

## ENT (Ear, Nose, Throat)

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### **Experience with the Use of LLLT in ENT Medicine**

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#### **ABSTRACT**

The authors present their twenty years of experience with treatments of ENT disorders. The following lasers were used: He-Ne, 670 nm and 830 nm wavelengths diodes. Laser radiation has proven to have positive effects in the treatment of inflammations/infections, such as tonsillitis, otitis, laryngitis and sinusitis, furthermore in treatment of badly healing wounds, pain conditions and tinnitus.

#### **INTRODUCTION**

The experience described in this paper is based on evaluations of clinical results of LLLT applications at the Clinic of Otorhinolaryngology of the Faculty Hospital Olomouc since 1980.

At first, we had been using He-Ne lasers with 632.8 nm wavelength and power output 30 mW, 70 mW, and 100 mW. Since 1995 we have been also working with diode lasers 670 nm / 10 mW and 30 mW, as well as IR diode lasers 830 nm / 30 mW and 120 mW.

Prior to irradiation it is necessary to know the power output of laser, whether the beam is collimated or divergent with a focus or without a focus, the distribution of the beam on the area and in the tissue, homogeneity of the diffusion etc.

He-Ne lasers used to emit in continuous mode only, diode lasers could work also with frequency modulation.

It is also important to assess how to reach the target area with laser beam after its output from the head of the probe. Whilst irradiation of pathologic surface of the body is rather simple and, if necessary, the light can be distributed to desired area with a scanner, lens, or mirrors, for irradiation of target structures in ENT, such as

drum, oral cavity, nasal cavity and pharynx, it is necessary to use lightguides. In this case it should be taken into account that guiding the light through lightguides can cause loss of output, and sometimes even coherence can be upset. Losses after the pass through a lightguide depend on the type of the lightguide and they can be significant. Therefore it is necessary to check always the initial output from the lightguide.

Furthermore, it is also necessary to ensure protection of the tip of the lightguide against contamination and to prevent possible infection of target area. If necessary the lightguide should be disinfected. For applications in oral cavity it is appropriate to cover the tip of the lightguide with a test tube.

In our clinical practice we have particularly been treating patients with badly healing wounds and with inflammations. Our results were evaluated in 1983 on 169 patients, followed by 500 patients in 1988. Till the end of 1994 we had been treating almost 1500 patients. In 1995 our indications have been widened to treatment of pathologies of nose, paranasal cavities, larynx, pharynx, treatment of tinnitus, and pain management. By the end of 1999 the number of treated patients has exceeded 2500.

Apart from exacerbation of an acute inflammation in 7 patients in the course of the therapy of chronic tonsillitis and tonsillopharyngitis with a He-Ne laser we noticed activation of teeth granuloma in two patients whose oral cavity was irradiated. We noticed a temporary oedema in the irradiated area in one patient suffering from relapsing parotitis. No other complications have been observed.

The way of application and recommended dosage of energy for individual pathologies are listed in the attached table.

## **THEORETICAL BACKGROUNDS**

Clinical experience has been verified by experiment results, published in Clinixperience No. 1 and Clinixperience No. 20 in the Laser Partner. Hereby only the results of our studies are summarized again:

- He-Ne laser emission  $1.5 \text{ J/cm}^2$  applied five times during the course of one week improves wound healing through fibroblasts stimulation in directly irradiated wound, as well as in a remote wound. After irradiation with  $1.8 \text{ J/cm}^2$  during a week the production of collagen differs depending on the phase of the healing of the wound. Early irradiation in the first week stimulates inflammatory type III collagen. Late irradiation in the third week inhibits inflammatory reaction and improves deposition of type I collagen. These findings have been little utilized in clinical practice so far.
- Fagocytic activity is an appropriate method for testing biostimulation lasers with various wavelengths, as well as of dosages and ways of application. Irradiations with He-Ne laser, as well as with diode 670 nm and 830 nm lasers are effective. Pulse mode prolonged the stimulative effect of irradiation. It is necessary to stress, especially for clinical applications, that little dosages stimulate, whilst higher dosages bring inhibitory effect.

