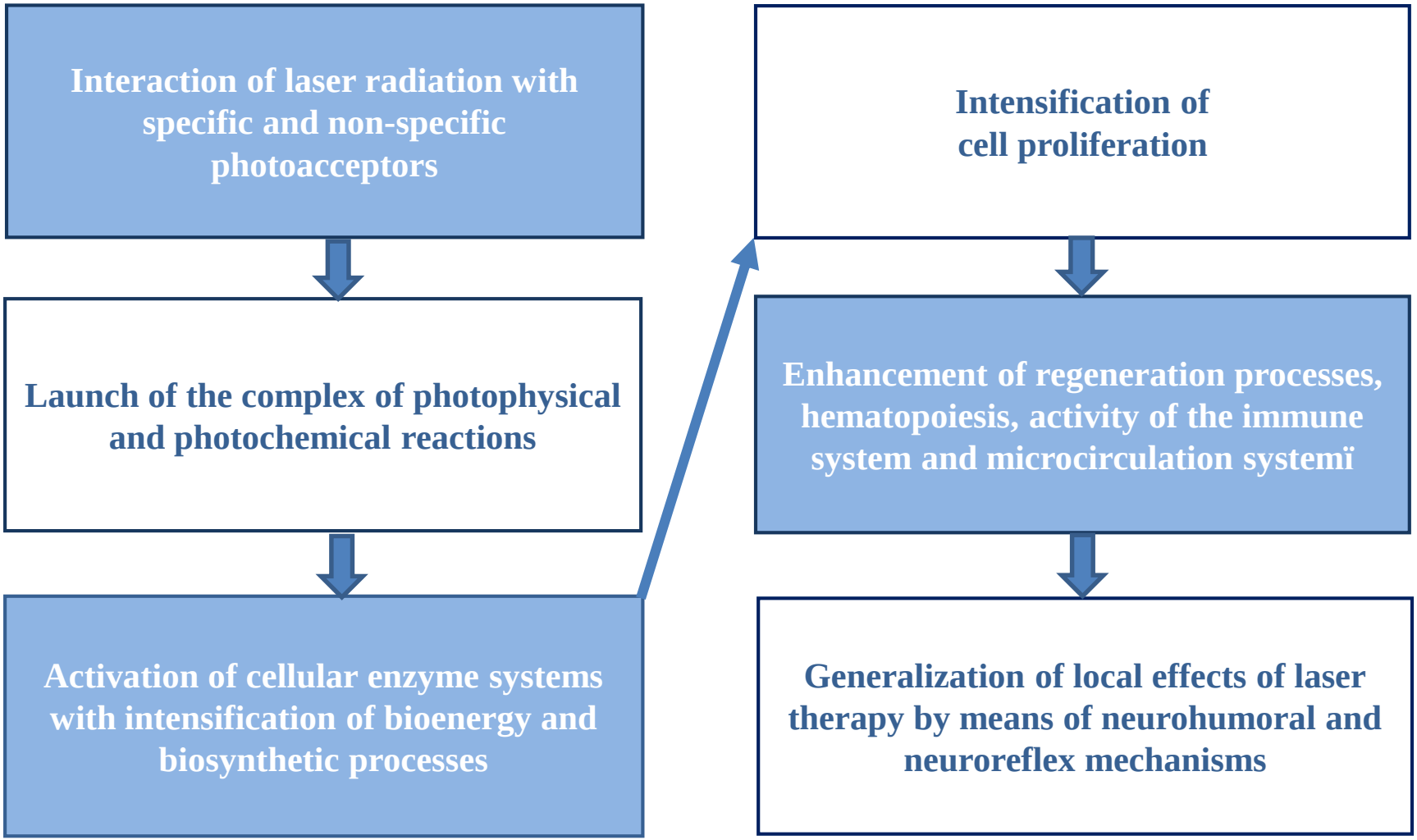
Laser thermotherapy using near-infrared radiation in emergency medicine

Laser therapy has been widely used in clinical medicine for the treatment of various diseases since the 1960s.

