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**BASIC TECHNIQUES
OF LOW LEVEL LASER THERAPY**

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The book describes a modern look at the mechanisms of therapeutic action of low-intensity laser illumination, explaining the high efficiency and safety of low level laser therapy. Basic techniques of treatment are presented in a simple and understandable form. For more information about the new techniques and the latest research in this field of science and medicine, please refer to our website <http://lasmik.ru>.

New laser therapeutic devices of the “LASMİK” series with unique laser emitting heads are the most effective when implemented by the majority of techniques presented in the book.

The book is intended for everyone who uses low level laser therapy in their professional practice.

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ABBREVIATIONS

AOS	– antioxidant system
AP	– acupuncture point
CCBI	– chronic cerebrovascular ischaemia
CCI	– craniocerebral injury
CI	– confidence interval
CIC	– circulating immune complexes
CVI	– chronic venous insufficiency
DEP	– dyscirculatory encephalopathy
DMW	– decimeter waves
EAC-RFC	– EAC-rosette forming cells of erythrocyte (E) – antibody (A) – complement (C) complex;
ED	– energy density
EH	– essential hypertension
NLBI	– non-invasive (external, extravenous, transcutaneous, percutaneous) laser blood illumination
GA	– gonarthrosis (arthrosis of the knee)
HDL	– high density lipoproteins
ILBI	– intravenous laser blood illumination
IR	– infrared (spectrum, band)
LDL	– low density lipoproteins
LLLT	– low level laser therapy
LILI	– low-intensity laser illumination
LPO	– lipid peroxidation
LUVBI®	– laser ultraviolet blood illumination
MAH	– major arteries of the head
MFPS	– myofascial pain syndrome
MLLLT	– magnetic low level laser therapy
MSS	– musculo-skeletal system
OA	– osteoarthritis
OP	– osteoporosis
PD	– power density
PMF	– permanent magnetic field
PsA	– psoriatic arthritis
RA	– rheumatoid arthritis
RCT	– randomized controlled trial
TC	– total cholesterol
TG	– thermography
TPT	– therapeutic physical training
USDG	– ultrasonic Doppler examination
UST	– ultrasound therapy
UV	– ultraviolet (spectrum, band)
UVBI	– ultraviolet blood illumination
VBI	– vertebrobasilar insufficiency
WMD	– weighted mean difference

INTRODUCTION

Laser was used in ancient Rome for coughing, during various infections and intestinal diseases as a stimulator and hypotensive agent. The fruits were also used in preparing a special kind of sausage, meat dishes and compote. This is, of course, referring to grass – *trilobate laserwort* – and its Latin name. We know the word laser (LASER) more commonly as an abbreviation composed of the initial letters of the English phrase: Light Amplification by Stimulated Emission of Radiation. The greatest invention of the 20th century appeared thanks to Russian scientists, laureates of Nobel Prize in Physics, N.G. Basov, A.M. Prokhorov and American C.H. Townes (1964). Later in 2000's, the Nobel Prize was awarded to Z.I. Alferov for the studies that formed the development of diode lasers. It is now impossible to imagine any science and technology industry where lasers are not used.

More than 50 years ago, laser light began to be used as a highly effective therapeutic agent in Russia for the first time. Today, low level laser therapy (LLLT) is developed through the efforts of mostly Russian scientists and doctors, but it is becoming more widespread and recognized in other countries. For several decades, hundreds of treatment techniques and relapse prevention of various diseases in almost all areas of medicine have been developed in Russia. Therefore, it can be said that we have the most effective LLLT techniques and the best equipment in the world – we can be proud of our achievements!

The basis of the therapeutic effect of low-intensity laser illumination (LILI) is a thermodynamic launch of Ca^{2+} -dependent processes. This has allowed us to have a new look, not only at the problem of increasing the effectiveness of low level laser therapy, but also to look at the methodological approaches of the choice of treatment strategies as a whole. Now there is a deep scientific basis, which describes in detail the processes occurring in the absorption of low-intensity laser light, and we were able to develop the technology of low level laser therapy while abiding to a strict compliance with a certain sequence of operations, setting an initial set of parameters that almost certainly guarantee to provide the desired therapeutic effect. This allows professionals to understand how and what characteristics of the technique (wavelength, power and pulse repetition

frequency of LILI, laser operational mode, exposure and localization) should be varied to enhance the effect.