- Irradiation of palatal tonsils with He-Ne laser 2 x 0.6 J/cm<sup>2</sup> over one week improves the number of T-lymphocytes and plasmatic cells in the tonsils. After irradiation of tonsils and mucose of mesopharynx 3 x 1.8 J/cm<sup>2</sup> on day 0, 3, and 9, general immunological response - improvement of phagocytosis and number of CD-4 lymphocytes in day 42 - has been detected.
- Irradiation of the mucose in oral cavity with a He-Ne laser 3 x 1.8 J/cm<sup>2</sup> increases levels of lysozyme in saliva.
- Emission of He-Ne laser in the range of 0.6 - 6.0 J/cm<sup>2</sup> has no bactericide effect. However, it reduces in vitro cytopathogenous effect of herpes simplex virus from 0.45 J/cm<sup>2</sup>.

Therapy has been performed mainly in continuous mode, however we have been monitoring frequency modulations recently.

## **PRACTICAL APPLICATIONS**

1) Treating acute catarrhal tonsillitis we irradiated each tonsil with 0.6 J/cm<sup>2</sup>, followed by irradiation during a check up after two three days. Evaluation of results is however very subjective, painfulness and local diagnosis were followed only. It is necessary to administer further medication to a number of patients, especially antipyretics and/or antibiotics. Furthermore, patients with acute feverish disorders need mainly rest in bed and therefore we apply LLLT in these cases very rarely.

2) We treated chronic tonsillitis in patients who had been previously treated for rather longer time in a conservative way with expressions and irrigations of tonsils. It was a case of chronic tonsillitis with diagnosis of pivots or pus in lacunas, with no marks of a focal infection. When after LLLT application no content of lacunas was noticed in an interval exceeding 2 months the result was considered positive. There were three patients with increased temperatures and exacerbated inflammations on the second day after irradiation, and thus laser irradiation can be considered a provocation test, too. We have treated 115 patients including 65 children. Success of the treatment is 75 per cent.

3) Patients with relapsing tonsillopharyngitis suffered from frequent recurrences of acute inflammations at least six times a year. At a standstill stage we observed only a slight redness of mucose and tonsils, quite rarely of pivots, too. We have considered a positive effect of irradiation in case that recurrence did not appear during one year at all, or could be detected no more than twice. Within this group we have also observed after the first irradiation an exacerbation of acute inflammation in four patients.

So far we have treated 176 patients, including 82 children. Success of the treatment is 80 per cent. It is recommended to repeat the treatment after one year.

4) Excellent results have been obtained in treatment of stomatitis aphtosa and herpes labialis. Mucosal and skin lesions were irradiated every other day with He-

Ne laser  $1.8 \text{ J/cm}^2$  from 1 cm distance with the use of a lightguide. 2 - 3 irradiations were sufficient to heal up the problem. During the treatment no other total or local therapy was applied. Check ups were performed during the treatment, one week after the treatment, in 6 months and after a year. The sooner the therapy started, the better the effects were. It could be best assessed in cases of patients with relapsing herpes labialis, when the patients could compare the course of the disease with laser treatment and without it. However, nearly in all cases cease of progression of the disease could be noted, regardless to time interval between the start of the complaints and the start of the treatment.

According to patients suffering from relapsing symptoms of the disease, who had been previously treated with other methods, it is obvious that LLLT cuts the course of the disease down by 2 - 3 days. Especially patients with herpes labialis appreciated an alleviation of tingle and pain usually within half an hour after irradiation.

We have been successfully irradiating three patients with post-herpetic neuralgia of the first ramus of nervus trigeminus with a 830 nm laser, 120 mW,  $16 \text{ J/cm}^2$ , every day or every other day, 10 - 15 times. After the treatment pain extincted.

Two patients reported alleviation of pain immediately after irradiation, pain gradually returned to original intensity during the day, in the course of therapy analgesic effect prolonged up to the point of permanent relief.

We have been also successful with LLLT in treating patients with post-herpetic pain after herpes zoster oticus.

5) As far as ear diseases are concerned, we have treated especially patients with perforations of eardrum. Best results have been obtained with traumatic perforations of drum. However, we are aware of the fact that traumatic perforations usually heal well even without any therapy. In a group of patients post-inflammatory perforations of drums could be compared with previously treated perforations after covering them with a folio of Wichterle's gel following treatment of edges of the perforation with trichlorvinegaric acid. Within the total of 52 perforations treated with a folio 21 perforations healed up, 19 decreased, and in 12 cases there was no effect noticed. The same procedure was applied on another group of 52 patients, but besides covering with the folio the drum was also irradiated with He-Ne laser. Better results were achieved: 28 patients healed up, 16 improved, 8 did not heal.