Nowadays, a new promising trend in the development of laser therapy has emerged - ***laser thermotherapy (LTT)***.

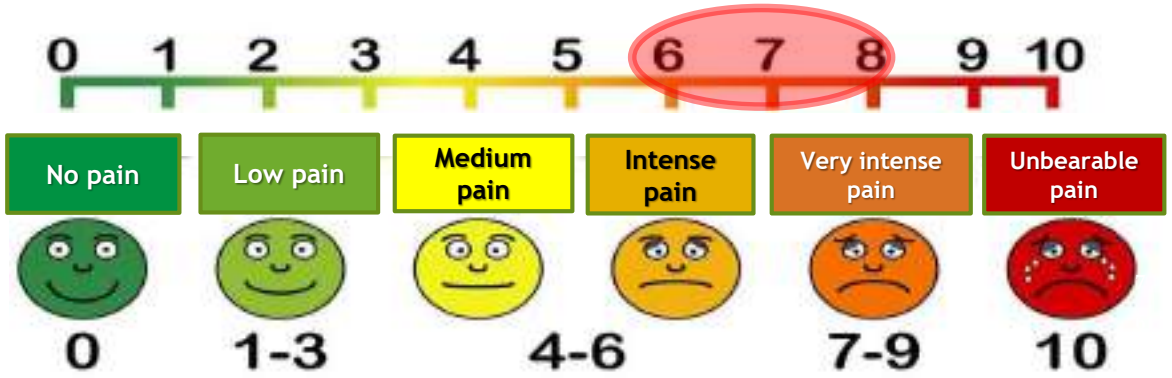
Laser thermotherapy involves heating of biological tissue during exposure to laser radiation in the near-infrared spectrum (wavelengths 810, 1060 nm) to a temperature of 37-42°C, which does not cause irreversible changes in biotissue. Optical radiation at these wavelengths is weakly absorbed by molecules of biological tissues (vibrational overtones). This ensures penetration of radiation into the depth of tissues with a slight decrease in optical radiation power density along the depth. Increasing the wavelength (compared to the visible wavelength) significantly reduces the scattering as the radiation passes through the tissue. This results in a minimum change in the geometry of the light spot deep within the tissue compared to the spot on the surface. Light spots on biotissue surfaces in laser thermotherapy have large linear dimensions (tens of millimeters in diameter). Therefore, considerable volumes of biological tissues are treated during laser thermotherapy and high-power laser radiation (units-tens of watts) is used to provide the above temperature increase. In laser thermotherapy, the laser light is applied both in a continuous and pulsed mode. This type of treatment is particularly suitable for the treatment of diseases in which pathological areas are located deep within the tissue (muscles, joint cavities, tendons, etc.).

Changes in the human body that occur in the process of laser thermotherapy (LTT)

