

Übersicht über LLLT-Studien nach 1991 zu chronischen Innenohr-Erkrankungen.

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[J Clin Laser Med Surg](#). 1998 Jun;16(3):159-65.

# The Importance of radiation phenomena of electrons and therapeutic low-level laser in regard to the mitochondrial energy transfer.

[Wilden L](#), [Karthain R](#).

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## **Abstract**

### **OBJECTIVE:**

The authors describe a consistent theoretical model of the cellular energy transfer (respiratory chain) by taking into consideration the radiation phenomena of electrons and therapeutic low level laser.

### **SUMMARY BACKGROUND DATA:**

Biochemical models of the cellular energy transfer regard the classical corpuscular aspect of electrons as the responsible energy carriers, thereby ignoring the wave-particle dualism of the electrons and the import of radiation energy in this process.

### **METHODS:**

The authors show the influence of radiation phenomena on the cellular energy transfer, explaining consistently some of the intermediate steps of this complex process.

### **RESULTS:**

Because of the inherent wave-particle dualism of the electrons, it is appropriate to regard radiation phenomena to explain the cellular energy transfer. The classical biochemical models use only the particle part of the electrons as energy carriers. The connection between energy transport by radiation and the order in structures may be understood if, for instance, structurally bound energy is released during the dissolution of structures (oxidation of foodstuffs) or is again manifested (final reduction of oxygen to water). With a attention to the energy values relevant for the respiratory chain, the import of electromagnetic radiation of characteristic ranges of wavelengths on the cellular energy transfer becomes evident. Depending on its wavelength, electromagnetic radiation in the form of light can stimulate macromolecules and can initiate conformation changes in proteins or can transfer energy to electrons. Low level laser from the red and the near infrared region corresponds well with the characteristic energy and absorption levels of the relevant components of the respiratory chain. This laser stimulation vitalizes the cell by increasing the mitochondrial ATP(adenosine-tri-phosphate)-production.

### **CONCLUSIONS:**

With regard to radiation phenomena and its enhanced electron flow in the cellular energy transfer (respiratory chain), it is possible to explain the experimentally found increase of ATP-production by means of low-level laser light on a cellular level. Intense research for this biostimulative effect is still necessary.

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9743654

[PubMed - indexed for MEDLINE]

[Int Tinnitus J.](#) 2008;14(2):175-80.

# **Effectiveness of combined counseling and low-level laser stimulation in the treatment of disturbing chronic tinnitus.**

[Cuda D, De Caria A.](#)

## **Source**

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## **Abstract**

We recruited 46 adult patients affected by disturbing tinnitus lasting for at least 3 years. All were treated with a combined counseling protocol constituting hypnotherapeutic and muscle relaxation techniques. We randomly assigned 26 patients to the group receiving low-level laser stimulation treatment and 20 to the placebo group. The laser power was 5 mV and the wavelength 650 nm. The irradiation lasted 20 minutes daily for 3 months. The Tinnitus Handicap Inventory (THI) questionnaire was submitted at the beginning and at the end of treatment. The THI scores improved in the entire sample after treatment 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 by one class, in comparison to 35% of the placebo group.

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19205171

[PubMed - indexed for MEDLINE]

[J Laryngol Otol.](#) 2008 May;122(5):447-51. Epub 2007 Jul 12.

# Effectiveness of transmeatal low power laser irradiation for chronic tinnitus.

[Gungor A](#), [Dogru S](#), [Cincik H](#), [Erkul E](#), [Poyrazoglu E](#).

## Source

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## Abstract

### OBJECTIVE:

To evaluate effectiveness of 5 mW laser irradiation in the treatment of chronic tinnitus.

### STUDY DESIGN:

Prospective, randomised, double-blind study. Methods: This investigation included 66 ears in 45 patients with chronic unilateral or bilateral tinnitus. A 5 mW laser with a wavelength of 650 nm, or placebo laser, was applied transmeatally for 15 minutes, once daily for a week. A questionnaire was administered which asked patients to score their symptoms on a five-point scale, before and two weeks after laser irradiation. A decrease of one scale point, regarding the loudness, duration and degree of annoyance of tinnitus, was accepted to represent an improvement.

### RESULTS:

The loudness, duration and degree of annoyance of tinnitus were improved, respectively, in up to 48.8, 57.7 and 55.5 per cent of the patients in the active laser group. No significant improvement was observed in the placebo laser group.

