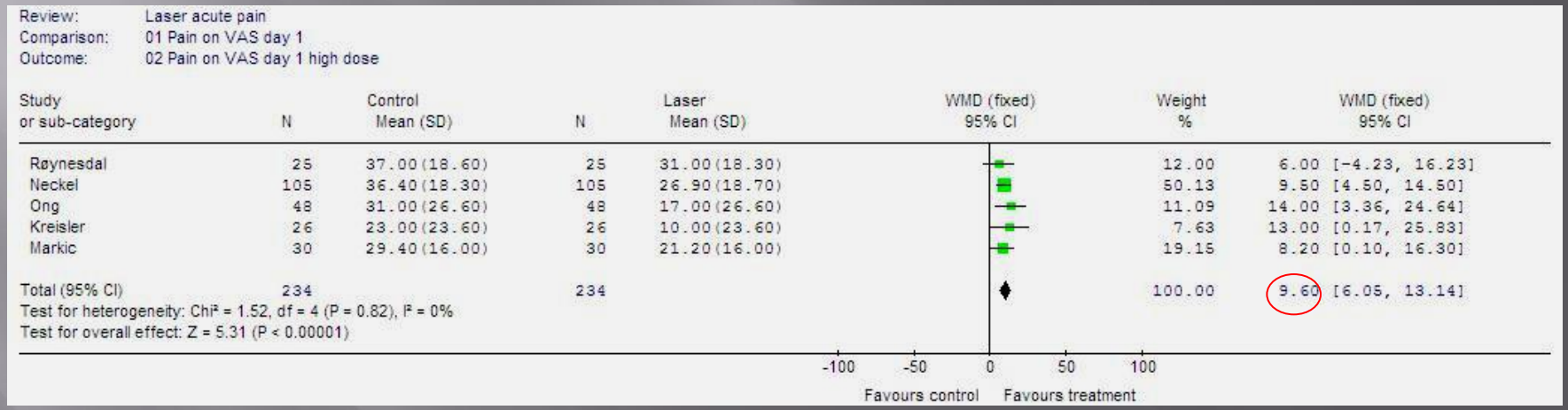
Low dose < 1 Joules



Not significantly different from placebo

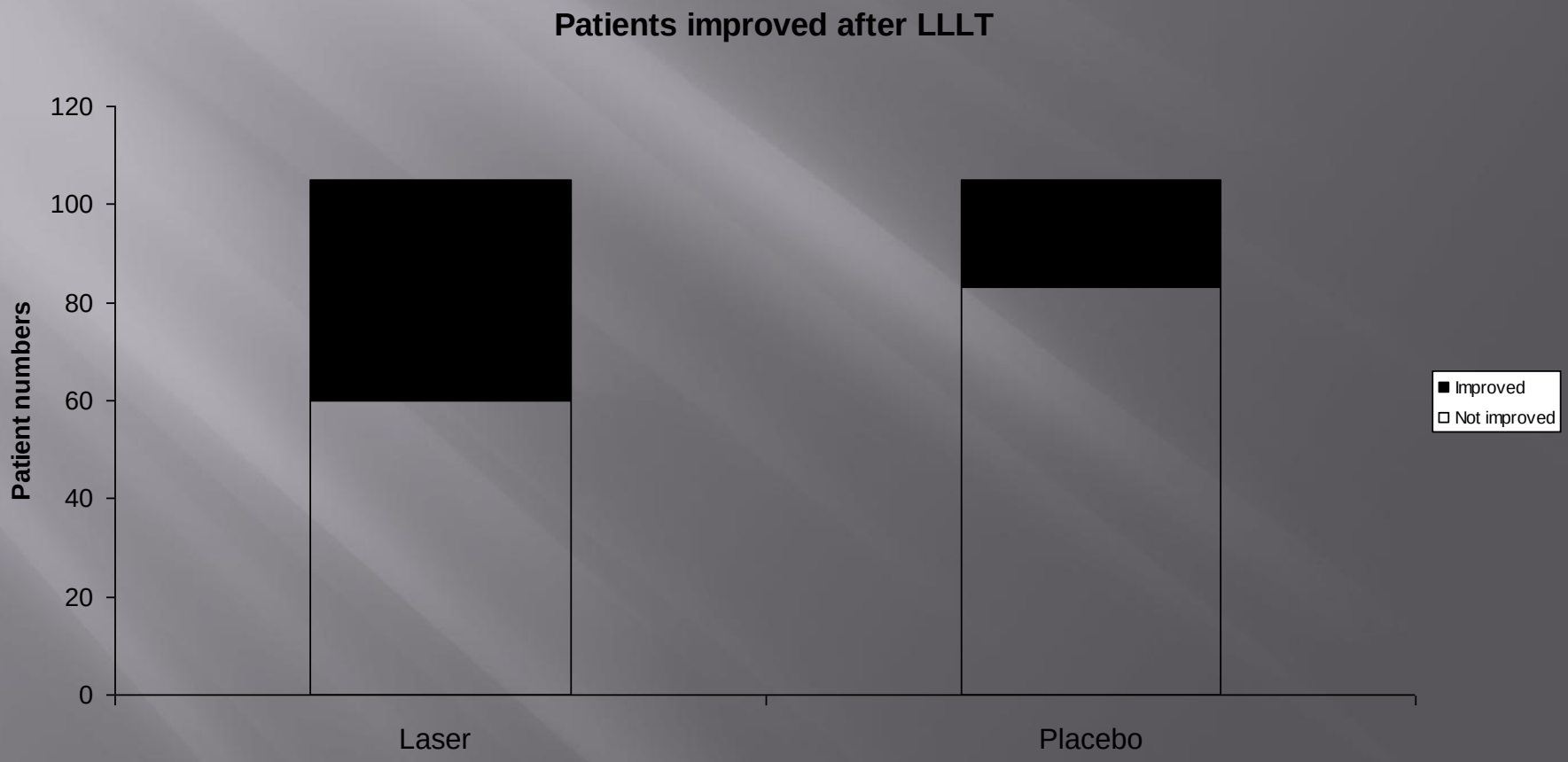
Randomized placebo-controlled LLLT trials in acute post-operative dental pain