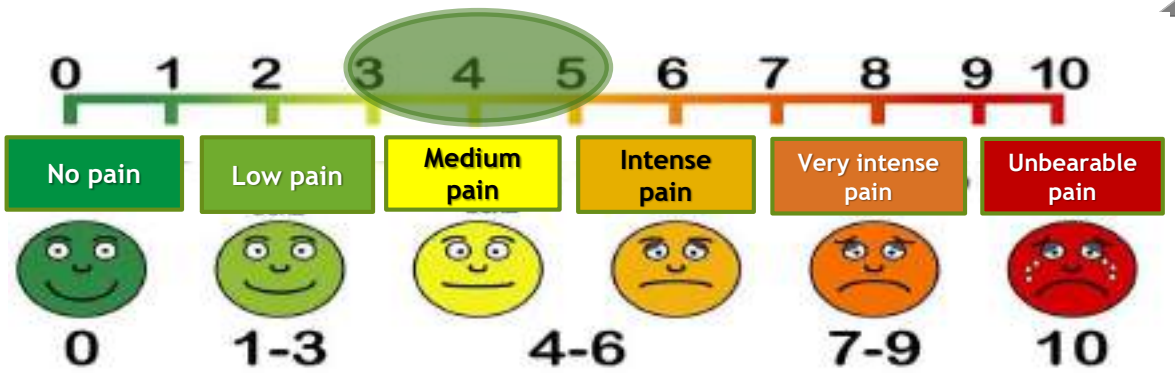


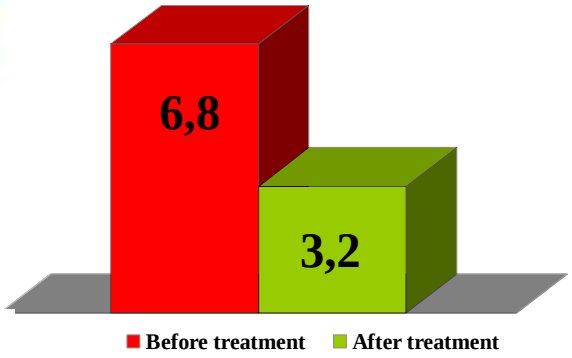
Dynamics of the level of pain in patients according to the VAS scale in the process of applying laser thermotherapy

Before treatment



After treatment





Indications for use of laser thermotherapy (LTT) using laser radiation in the near-infrared band of the spectrum

- Injuries of various localization and etiology
- Gunshot injuries
- Post limb amputation conditions
- Conditions after plasty of soft tissues
- Burns and wounds
- Muscle damage
- Tendinitis
- Arthrosis
- Tendovaginitis
- Epicondylitis
- Bursitis
- Tunnel syndromes
- Osteochondrosis
- Dorsalgia of various localization
- Radiculitis
- Herniated intervertebral discs

- Closed craniocerebral injuries of varying degrees of severity: brain concussion, cerebral contusion of mild, medium and severe degrees of severity in the immediate, intermediate and distant periods
- Open craniocerebral injuries
- Spinal cord injuries
- Traumatic injuries of peripheral nerves in preoperative and postoperative periods
- Tunnel neuropathy of cranial nerves
- Blood circulation and microcirculation disorders
- Pain syndromes of various localization: neuralgia of the trigeminal nerve, radicular pain syndromes, etc.

At the meeting of the Academic Council of the Kharkiv Medical Academy of Postgraduate Education (*protocol No. 5 dated August 30, 2022*), **methodical recommendations were approved for publication:**

«Laser thermotherapy using laser radiation of the near-infrared range of the spectrum in the treatment of patients with orthopedic and traumatological, neurological profiles and in sports medicine»

Edited by: Dr. Sc. (Med.), Professor of the Department of Anatomy, Clinical Anatomy and Operative Surgery of the Kharkiv Medical Academy of Postgraduate Education - ***Romayev S.***

Reviewers:

Mykhailosov R. - Dr. Sc. (Med.), Professor of the Department of Endoscopy and Surgery of Kharkiv Medical Academy of Postgraduate Education.

Krysa V. - Dr. Sc. (Med.), Professor of the Department of Disaster Medicine and Military Medicine of the Ivano-Frankivsk Medical University.

The availability of methodological recommendations with clearly indicated parameters of laser radiation in the treatment of various pathologies will greatly facilitate the work of doctors in providing medical assistance to patients with orthopedic and traumatological, neurological profiles and in sports medicine.

Surgical diode laser «LIKA-surgeon+» for laser thermotherapy (LTT)

Wavelength: 810 nm; 1060 nm
Optical power: 10 W-20 W

FOTONICA PLUS

FOTONICA PLUS CO is accredited for compliance with the requirements of the international standard ISO 13485:2016 and received the corresponding Certificate of the European certification body Quality Austria.