### CONCLUSION:

Transmeatal, low power (5 mW) laser irradiation was found to be useful for the treatment of chronic tinnitus.

PMID:

17625032

[PubMed - indexed for MEDLINE]

[Neurosci Lett](#). 2007 Jan 16;411(3):189-93. Epub 2006 Nov 22.

# Neural correlates of transmeatal cochlear laser (TCL) stimulation in healthy human subjects.

[Siedentopf CM](#), [Ischebeck A](#), [Haala IA](#), [Mottaghy FM](#), [Schikora D](#), [Verius M](#), [Koppelstaetter F](#), [Buchberger W](#), [Schlager A](#), [Felber SR](#), [Golaszewski SM](#).

## Source

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## Abstract

Transmeatal cochlear laser (TCL) treatment has recently been proposed as a therapeutic procedure for cochlear dysfunction such as chronic cochlear tinnitus or sensorineural hearing loss. The aim of this study was to investigate whether TLC has any influence on the central nervous system using functional MRI with healthy young adults. The laser stimulation device was placed on the tympanic membrane of both ears. A laser stimulation run and a placebo run were performed in random order. The participants were unable to differentiate between verum and placebo stimulation. In the comparison of verum to placebo runs, we observed significant activations within the left superior frontal gyrus, the right middle and medial frontal gyrus, the right superior parietal lobule, the left superior occipital gyrus, the precuneus and cuneus bilaterally, the right anterior and the left and right middle and posterior cingulate gyrus and the left thalamus. This network of brain areas corresponds well to results from previous PET studies of patients with tinnitus. Though TCL seems to have a clinically measurable effect on the central nervous system the neurophysiological mechanism leading to the observed activated neuronal network remains unknown.

PMID:

17123710

[PubMed - indexed for MEDLINE]

# Transmeatal cochlear laser (TCL) treatment of cochlear dysfunction: a feasibility study for chronic tinnitus.

[Tauber S](#), [Schorn K](#), [Beyer W](#), [Baumgartner R](#).

## Source

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## Abstract

Low-level-laser-therapy (LLLT) targeting the inner ear has been discussed as a therapeutic procedure for cochlear dysfunction such as chronic cochlear tinnitus or sensorineural hearing loss. Former studies demonstrate dose-dependent biological and physiological effects of LLLT such as enhanced recovery of peripheral nerve injuries, which could be of therapeutic interest in cochlear dysfunction. To date, in patients with chronic tinnitus mastoidal and transmeatal irradiation has been performed without systematic dosimetric assessment. However, light-dosimetric studies on human temporal bones demonstrated that controlled application of laserlight to the human cochlea depends on defined radiator position within the external auditory meatus. This feasibility study first presents a laser application system enabling dose-controlled transmeatal cochlear laser-irradiation (TCL), as well as preliminary clinical results in patients with chronic cochlear tinnitus. The novel laser TCL-system, consisting of four diode lasers ( $\lambda=635\text{ nm}-830\text{ nm}$ ) and a new specific head-set applicator, was developed on the basis of dosimetric data from a former light-dosimetric study. In a preliminary clinical study, the TCL-system was applied to 35 patients with chronic tinnitus and sensorineural hearing loss. The chronic symptoms persisted after standard therapeutic procedures for at least six months, while retrocochlear or middle-ear pathologies have been ruled out. The patients were randomised and received five single diode laser treatments ( $\lambda=635\text{ nm}$ , 7.8 mW cw,  $n=17$  and  $\lambda=830\text{ nm}$ , 20 mW cw,  $n=18$ ) with a space irradiation of 4 J/cm<sup>2</sup> site of maximal cochlear injury. For evaluation of laser-induced effects complete otolaryngologic examinations with audiometry, tinnitus masking and matching, and a tinnitus-self-assessment were performed before, during and after the laser-irradiation. The first clinical use of the TCL-system has been well tolerated without side-effects and produced no observable damage to the external, middle or inner ear. Changes of tinnitus loudness and tinnitus matching have been described. After a follow-up period of six months tinnitus loudness was attenuated in 13 of 35 irradiated patients, while two of 35 patients reported their tinnitus as totally absent. Hearing threshold levels and middle ear function remained unchanged. Further investigations by large double-blind placebo-controlled studies are mandatory for clinical evaluation of the presented TCL-system and its therapeutic effectiveness in acute and chronic cochlear dysfunction.