We irradiated patients after a myringoplasty after removal of tampons on day 14 with He-Ne laser aimed at the area of the implant, where marks of persisting inflammation appeared and where no tendency to healing was noticed. LLLT was successful in 80 per cent.

Patients with discharge from trepanation cavity were in the long-term treated

locally and totally and LLLT was applied into the cavity after rinse. Therapy was successful in 75 per cent.

6) In 10 patients who had had a tonsillectomy we irradiated at first only one side, and analgesic effect of irradiation and speed of the healing were then compared with non-irradiated side. Pain relief on the irradiated side and healing time shorter by 1 - 2 days were recognized as success. With regard to this finding we recognize LLLT after a tonsillectomy as effective. Irradiation shortens healing and has analgesic effect in 80 per cent.

7) In treatments of non healing wounds after operations density of irradiation differed according to the scope of the defect. For quick healing of badly healing wounds, post op fistuli, and peripheral necroses of skin transplants or lobes irradiation every other day with total number of 3 - 5 applications was sufficient. Effect of therapy was ascertained in 85 per cent of cases. For disintegrations of wounds, especially in the event of defective healing after operations in the area changed by unsuccessful actinotherapy (conditions after laryngectomy, block resections, nose tumors) it was necessary to prolong the time of irradiation as well as the number of applications. As the first sign of positive reaction clearing of the base of defect followed by gradual epithelisation was noticed.

Apart from stimulation of fibroblasts and synthesis of collagen, laser irradiation also contributes to better healing of wounds, as well as to stimulation of epithelization and protective mechanisms. LLLT was successful in 62 per cent.

It is necessary to stress the importance of increased caution when irradiating non healing post operative wounds in oncologic patients, especially after paliative treatments. Increased caution is motivated by the apprehension of possible stimulation of neoplastic cells with laser irradiation, with dosages of 3 - 6 Joules every day, or every other day, in the course of rather long series of treatments.

It is frequently recommended to irradiate the area of incision prior to surgery, or to irradiate the operation area in the course of surgery or after it. However, we regard this as useless in the event of patients in a good overall condition. Laser therapy is usefull in case of exhausted patients, patients with an immunity deficiency, in case of surgery in a contaminated wound area, or where healing deficiency is known from the anamnesis.

Furthermore, irradiation of small wounds, excoriations (He-Ne laser), and distorsions (830 nm laser) speeds up healing.

8) Laser irradiation is also successful in treatments of acute, relapsing, or chronic sinusitis. We have been using laser 830 nm, 120 mW, irradiating with the dosage of 2.5 - 4.0 J/cm<sup>2</sup> on cavity, continuous mode, every other day, in cases of acute sinusitis 2 - 3 times, in chronic cases 5 - 15 therapies. The probe should be applied over the cavity with a slight pressure to the bone, and according to the size of cavity we should irradiate either one or two points.

We have been treating 29 cases of acute catarrhal sinusitis, 9 relapsing and 20 chronic (X-ray detected hypertrophic epithelium).

At the end of 1999 we evaluated 29 patients suffering from acute catarrhal maxillar sinusitis. The patients took only anaemical drops from time to time, laser was applied together with antibiotics in 4 patients, 10 patients were treated with LLLT and with Wobenzym, and 15 patients were treated with LLLT only. Laser treatment shortens the course of disease and it has analgesic effect. No puncture of cavities had to be performed.

LLLT was added to the Wobenzym therapy in patients with relapsing and chronic sinusitis. Due this combination the doses of Wobenzym could be reduced. X-ray picture confirmed in 16 cases of 20 patients with chronic maxillar sinusitis normal aeriality of the cavities after the treatment.

9) As far as chronic laryngitis is concerned, LLLT is very suitable in treatment of hypertrophic laryngitis as well as of oedemas of vocal chords, especially in case of Reinke`s type of oedemas. LLLT is combined with Wobenzym, and on the basis of our experience with 12 patients this therapy can be considered to be very successfull.

Above mentioned therapy is a benefit also in case of treatment of long-term persisting cough or after endured laryngotracheitis. Caugh not declining after application of anti-tussicas was disappearing in 14 days after LLLT and Wobenzym. Apart from anti-oedemative effect LLLT is supposed to affect tussigenous zones of larynx.