CERTIFICATE

СЕРТИФІКАТ * CERTIFICAT * ZERTIFIKAT * СЕРТИФИКАТ * CERTIFICADO

BODY FOR MANAGEMENT SYSTEMS CERTIFICATION
«UKRMETRTESTSTANDARD»
CERTIFIES THAT

QUALITY MANAGEMENT SYSTEM of

FOTONICA PLUS Co

Dakhnivska street, 50/12, Cherkasy, Ukraine, 18009
Company code: 24411216

for
regarding development, production, sale, installation and service of laser surgical, therapeutic and photodynamic equipment

MEETS REQUIREMENTS OF
ДСТУ EN ISO 13485:2018
(EN ISO 13485:2016, IDT; ISO 13485:2016, IDT)

Certificate Registration Number within the Certification Body Register: № UA.C.511-22
registered: February 25, 2022
valid until: February 24, 2025

Head
of Certification Body — Dmytro SABATOVYCH

USM

Зареєстровано в реєстрі за №
Registered Certificate Number
UA.TR.001.023272-20
дійсний до 26.12.2024

ДП «УКРМЕТРТЕСТСТАНДАРТ»
SE "UKRMETRTESTSTANDART"

СЕРТИФІКАТ ОЦІНЮВАННЯ ВІДПОВІДНОСТІ
CONFORMITY ASSESSMENT CERTIFICATE
ЗАБЕЗПЕЧЕННЯ ФУНКЦІОНУВАННЯ КОМПЛЕКСНОЇ СИСТЕМИ УПРАВЛІННЯ ЯКІСТЮ,
ДОДАТОК 3 (БЕЗ ПЕРЕВІРКИ ПРОЕКТУ МЕДИЧНОГО ВИРОБУ)

Продукція / Product: лазер хірургічний діодний, клас IIb

Торгова марка / Trademark:

Модель/Тип / Model/Type Ref.: "LIKA-хірург++"

Відповідає вимогам / Comply with the requirements: Технічного регламенту щодо медичних виробів, затвердженого постановою КМУ від 02.10.2013 №753, ДСТУ EN ISO 13485:2018, ДСТУ EN60601-1:2015, ДСТУ EN60601-1-6:2015, ДСТУ EN60601-2-22:2015, ДСТУ EN62366:2015, ДСТУ EN60601-1-2:2018

Назва та адреса виробника та/або уповноваженої особи / Name and address of the applicant and/or authorized representative: Приватне підприємство "Фотоніка Плюс", м.Черкаси, вул. Дахнівська, 50/12, Україна
Код ЄДРПОУ 24411216

Назва та адреса виробника / Name and address of the manufacturer: Приватне підприємство "Фотоніка Плюс", м. Черкаси, вул. Дахнівська, 50/12, Україна

Назва та місцезнаходження виробництва / Name and location of production: Приватне підприємство "Фотоніка Плюс", м. Черкаси, вул. Дахнівська, 50/12, Україна

Додаткова інформація / Additional information: нагляд за системою управління якістю проводиться згідно з програмою технічного нагляду

Виданий на підставі / Issued on the grounds of: рішення ООІВ №2515УкрТЕСТ5-20 від 11.12.2020 (атестат акредитації №10023 від 10.04.2019), протоколу №2087-2-2020 від 09.12.2020 (атестат акредитації №20035 від 17.02.2020); Сертифікат на систему управління якістю №UA.C.422-20 від 30.10.2020 з терміном дії до 24.02.2022 (атестат акредитації №ВО020)

Заступник керівника органу з сертифікації / Deputy head of Certification Body — В.Д. Ринер / V.D. Rymer

Дата реєстрації / Date: 11.12.2020

From 24.02.2022 - the day of the start of a full-scale war in Ukraine with Russia – **«Fotonica Plus Co»** manufactured, delivered, installed at the workplace and transferred for free use **diode lasers «LIKA-surgeon+»** for laser thermotherapy (LTT) procedures to 15 clinical medical institutions. Another 4 hospitals received laser devices for LTT thanks to the financing of charitable organizations – **«PA RI DISTRICT 2232», «ROTARY CHERKASY», CHARITABLE FOUNDATION THE FOUNDATION FOR MILITARY MEDICINE SUPPORT.**

To date, laser thermotherapy, carried out with the help of the diode lasers «LIKA-surgeon+» emitting in the infrared range of the spectrum, has already proven its high efficiency in the treatment of injuries and wounds of various etiology and localization, as well as in the rehabilitation period.