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14505199

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[Acta Otolaryngol Suppl.](#) 2001;545:92-3.

## **Combined laser-EGb 761 tinnitus therapy.**

[Hahn A](#), [Sejna I](#), [Stolbova K](#), [Cocek A](#).

### **Source**

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### **Abstract**

The treatment of patients with chronic tinnitus is very problematic and therefore otologists are trying to discover more suitable courses of therapy. In this study we wanted to evaluate the outcome of using a combination of EGb 761 and soft laser therapy. We examined 120 patients with an average duration of tinnitus of 10 years. The patients underwent pure-tone audiometry, speech audiometry and objective audiometry tests. The intensity and frequency of tinnitus was also determined. EGb 761 was administered 3 weeks before starting soft laser therapy. Patients underwent 10 sessions of laser therapy, each lasting for 10 min. An improvement in tinnitus was audiometrically confirmed in 50.8% of patients: 10 dB in 18; 20 dB in 22; 30 dB in 10; 40 dB in 6; and 50 dB in 5.

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11677752

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# **Pain threshold improvement for chronic hyperacusis patients in a prospective clinical study.**

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## **Source**

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## **Abstract**

### **OBJECTIVE:**

The aim of this study was to investigate if laser therapy in combination with pulsed electromagnetic field therapy/repetitive transcranial magnetic stimulation (rTMS) and the control of reactive oxygen species (ROS) would lead to positive treatment results for hyperacusis patients.

### **BACKGROUND DATA:**

Eight of the first ten patients treated for tinnitus, who were also suffering from chronic hyperacusis, claimed their hyperacusis improved. Based upon that, a prospective, unblinded, uncontrolled clinical trial was planned and conducted. ROS and hyperacusis pain thresholds were measured.

### **MATERIALS AND METHODS:**

Forty-eight patients were treated twice a week with a combination of therapeutic laser, rTMS, and the control and adjustment of ROS. A magnetic field of no more than 100 microT was oriented behind the outer ear, in the area of the mastoid bone. ROS were measured and controlled by administering different antioxidants. At every treatment session, 177-504 J of laser light of two different wavelengths was administered toward the inner ear via meatus acusticus.

### **RESULTS:**

The improvements were significantly better in the verum group than in a placebo group, where 40% of the patients were expected to have a positive treatment effect. The patients in the long-term follow-up group received significantly greater improvements than the patients in the short-term follow-up group.

### **CONCLUSION:**

The treatment is effective in treating chronic hyperacusis.

PMID:

19821704

[PubMed - indexed for MEDLINE]



## **Low-level laser for treatment of tinnitus: a self-controlled clinical trial.**

- [Okhovat A,](#)
- [Berjis N,](#)
- [Okhovat H,](#)
- [Malekpour A,](#)
- [Abtahi H.](#)

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**BACKGROUND:** Despite the high prevalence and morbidity, tinnitus still remains an obscure symptom. We assessed the efficacy of low-level laser for treatment of tinnitus. **METHODS:** It was a self controlled clinical trial study on 61 outpatients with subjective tinnitus. The patients were irradiated with a 650-nm, 5-mW soft laser for twenty days and twenty minutes per day. The sensation of tinnitus was measured on a Visual Analog Scale (VAS) before and two weeks after treatment and they were compared by means of Wilcoxon signed ranktest. **RESULTS:** Thirty-eight (62.3%) patients were men and twenty-three (37.7%) were women. Fourteen patients (31.8%) worked in noisy environment. The VAS mean difference before and after the treatment was statistically significant ( $p < 0.0001$ ). The best treatment effect was in the youngest group and there were significant differences between this group and the middle age and older groups ( $p = 0.018$  and  $0.001$ , respectively). The mean VAS score reduction was not statistically significant between male and female patients ( $p = 0.23$ ). Also, the treatment outcome according to the noise level in patient's workplaces was not significantly different in women ( $p = 0.693$ ), but it was significant in men ( $p = 0.029$ ). **CONCLUSIONS:** Transmeatal low-level laser irradiation is effective for the treatment of tinnitus and some variables like age and job can affect the treatment outcome.