LLLT was also successfull on two patients with post-traumatic haematomas of vocal chords.

10) Treating tinnitus we have applied gained experience. We have been using Tanakan treating 30 patients with tinnitus with hypacusis perceptiva, hypacusis conductiva, as well as with tinnitus with normal hearing. Tinnitus disappeared in 9 patients, improved in 13 patients, and 8 patients reported no improvement. Treating another group of 30 patients we have been using Tebokan, and tinnitus disappeared in 12 patients, 11 patients improved and 7 patients had no relief. It should be stressed that our patiens suffered from no other major disease. Treatment of patients with tinnitus with normal hearing was the most successfull. Patients treated with Tebokan were exposed to laser irradiation  $10 \text{ J/cm}^2$ , and 3 patients improved within the group of 7 with no relief reported before.

That is why we now combine LLLT with application of Gingko Biloba extracts, possibly of Wobenzym, or of Xanax if necessary, and, furthermore, we irradiate C vertebra in most patients. This method of treatment has been applied in 65 patients so far. Treatment results are not so good as in the previous group. A number of

patients have been already treated unsuccessfully before, some of them are being simultaneously treated for general overall diseases, such as hypertension, hyperlipidemy, diabetes, thyroid disorders and others. Many patients point out previous unsuccessful treatments in their anamnesis, some of them acknowledge only partially. Patients are reporting various medications, physiotherapy, acupuncture, oxygenotherapy, phytotherapy, homeopathy, yoga, Reiki, traditional healers. Combinations of listed therapies have been very frequent. We abandoned irradiation through processus mastoideus and are irradiating through external auditory canal ( $10 - 16 \text{ J/cm}^2$ ). As to our experiments measuring fresh preparations of temporal bone, no more than 1 per cent of radiation can penetrate into the cochlear area through processus mastoideus (IR laser 830 nm).

It is very difficult to compare results stated in individual publications. These are usually very little or heterogenous groups, ethiology of the murmur is not specified as well as overall condition of patients, time duration of success of the treatment is missing etc.

Examination of a patient suffering from tinnitus is very demanding. Apart from an ENT examination, tone audiograms, impedance audiometry, BERA, murmur masking, otoneurological examination, X-ray or CT, and lab tests, neurological, internal, physiotherapeutic and psychological examinations are necessary, too.

However, results of therapy of individual clinics should be given or published within scientific meetings and periodicals, and not in daily nor even gutter press.

Significance of LLLT of tinnitus must be evaluated with the help of standard unified criteria in cooperation of several clinics.

11) LLLT is very successful in treatment of glossodynia. However, it is necessary to exclude serious general diseases before initial treatment. Furthermore, urine and general blood tests as well as basic biochemical levels should be examined at least. We have achieved total pain relief in our 11 patients (incl. 8 females). At first we had been using He-Ne laser, at present we use IR diode laser 830 nm.

## **CONCLUSIONS**

LLLT is a very efficient therapy in ENT for treatments of inflammations, badly healing wounds and sores, drum perforations, tinnitus and for pain management. Its potentials within this particular specialty are much greater than indicated in this paper. The most successful procedures must be sought for and verified. There will be new challenges appearing with development of new lasers with various wavelengths and outputs. It is necessary to achieve LLLT be covered by medical insurance system.