Laser thermotherapy helps in the recovery of military and civilian personnel, after receiving injuries as a result of combat operations, and has already received favorable reviews from doctors who work with this method.

Mine-explosive injury of the left lower leg. External fixation device

Mine-explosive injury of the right hand. Condition after plastic surgery of skin, soft tissue, bone defects, suturing of the ulnar nerve

Mine-explosive injury of the left hand.
Condition after plastic surgery of skin defects,
soft tissues, bones,
stapling of the radial nerve

Condition before surgery
20.06.2022

Condition after surgery
20.06.2022

Condition after the procedure
05.07.2022

Condition after the procedure
08.07.2022

Condition after the procedure
11.07.2022

Condition after the procedure
20.07.2022

Multiple wounds of the lower extremities.
On June 22, 2022, skin plastic surgery was performed on the dorsum of the right foot. A skin flap was transplanted from the sole of the right foot to the lateral surface.

Procedure 1 (30.09.2022). Slight swelling of the transplanted flap, stage II of "young" scar formation.

Procedure 2 (3.10.2022). The transplanted skin is dry and looks like scales. The edges are dry, smoothed.

Procedure 3 (4.10.2022). The dried surface has the appearance of "scales" with cracks. III stage of "mature" scar formation.

Procedure 4 (5.10.2022)

Procedure 5 (6.10.2022). The skin has been cleared of scales, has a smooth, elastic surface

Procedure 10 (14.10.2022)

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Consequences of an injury to the forearm in the lower third (1.04.2022). Slowly consolidating multifragmentary fracture of the right radius in the middle and lower third. Soft tissue defect of the dorsal surface of the middle and distal third of the forearm. Condition after plastic surgery with a skin flap (7.07.2022). Combined contracture. Pain syndrome. The patient underwent a course of 10 LTT procedures.

Condition after the procedure (05.10.2022)

Condition after the procedure (06.10.2022)

Condition after the procedure (12.10.2022)

Condition after the procedure (19.10.2022)

Condition after the procedure (24.10.2022)

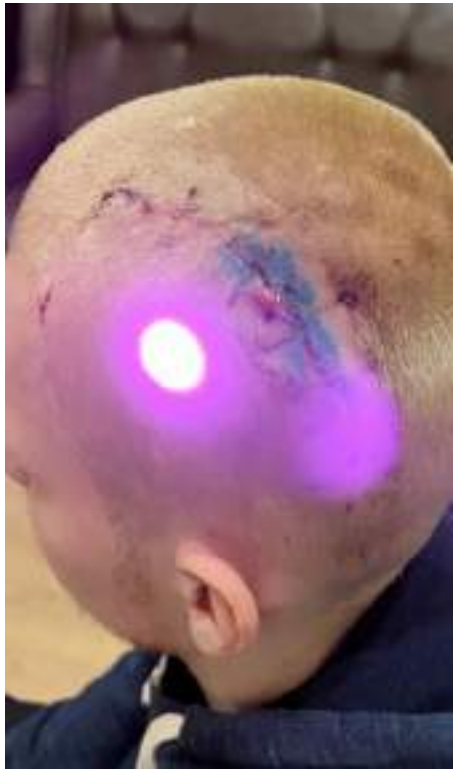


Postoperative suppurative wound of the knee

There is no positive dynamics for almost two weeks before the use of laser thermotherapy.

After 5 LTT procedures for 3 weeks from 1.08.2022 to 22.08.2022, using only ointment dressings, a positive dynamics of wound healing is observed.

