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THERAPY MANUAL
Laser therapy

Laser therapy manual

Laser therapy with deep action

Lasers in physical medicine

The development of increasingly specialised medical laser systems in the past four decades has given rise to an increasing narrowing of the individual methods to ranges of indications within a rational system. Appropriate therapeutic objectives were allocated to the laser systems as well as the operating conditions. Physical medicine also uses certain laser methods whose effects undoubtedly demonstrate success in the established range of indications.
The design of the "Opton", a special high-power laser for physical medicine, is based on this scientific development.

Laser radiation develops through the stimulation and amplification of light (**L**IGHT **A**MPLIFICATION by **S**TIMULATED **E**MISSION of **R**ADIATION) in special resonators.
In contrast to regular light, the features of laser radiation are defined with the following terms:

– Beam intensity
– Monochromasia
– Collimation
– Coherence

Beam intensity

The beam intensity is the radiation power emitted per emitter surface and per solid angle unit and it is used to describe the brightness and power density.

Monochromasia

Lasers emit their light in a very narrow frequency and wavelength range; Opton/Opton*Pro* lasers generate light with two or three defined wavelengths in the near infrared range of 810 nm, 980 nm and 1064 nm.

Collimation

The bundle of beams of laser light are aligned parallel to one another, that is, they are collimated. In physical medicine, there is to be no destruction of tissue and for this reason, the laser beam of the Opton/Opton*Pro* laser is spread out when emitted, with an opening angle of 35°/32°.

Coherence

Coherence refers to the in-phase radiation of the laser light: the photons vibrate at the same time (chronological coherence) and in the same direction (spatial coherence) and as a result, there are no overlay effects.

Physical parameters

$$\text{Power [W]} = \frac{\text{Energy [J]}}{\text{Time interval [s]}}$$

$$\text{Power density [W/cm}^2\text{]} = \frac{\text{Laser radiation power [W]}}{\text{Beam cross-section [cm}^2\text{]}}$$

$$\text{Energy density [J/cm}^2\text{]} = \frac{\text{Laser energy [J]}}{\text{Beam cross-section [cm}^2\text{]}}$$

The power density and the therapy time represent the most important parameters for the therapy; they describe and determine the energy introduced into the tissue per time and area. The laser power is of less importance for the biological effects achieved since it describes the output power at the laser source and not the power effective in the therapy area. For treatment with the Opton laser, this should be taken into account in particular if spacers are to be used to enlarge the therapy area.

The effects of lasers

General effects

Like regular light, laser light is subject to the laws of optics. Therefore, laser light is to some extent reflected on the surface of the tissue; on the other hand, it penetrates into the tissue, is scattered and absorbed there, and thus enters into interaction with the tissue. A small part of the laser light also passes through the tissue and exits at the opposite side.

In physical medicine, the portion of the laser light which is scattered and absorbed in the tissue is therapeutically relevant. The site and amount of the laser energy which remains in the tissue and is converted into other forms of energy are crucial for the effect.

The biological effects of the laser light are described as biostimulation and thermal effects.

Interactions

In the tissue, the laser light encounters molecules with certain colours and colour properties. In the near infrared range (780-1400 nm) it is primarily absorbed by melanin, myoglobin and haemoglobin. In doing so, there is a thermal reaction due to the conversion of light energy into heat, that is, there is a heating of the tissue.
The heat which develops also spreads to adjacent areas of tissue via conduction (thermal conduction).

Note: Other effects, such as ionisation or the breaking of molecular bonds, do not occur with lasers in the near infrared range in the energy spectrum of the Opton laser.

The heating of the skin limits the total energy since thermal damage occurs at an excessively high dosage. The total energy administered can be increased through cooling at least in white skin since there is less blood due to the vasoconstriction because of the cold and thus also less haemoglobin in the skin.
Thus less laser energy is absorbed; the laser light penetrates deeper into the tissue.

Biostimulation

At the same time, a part of the laser energy is converted into chemical reaction energy, as a result of which molecules are directly excited through the transmission of electrons and indirectly through the formation of oxygen radicals.
These primarily include coloured molecules of the respiratory chain, such as flavoproteins and cytochromes. This results in an increase in energy metabolism activity which is known as “biostimulation”.