Pain on VAS with optimal doses 2-8 Joules



LLLT significantly better than placebo

Randomized placebo-controlled LLLT trials in acute post-operative dental pain



Relative Risk for improvement: 2.1 (95% CI 1.3 to 3.2) p=0.001

- Annals of Laser Therapy Research

www.laserannals.com

WALT



www.walt.nu

Clinical dosage recommendations



http://www.walt.nu

WALT

Recommended anti-inflammatory dosage for Low Level Laser Therap

Laser classes 3 or 3 B, 780 - 860nm GaAlAs Lasers. Continuous or pulse output less than 0.5 W

Energy dose delivered to the skin over the target tendon or synovia

Diagnoses

Tendinopathies	Points or cm2	Joules 780 - 820nm	Notes
Carpal-tunnel	2-3	12	Minimum 6 Joules per point
Lateral epicondylitis	1-2	4	Maximum 100mW/cm2
Biceps humeri c.l.	1-2	8	
Supraspinatus	2-3	10	Minimum 5 Joules per point
Infraspinatus	2-3	10	Minimum 5 Joules per point
Trochanter major	2-4	10	
Patellartendon	2-3	6	
Tract. Iliotibialis	2-3	3	Maximum 100mW/cm2
Achilles tendon	2-3	8	Maximum 100mW/cm2
Plantar fasciitis	2-3	12	Minimum 6 Joules per point
Arthritis	Points or cm2	Joules	
Finger PIP or MCP	1-2	6	
Wrist	2-4	10	
Humeroradial joint	1-2	4	
Elbow	2-4	10	
Glenohumeral joint	2-4	15	Minimum 6 Joules per point
Acromioclavicular	1-2	4	
Temporomandibular	1-2	6	
Cervical spine	2-4	15	Minimum 6 Joules per point
Lumbar spine	2-4	40	Minimum 8 Joules per point
Hip	2-4	40	Minimum 8 Joules per point
Knee medial	3-6	20	Minimum 5 Joules per point
Ankle	2-4	15	

Daily treatment for 2 weeks or treatment every other day for 3-4 weeks is recommended

Irradiation should cover most of the pathological tissue in the tendon/synovia.
Tendons
Start with energy dose in table, then reduce by 30% when inflammation is under control
(Does not apply for carpal tunnel tenosynovitis)

Therapeutic windows range from typically +/- 50% of given values
Recommended doses are based on ultrasonographic measurements
of depths from skin surface and typical volume of pathological tissue
and estimated optical penetration for the different laser types in caucasians

Disclaimer
The list may be subject to change at any time when more research trials
are being published. World Association of Laser Therapy is not responsible
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performed at the therapist/doctor´s discretion and responsibility

Revised August 2005

WALT

Recommended anti-inflammatory dosage for Low Level Laser Therapy

Laser classes 3 or 3B, 904 nm GaAs Lasers (Peak pulse output more than 1 Watt)