Diagnosis	Laser	No. of applic.	Dosage J/cm <sup>2</sup>	Way of application
Tonsillitis catarrhalis ac.	He-Ne	1 - 2	1,2	every other day, both tonsils, 2x 0.6 J/cm <sup>2</sup>
Tonsillitis chronica	He-Ne	4 - 10	1,2	every other day, both tonsils, 2x 0.6 J/cm <sup>2</sup>
Tonsillopharyngitis recidivans	He-Ne	4 - 6	1,8	2x a week both tonsils and mucose of pharynx, 3x 0.6 J/cm <sup>2</sup>
Stomatitis aphtosa	He-Ne	4 - 6	1,8	every other day
Herpes labialis	He-Ne	2 - 3	1,8	every other day
Perforation of drum traumatic	He-Ne	2 - 4	0,6	every other day
Perforation of drum post - inflammatory	He-Ne	5 - 7	0,6	every other day
Healing after myringoplasty	He-Ne	2 - 3	0,6	every other day
Discharge from trepanation cavity	He-Ne	5 - 9	0,6	every other day
Healing after tonsillectomy	He-Ne	2 - 3	1,2	every other day 0.6 J/cm <sup>2</sup> on post op wound
Healing of operation wound	He-Ne	3 - 5	1,8 - 3	every other day
Disintegration of post op wound	He-Ne	10 - 30	3 - 6	every day
Sinusitis acuta	830 nm	2 - 3	2,5 - 4	2 - 3x a week, external irradiation 2.5-4 J/cm <sup>2</sup> on each cavity
Sinusitis chronica	830 nm	5 - 15	2,5 - 4	2 - 3x a week, external irradiation 2.5-4 J/cm <sup>2</sup> on each cavity
Laryngitis chronica	830 nm	5 - 10	8	2 - 3x a week, external irradiation 4 J/cm <sup>2</sup> on both sides of larynx
Cough	830 nm	5 - 10	8	2 - 3x a week, external irradiation 4 J/cm <sup>2</sup> on both sides of larynx
Tinnitus	830 nm	10 - 30	10 - 16	every day or every other day through meatus on the area of cochlea
Glossodynia	830 nm	4 - 10	4 - 6	2x a week on the tongue

He-Ne laser can be substituted by a 670 nm diode laser with the same effect.

## LITERATURE

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Further literature with the author.

## **LOW INTENSITY LASER IN COMPLEX TREATMENT FOR PURULENT-INFLAMMATORY CASES OF ENT-PATIENTS**

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Low intensity laser irradiation of blood was applied to 54 ENT-patients with purulent-inflammatory state, bound with intensive complex therapy. 33 patients at different disease age with distinct intoxication and/or traditional therapy inefficiency were treated with intravascular laser irradiation of blood (ILIB). LG-75 helium-neon laser was used. Light-guide was inserted into the vein through a syringe needle or a catheter. Radiance power at the tip of the light-guide - 5-6 mW Number of sessions per course: 5-6 on a daily basis. Session duration - 20 min. Exogenous antioxidants were prescribed - vitamin E, "Aevit". Dynamics of clinical disease progression was monitored, as well as pain degree, body temperature, coagulogram, biochemical blood tests. For evaluation of the endotoxemia degree leukocytic index of intoxication (LII) and level of medium size molecule (MSM) were observed. Clinical effect was evident, fever spells shortened. Most remarkable were results after 4-5 sessions of ILIB. Consequential lab tests revealed toxic plasma decrease. No complications were observed. Positive results were reported for transdermic supravascular laser irradiation of blood by "MILT A" Magnetic-Infrared Laser Therapy Apparatus to 21 ENT-patients with purulent-inflammatory cases. Non-invasive transdermic irradiation of blood at cubital fossa was performed in pulse mode at 5 Hz frequency for 5-10 min. Power density was adjustable within 25-50 mW/cm<sup>2</sup>. A course was made of 5-7 sessions. No complications were observed, all patients were discharged in full recovery.

The knowledge received from the tests allows conclusion that ILIB and transdermic supravascular laser irradiation of blood is an effective therapeutic technology for purulent-inflammatory cases of ENT-patients, and makes for easier flow of the disease.

Stomatologiya (Mosk). 2003;82(3):32-7.

### **[Treatment of inflammatory pyodestructive processes of the oral cavity, maxillofacial area, and neck by laser and magnetic-laser exposure of the carotid sinus using the Optodan laser apparatus]**

[Article in Russian]

**Zhizhina NA, Prokhonchukov AA, Vakhtin VI, Geniuk VIa.**

This paper presents the priority original methods (patent No. 2101046, Russia) for the treatment of inflammatory pyodestructive processes in the oral cavity, maxillofacial area, and neck (odontogenic abscesses and phlegmons including those complicated by mediastinitis and sepsis), sinusitis, carbuncles and furuncles of face and neck skin, parotitis, sialadenitis, adenophlegmons, lymphadenitis, perititis, alveolitis, arthritis, arthrosis of the temporomandibular joint, odontogenic and traumatic osteomyelitis,

infected purulent traumas (including gunshot ones), fractures of the jaws, etc. making use of Optodan laser (patent No. 2014107, Russia) for laser and magnetic-laser therapy.