Wavelengths / Effects of the laser on biological tissue

Absorption spectrum

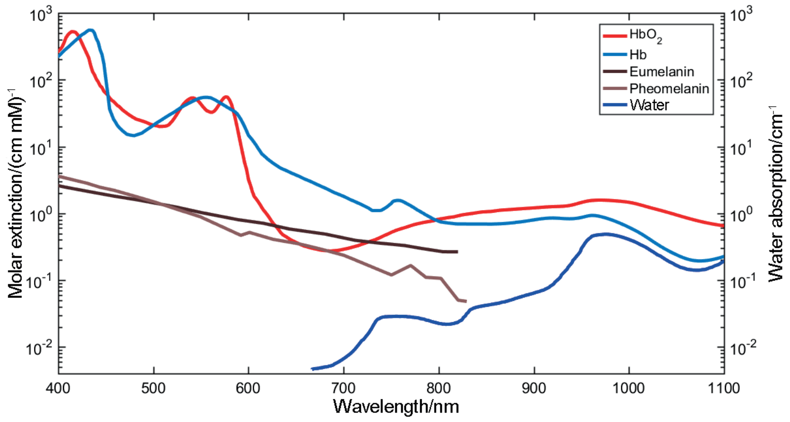
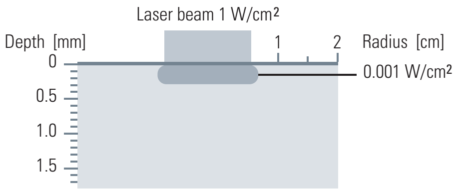


Fig. 1

Light distribution in tissue if absorption >> scatter



Light distribution in tissue if scatter >> absorption

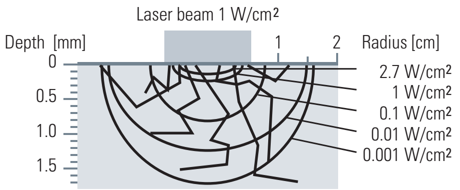
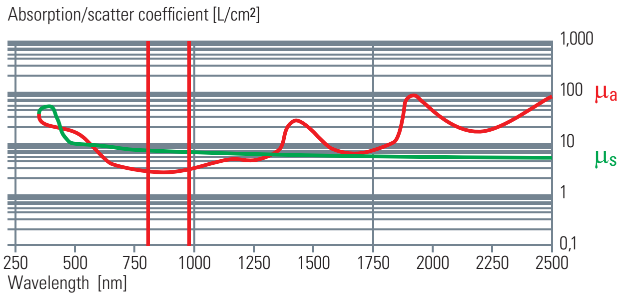


Fig. 2

Typical spectral dependence of the scatter and coefficients in biological tissue

Fig. 3



Source:
Einführung in die Lasermedizin [Introduction to laser medicine], Institute for Laser Medicine, Heinrich Heine University, Ed.: Hering P.; H.-J. Schwarzmaier

The wavelengths of the Opton/Opton*Pro* laser – depending on the model – of 810 nm, 980 nm and 1064 nm, are within the absorption minimum of melanin and haemoglobin. In this way, the maximum penetration ability of the laser light is achieved. Melanin is contained in the epidermis which forms a very thin layer. For this reason, the laser energy can penetrate this layer very easily.
The wavelength 1064 nm favours penetration of the radiation into the tissue. The scatter of the laser radiation decreases as the wavelength increases. Since the penetration depth is limited not only by absorption but rather also by scatter, a higher depth of penetration is expected for radiation of the wavelength 1064 nm. The absorption through water is lower at 1064 nm than at 980 nm, however approximately seven times higher than at 810 nm. The absorption of the 1064 nm radiation by haemoglobin is approximately less by the same factor than that of the 810 nm radiation. This can be advantageous, especially in the case of highly vascularised tissue (tissue with many blood vessels) and high perfusion (circulation) and ensure good penetration of the laser radiation.
In this case, it should be borne in mind that the absorption coefficients are typically indicated for an Hb/HbO_2 concentration of 1 mol/l, whereby physiological Hb/HbO_2 concentrations are below 1 mmol/l. As a result, the absorption values from the graphs are reduced by a factor of about 1000 and are thus approximately in the magnitude of the absorption value of water.

Frequency maintenance and superposition

These principles apply to radiation intensities as used in physical medicine.
For therapy, this means that for the two wavelengths of the Opton/Opton*Pro* laser, different target sites are expected.
Note: High-energy, pulsed lasers for surgery and coagulation use nonlinear effects which lead to photoablation and plasma formation. These effects do not play any role in the dosage ranges of physical medicine.

Frequency maintenance

No new frequencies develop in the case of an interaction between light and matter. Despite scatter, reflection, etc., the laser light remains monochromatic.

Superposition principle

Light waves in matter do not mutually influence each other (also not the three different wavelengths of 810 nm, 980 nm and 1064 nm length); they spread independently of each other.

Interactions in the tissue

The important therapeutic effects based on the interaction of the light with the tissue are based in the distribution of the light energy in the tissue which is determined by the ratio of the absorption to the scatter of the laser light.
If the laser light is heavily absorbed, it transmits its energy along a very short distance on the surface of the tissue. In this case, the power density drops off very quickly. As a result, tissue can be precisely destroyed, as is desired in the case of surgical lasers (see Fig. 1).
By contrast, if the laser light is heavily scattered, a homogeneous and deeper heating of the tissue is achieved, depending on the dose. Moreover, the scatter leads to a higher power density just underneath the surface of the irradiated tissue. From there, the power density decreases