Complications of an uncontaminated head wound. The course of LTT procedures is 10 days



Gunshot wound to the head: entry hole. A course of LTT procedures was conducted

Condition after the procedure
(18.03.2023)

Condition after the procedure
(28.03.2023)

Through shrapnel wound.
The course of laser thermotherapy procedures is 10 days

Neurotrophic changes in tissues of shin

Condition after the course of LTT procedures (duration 20 days)

Traumatic vasospasm, tissue ischemia of the 4th finger (the patient twisted her leg). After one procedure of laser thermotherapy (irradiation of the skin on the foot in the projection of disturbed blood flow), blood circulation is fully restored.
Recurrence of blood flow disturbance was not observed after the procedure.




The stump of the middle third of the left lower leg. 15 laser thermotherapy procedures were performed

Condition after the procedure
(07.02.2023)

Condition after the procedure
(08.02.2023)

Condition after the procedure
(13.02.2023)

Condition after the procedure
(28.02.2023)

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The patient came in with a carbuncle on the right lower leg (the patient has Crohn's disease). Necrotization of tissues began, there was no positive reaction to antibiotic therapy. The patient underwent 5 UHF-therapy procedures. From September 25, 2023, a course of laser thermotherapy (LTT) and supravenous laser irradiation of blood (SLIB) was started. Tissue necrosis stopped spreading after the first sessions. During the course of treatment, 13 LTT procedures and 10 SLIB procedures were performed. The patient was discharged on October 11, 2023.

Condition before the start of treatment
(18.09.2023)

State after the procedure LTT+SLIB
(25.09.2023)

Patient condition
(09.10.2023)

Patient condition
(11.10.2023)

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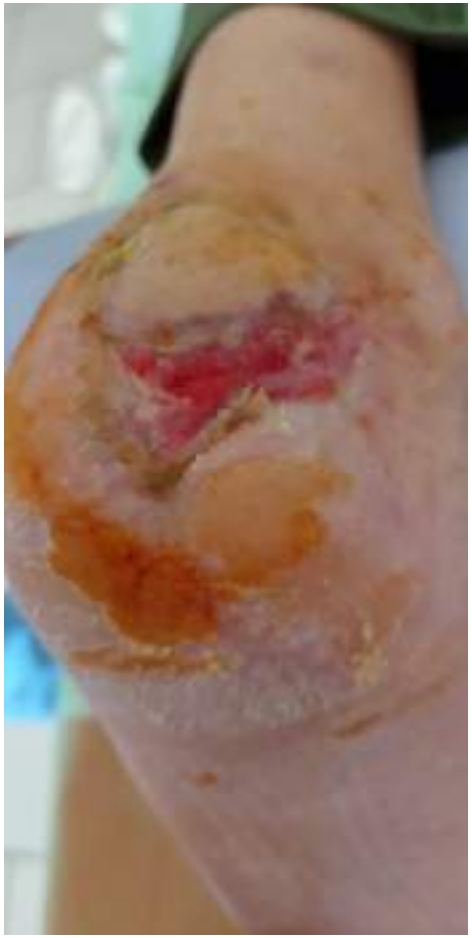
Heel with skin graft.
Laser thermotherapy procedures were performed once every 3 days (during dressing)

Condition before the start of treatment
(18.09.2023)



Condition after treatment
(04.10.2023)

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A facial wound complicated by a fracture of the lower jaw.
The patient underwent laser thermotherapy (LTT) procedures. After two weeks of treatment, the wound would be sutured. After suturing, the treatment continued for another week (5 LTT procedures were performed). The total duration of the patient's treatment was 3 weeks.

Condition before the start of treatment

Patient condition after 1 week of LTT use

Patient condition after 2 week of LTT use

Patient condition after 3 week of LTT use

Since February 24, 2022, the **method of laser thermotherapy (LTT)**, carried out with the help of the diode laser «LIKA-surgeon+», has been effectively used in the treatment and rehabilitation of many patients with various types of injuries and other pathologies

The method of laser therapy has shown high efficiency in the treatment of injuries and wounds and has received favorable reviews from doctors from various medical institutions.