The authors hope that this book will help in daily work, and any questions can be emailed to: 7652612@mail.ru.

GENERAL POINTS OF LOW LEVEL LASER THERAPY

Mechanisms of the Therapeutic Effect of Low Level Laser Therapy

The process of therapeutic effects of low level laser illumination (coherent, monochromatic and polarized light) can be conventionally divided into three main stages:

- 1) primary effects (change of state of the electronic levels of the living matter of molecules, the stereo-chemical rearrangement of molecules, the local thermodynamic shifts and the emergence of an increased concentration of calcium ions in the cytosol);
- 2) secondary effects (propagation of waves of increased Ca^{2+} concentration in the cell, between cells, stimulation or inhibition of biological processes at a cellular level and changes in the functional state of individual biological cell systems and the body as a whole);
- 3) residual after-effects (formation of tissue metabolism products, response of the immune, endocrine and neurohumoral regulation systems, etc.).

All this variety of the developing processes determine the widest range of the body's responses to laser illumination. Fig. 1 shows virtually the entire sequence of events starting from the initial act of photon absorption and finishing with effects at the 'whole body' level. This explains numerous, if not all known phenomena in this field of biology and medicine.

It was previously shown that the initial starting moment of the biological effects of LILI is a local violation of the thermodynamic equilibrium, causing the release of calcium ions from the intracellular store and the propagation of waves with an increased concentration of Ca^{2+} in the cytosol of the cell, triggering Ca^{2+} -dependent processes [Moskvin S., 2016; Moskvin S.V., 2003, 2008, 2014, 2016]. Then secondary effects develop, which are a complex of the non-specific adaptive and compensatory reactions that occur in the tissues, organs and entire living body, among which the following: effects are distinguished most often:

- activation of the cell metabolism and increase in its functional activity,
- stimulation of reparative processes,
- anti-inflammatory effect,

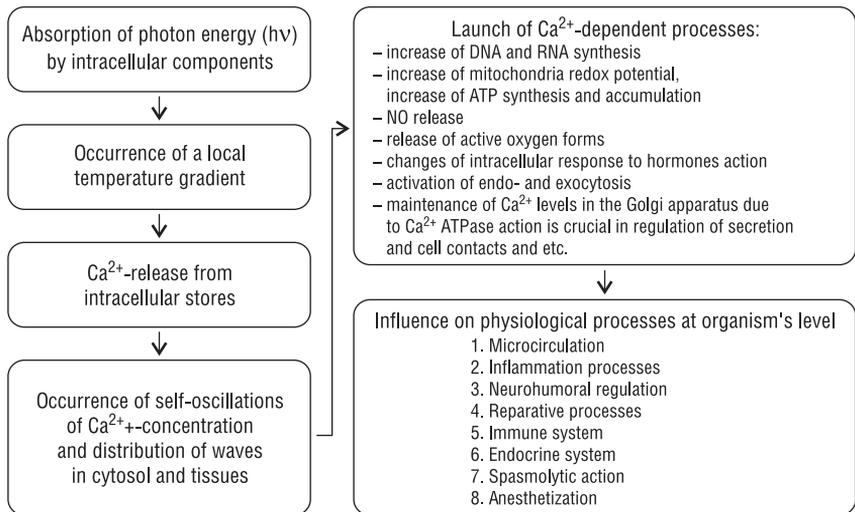


Fig. 1. The sequence of the developing biological effects of laser exposure

- activation of blood microcirculation,
- increase in tissue trophic support,
- analgesic and immunomodulatory effect,
- reflexogenic impact on the functional activity of various organs and systems.

Numerous studies have shown that LILI acts as an activator of cellular responses aimed at restoring and normalizing the bioenergetic status of the body's tissues and immune system. LILI increases enzymatic and catalase activity, permeability of the cytoplasmic membranes, contributing to the acceleration of metabolic and transport processes in tissues. Accelerated oxygen exchange reduces hypoxia accompanying inflammatory processes.