PMID: 21448380 [PubMed]

# **Efficacy of low-level laser therapy in Ménière's disease: a pilot study of 10 patients.**

[Teggi R](#), [Bellini C](#), [Fabiano B](#), [Bussi M](#).

## **Source**

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## **Abstract**

### **OBJECTIVE:**

To assess the efficacy of low-level laser therapy (LLLT) for Ménière's disease (MD).

### **MATERIALS AND METHODS:**

Twenty patients with unilateral MD were included in the study; all presented with uncontrolled vertigo. The patients were randomly divided into two groups: group 1 patients received LLLT 20 min a day with a 5-mW soft laser for 6 mo, while group 2 received betahistine 16 mg twice a day for 6 mo. According to American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) guidelines, the main outcome for vertigo control was considered to be the number of spells per month in the 6 mo before treatment compared with the same parameter in the 6 mo of therapy. The duration of spells expressed in minutes was also considered. Moreover, a hearing test was performed before and after therapy and results were reported as the pure tone average of 500-, 1000-, 2000-, and 3000-Hz frequencies. All results were valued at baseline, and after 3 and 6 mo of therapy.

### **RESULTS:**

Compared to baseline, the number and duration of spells were significantly reduced in both groups; statistical significance was detected for the 3-mo control in both groups ( $p < 0.05$  with the multiple pair comparison test). Betahistine seems to have a faster action in spell reduction ( $p < 0.05$  comparing the 3-mo results between the two groups). Audiometric examination did not show a statistically significant difference between the two groups.

### **CONCLUSIONS:**

In our experience, LLLT seems to prevent vertigo spells in MD, although results indicate that it has a slower action than betahistine. Dose-dependent therapeutic effects could explain the last result. In our opinion, increased blood flow in the inner ear is the main mechanism leading to the therapeutic results.

### **PMID:**

18665761

[PubMed - indexed for MEDLINE]

# Lightdosimetric quantitative analysis of the human petrous bone: experimental study for laser irradiation of the cochlea.

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## Source

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## Abstract

### BACKGROUND AND OBJECTIVE:

Application of laser irradiation targeting the inner ear has to be investigated for therapeutic effectiveness in cochlear injury and dysfunction. In vitro data demonstrate low-level laser-induced photochemical and photobiologic cell response, depending on cell type and irradiation parameters such as light dose. The aim of the presented study was to determine the light dose received by the cochlear hair cells by using different irradiation modalities for the human petrous bone.

### STUDY DESIGN/MATERIALS AND METHODS:

Lightdosimetric assessment was performed in human cadaver temporal bones ( $n = 13$ ) after removing the cochlear membranous labyrinth. The external auditory meatus, the tympanic membrane (quadrants), and the mastoid bone were illuminated by a helium-neon laser ( $\lambda = 593$  nm) and diode lasers of different wavelengths ( $\lambda = 635, 690, 780,$  and  $830$  nm). The spatial distribution of transmitted light in the cochlear windings was measured by means of a retrocochlearly positioned endoscopic CCD camera for image processing and was assigned to acoustic frequencies according to the tonotopic organization of the cochlea. For an estimation of the corresponding space irradiance in an intact cochlea, correction factors have been calculated by a Monte Carlo procedure on the basis of experimentally determined optical properties of skull bone.

### RESULTS:

The transmission of light across the tympanic cavity and the promontory depends strongly on wavelength of the laser and the position of the radiator. Transtympanal irradiation results in spatial intensity variations of a factor 4 to 10 within the cochlear windings. The space irradiance in an intact cochlea is 10 to 20 times the measured irradiance. For an irradiation of the mastoid, the light transmission within the cochlea is 10(3) to 10(5) times smaller compared with an irradiation of the tympanic membrane and is extremely variable for different specimens.

### CONCLUSION:

The strong dependence of the cochlear light distribution on various irradiation parameters demonstrates the impact of preclinical lightdosimetric investigations for effective individual laser

irradiation of the human cochlea. Because of the observed spatial intensity variations, the optimal external light dose has to be chosen with regard to the tonotopy of the human cochlea. The obtained results are enabling us to apply defined laser light doses to different cochlear winding areas. Mastoidal irradiation leads to therapeutically insufficient light doses within reasonable treatment times, whereas transmeatal irradiation is recommendable. Further studies are mandatory for development of clinical devices for transmeatal irradiation of the cochlea.

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11430438

[PubMed - indexed for MEDLINE]