Energy dose delivered to the skin over the target tendon or synovia

Diagnoses

Tendinopathies	Points or cm2	Joules 904nm	Notes
Carpal-tunnel	2-3	4	Minimum 2 Joules per point
Lateral epicondylitis	1-2	1	Maximum 100mW/cm2
Biceps humeri cap.long.	1-2	2	
Supraspinatus	2-3	3	Minimum 2 Joules per point
Infraspinatus	2-3	3	Minimum 2 Joules per point
Trochanter major	2-3	2	
Patellartendon	2-3	2	
Tract. Iliotibialis	2-3	2	Maximum 100mW/cm2
Achilles tendon	2-3	2	Maximum 100mW/cm2
Plantar fasciitis	2-3	3	Minimum 2 Joules per point
Arthritis	Points or cm2	Joules 904nm	
Finger PIP or MCP	1-2	2	
Wrist	2-3	3	
Humeroradial joint	1-2	2	
Elbow	2-3	3	
Glenohumeral joint	2-3	6	Minimum 2 Joules per point
Acromioclavicular	1-2	2	
Temporomandibular	1-2	2	
Cervical spine	2-3	6	Minimum 2 Joules per point
Lumbar spine	2-3	10	Minimum 4 Joules per point
Hip	2-3	10	Minimum 4 Joules per point
Knee anteromedial	2-4	6	Minmum 2 Joules per point
Ankle	2-4	6	

Daily treatment for 2 weeks or treatment every other day for 3-4 weeks is recommended

Irradiation should cover most of the pathological tissue in the tendon/synovia.
Tendons
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WALT
World Association for Laser Therapy

WORLD ASSOCIATION FOR LASER THERAPY

World Association for Laser Therapy Conference September 2012 at Australia's Gold Coast

(Preconference Laser Safety Course with Penny Smalley and WFLD lasers in dentistry-

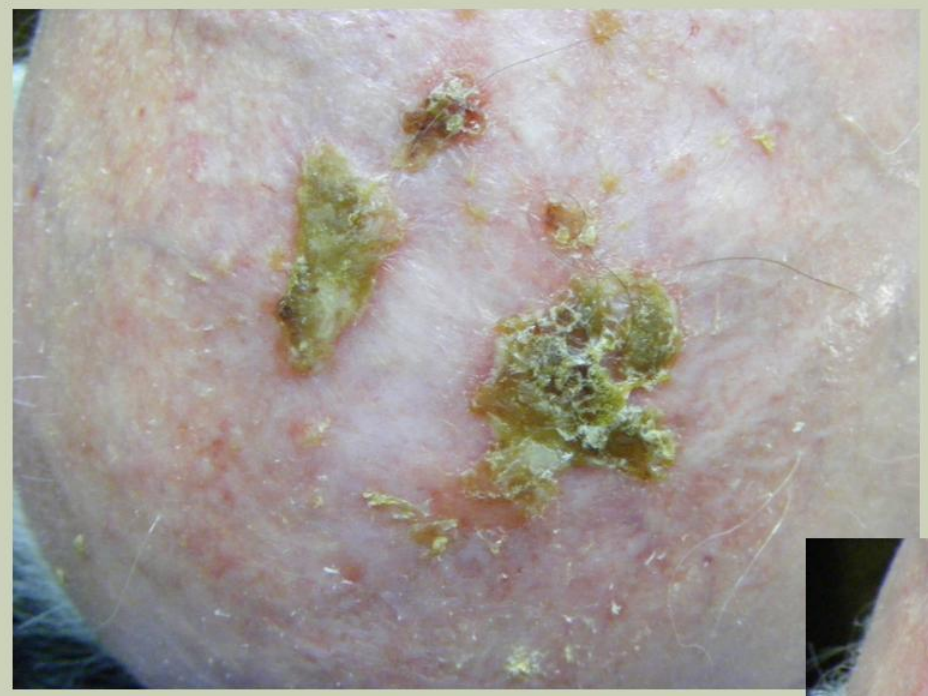
Sept 26-27th)

amla AUSTRALIAN MEDICAL LASER ASSOCIATION



Photomed Laser Surg. 2009 Apr;27(2):221-226. Blue 470-nm light kills methicillin-resistant Staphylococcus aureus (MRSA) in vitro. Enwemeka CS, Williams D, Enwemeka SK, Hollosi S, Yens D.









The literature confirms: LLLT improves grip strength!