LILI activates the regenerative processes in pathological conditions (trauma, surgical procedures, transplantation) due to changes in the cellular composition in the area of the wound or ulcer by increasing the number of neutrophils, as well as by accelerating the growth of capillaries and accumulating collagen produced by them, which determines the speed and quality of wound or ulcer surface epithelialization. In addition, hormonal and neurotransmitter components of the adaptive mechanism are activated. An increase in non-specific immunity of the body after LILI

exposure is confirmed by the rising titer of hepagglutinin, hemolysins, lysozyme, activation of neutrophils and interferons, increased synthesis of immunoglobulins and changed function and structure of plasma membranes and increase in the number of lymphocyte blast forms.

Laser illumination reduces the concentration of lipid peroxidation products in the blood, enhancing the antioxidant system, increases the level of catalase, activates the cellular elements of mononuclear phagocytes (macrophages) that stimulate cell proliferation and accelerates restoration of morpho-functional state of the cell membranes.

In development of the body response an important role is played by the impact of LILI on the blood, exerting a beneficial complex (systemic) influence caused by common hemocirculation. Studies using vital microscopy, computer capillaroscopy and photographic recording showed an increase in the number of functioning capillaries, acceleration of blood flow and normalization of microcirculation in general. Central hemodynamics are changing as well; it is proved that LILI has venomotor and artery dilation effects in case of initially decreased indicators.

Low level laser therapy, conducted before the start of any surgery intervention in order to prevent infiltration and suppuration, improves local blood circulation, metabolism, oxygenation and maintenance of the trophic support of tissues, which stabilizes the postoperative course, reducing the probability of developing complications by several times.

LILI's ability to increase the content of neurohormones in tissues, to involve various specific proteins of cell membranes in the process which activate enzymes such as adenocyclase, adenylate cyclase, denyl cyclase, phosphodiesterase and calcium ions, altering the intra- and extracellular metabolism, to affect sensitive components of intercellular spaces leads to the normalization of the local and general physiological response, contributes to the preservation or restoration of homeostasis and body adaptation to stress conditions.

Equipment for Low Level Laser Therapy

A variety of techniques and applications of low level laser therapy devices require maximum versatility of the equipment used to ensure maximum efficiency of the therapeutic effects, which, in turn, is ensured by the following procedures:

- (separate) use of LILI with different wavelengths;

- operation in modulated and pulsed modes;
- external illumination modulation (BIO mode, modulation by musical rhythm, etc.);
- illumination delivery with minimal losses through the light guides (ILBI, abdominal procedures); illumination
- optimal spatial distribution of the laser illumination (providing optimum power density);
- reliable and continuous monitoring of the impact parameters.

The proposed modular design concept allows the successful solving of all of these tasks, according to which the laser therapeutic equipment is conventionally divided into four mating parts (Figure 2.): 1 – the base unit (usually 2 – and 4-channel); 2 – laser emitting heads for different low level laser therapy techniques; 3 – optical and magnetic nozzles; 4 – Matrix-Bio biocontrol unit.

The base unit is the basis of each set; it is a power supply and control unit. Its main functions include setting emission modes with mandatory control of the parameters: frequency, session time, beam output power, etc.

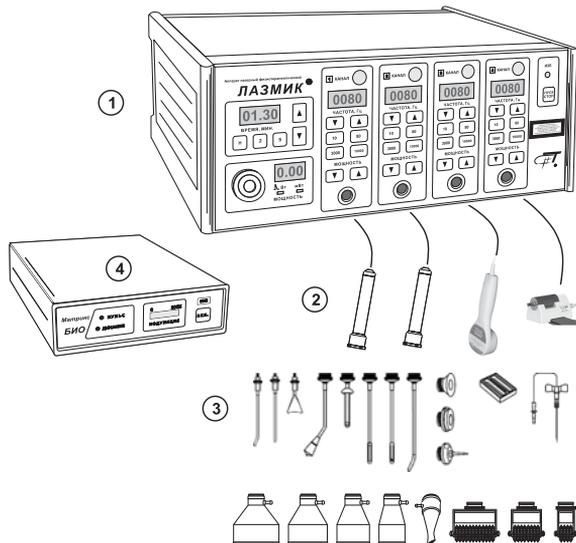


Fig. 2. Modular design concept of low level laser therapy equipment exemplified by a series of Matrix and LASMIK devices