«Fotonica Plus Co» is very grateful for the effective cooperation in the implementation of the laser thermotherapy (LTT) in clinical medicine to organizations and specialists in the field of medicine, optoelectronics, medical technology, public organizations and public figures.

Dr. Sc. (Med.) Borzykh N.; Ph.D. (Med.) Borozenko O.; Ph.D. (Tech.) Chuhraev M.; Drager N.; Ph.D. (Med.) Goloborodko B.; Goncharenko I.; Gorbatiuk S.; Katyukova L.; Korsun I.; Dr. Sc. (Med.) Krysa V.; Lemomnjavi Z.; Lesko V.; Ph.D. (Econ.) Lugovskaya I.; Dr. Sc. (Med.) Lyakhovskiy V.; Maslyanko L.; Dr. Sc. (Med.) Mykhailosov R.; Dr. Sc. (Med.) Paliychuk O.; Dr. Sc. (Tech.) Pavlov S.; Pokhylyuk R.; Ph.D. (Med.) Popov V.; Porel N.; Ph.D. (Med.) Posokhov M.; Pylypenko T.; Dr. Sc. (Med.) Romayev S.; Dr. Sc. (Med.) Roy I.; Savchenko A.; Skalskyi I.; Spodenyuk A.; Svyridenko O.; Tsven P.; Varvinskiy O.; Ph.D. (Phys.-Math.) Voitsekhovych V.; Voloshchenko I.; Voronkov V.; Yankovskiy O.; Dr. Sc. (Tech.) Zabulonov Yu.; Zitser G.; Ph.D. (Med.) Zhuravlev V.

- ✓ «Academy of Laser Medicine», Ltd (Cherkasy, Ukraine)
- ✓ Vinnytsia National Medical University named after M. Pirogov
- ✓ Vinnytsia National Technical University
- ✓ Public Association «ROTARY INTERNATIONAL DISTRICT 2232»
- ✓ Ivano-Frankivsk National Medical University
- ✓ Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine
- ✓ Institute of Neurology, Psychiatry and Narcology of the National Academy of Medical Sciences of Ukraine
- ✓ «INFRA-CENTER CO», Ltd (Cherkasy, Ukraine)
- ✓ Medical Commission of the National Olympic Committee of Ukraine
- ✓ «Science and Engineering Center «SCANER», Ltd (Cherkasy, Ukraine)
- ✓ «ONTF Company Ltd» (Cherkasy, Ukraine)
- ✓ Public organization «ODESSA ROTARY CLUB»
- ✓ Poltava State Medical University
- ✓ Public Organization «ROTARY CLUB «RICHELYE» ODESSA»
- ✓ Public Organization «ROTARY CLUB CHERKASY - CENTER»
- ✓ Public Organization «RK Odesa INTERNATIONAL»
- ✓ Public Association «UKRAINIAN FOOTBALL ASSOCIATION»
- ✓ Kharkiv Medical Academy of Postgraduate Education
- ✓ «HERACLE GMBH» (Jena, Germany)

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On April 19, 2023, "Fotonica Plus Co" together with the Department of Biomedical Engineering and Opto-Electronic Systems of Vinnytsia National Technical University and Mykola Pirogov Vinnytsia National Medical University held a **scientific and practical seminar "Laser thermotherapy using near-infrared laser radiation spectrum range in case of polytrauma". About 80 specialists in the medical field of specialized medical institutions**, where the wounded are treated and rehabilitated, took part in the seminar. Scientists from more than 15 institutions of higher education and scientific institutions were also involved, including:

- ✓ Research Institute of Rehabilitation of Persons with Disabilities of VNMU named after M. Pirogov
- ✓ State University "Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine“ (Kyiv)
- ✓ Poltava State Medical University
- ✓ Kharkiv National Medical University
- ✓ Kharkiv National University of Radio Electronics
- ✓ National Aviation University
- ✓ NU "Odesa Polytechnic"
- ✓ National University of Water Management and Nature Management (Rivne)
- ✓ "Academy of Laser Medicine“, Ltd (Cherkasy)

The seminar was moderated by ***Serhii Pavlov*** - PhD, professor of the Department of Biomedical Engineering and Optical-Electronic Systems of VNTU. Vice-rector for scientific work of VNMU named after M. Pyrogova, Doctor of Medicine, Professor ***Oleg Vlasenko*** gave a welcome speech at the seminar.

Speakers spoke at the seminar::

• ***Serhiy Pavlov*** (Ph.D., Professor of the Department of Biomedical Engineering and Optical-Electronic Systems of VNTU) - **report "Peculiarities of the biophysical mechanism of the action of laser radiation on biological objects".**

• ***Serhiy Tertyshny*** (Ph.D., trauma surgeon of the highest category, head of the department of the Thoracic Surgery Clinic for thermal injuries and surgical infections) - **report "Modern aspects of the use of laser thermotherapy and photodynamic therapy of wounded with gunshot injuries of integumentary tissues.«**

• ***Katyukova Liliya*** (physician of physical rehabilitation medicine, Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine) - **report "Application of the high-intensity laser treatment method for combat trauma of gunshot and non-gunshot injuries."**

• ***Popov Vyacheslav*** (Chairman of the Sports Medical Committee of the UAF, Member of the NOC Medical Commission, Professor, Honored Doctor) - **report "Methods of quantum therapy and laser thermotherapy in high-performance sports."**


WHAT SHOULD / CAN I DO ...?????


АЛЬТЕРНАТИВНІ МЕТОДИ
ОЦІНКИ ЖИТТЄЗДАТНОСТІ
ТКАНИН


Бойова травма
кісткових тканин
анатомо-функціональних структур

The participants of the seminar discussed the practical aspects of using the laser thermotherapy technique and the results of its application in various specialized medical institutions of Ukraine. Doctors who already have experience using the LTT technique in their clinical practice have noted its high efficiency in the treatment and rehabilitation of orthopedic and traumatological patients with injuries of various localization and neurological pathologies. Positive results of the use of LTT in sports medicine were noted both for the treatment of injuries and rehabilitation of athletes, and for increasing their working capacity.

During the discussion, recommendations and proposals were formed for the further development and improvement of laser thermotherapy techniques for use in clinical medicine, in particular for the rehabilitation of military personnel and the wounded.

It is noted that laser thermotherapy is especially relevant in the treatment of polytraumas of various localization and etiology, gunshot injuries, muscle damage, tendinitis, arthrosis, epicondylitis, bursitis, as well as in rehabilitation after operations for limb amputations and plastic defects of soft tissues.

It should be noted that the "Fotonica Plus Co" is currently one of the leading companies in Ukraine, as a developer and manufacturer of laser equipment for surgery and therapy, as well as an instrument based on optical fiber for it, which is used in gynecology, otorhinolaryngology, general surgery , proctology, phlebology, dermatology, neurosurgery, photodynamic therapy, etc.

We would like to summarize that such cooperation between universities and manufacturing companies promotes the integration of education, science and production and provides an opportunity to integrate modern technologies and practical results into the educational process and scientific research.

We are very grateful to the speakers and participants of the seminar!

During the use during the war, the laser thermotherapy method (LTT) helped in the rehabilitation of many patients after injuries, wounds and in the postoperative period.

But, unfortunately, the war in Ukraine is still going on, the number of wounded among the civilian population and the military is increasing every day...

Many hospitals in our country would benefit from lasers for laser thermotherapy procedures.

We would like to continue to help hospitals by manufacturing our products for them, but unfortunately, we are no longer able to provide free assistance.

The war caused an economic downturn in Ukraine, manufacturing companies are holding on with their last strength to save jobs and at the same time support the country's economy...

We would be very grateful for any form of assistance in the manufacture of diode lasers «LIKA-surgeon+» for transfer to other hospitals in the country to improve the quality and efficiency of treatment of the wounded.

We hope for further effective cooperation!