Depth of penetration

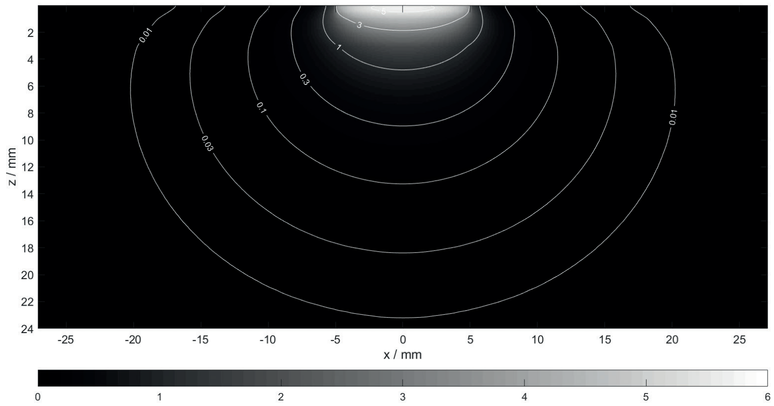
exponentially as the depth increases (see Fig. 2). The scatter and absorption are each described with the scatter coefficient μ_s and the absorption coefficient μ_a. These properties are on the one hand properties of the tissue itself; on the other hand, however, they are dependent on the wavelength of the radiated light.
The two wavelengths of the laser light of the "Opton" are primarily scattered in the tissue; μ_s is larger than μ_a, which is why they can also be used therapeutically in deeper tissue layers (Fig. 3).

The largest energy density is – due to the scatter – only achieved under the epidermis. It is defined as the tissue depth in which the surface dosage is reduced through scatter and absorption by about 67% (= e^{-1}).
The depth of penetration depends on the wavelength and the amount of chromophores, thus pigmented components, on the path of the laser light in the tissue.
The actual depth of penetration of the laser light is not homogeneously distributed, since the tissue is made up of more or less normally composed constituents.
Components containing water, such as cells and intercellular fluid, exist in parallel next to blood-carrying structures, such as capillaries; the distribution is also relatively nonhomogeneous, for example, in the case of chromophores containing melanin.

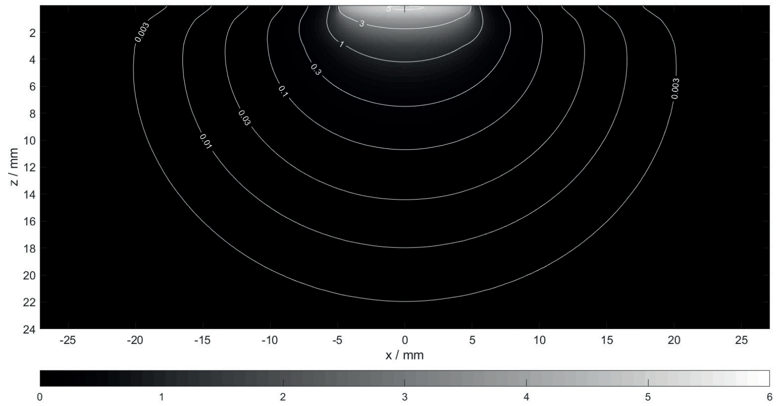
Skin types according to Fitzpatrick

Type I: Never tans, always burns
(Very pale skin, blonde hair, blue/green eyes)
Type II: Occasionally tans, frequently burns
(Pale skin, dark blonde/brown hair, green/brown eyes)
Type III: Frequently tans, sometimes burns
(Medium skin tone, brown hair, brown eyes)
Type IV: Always tans, no sunburns
(Olive-coloured skin, brown/black hair, dark brown/black eyes)
Type V: Never burns
(Dark brown skin, black hair, black eyes)
Type VI: Never burns
(Black skin, black hair, black eyes)

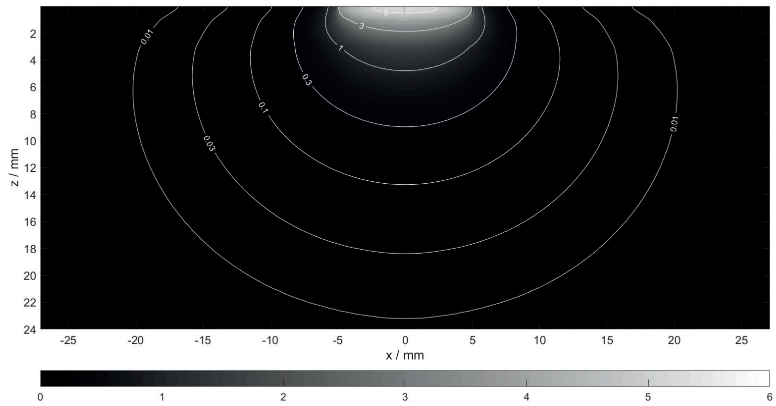
The actual depth of penetration is determined by the density of the melanin (depending on skin type) and in deeper layers by the capillarisation.



Luminous flux in the tissue at an intensity distribution for λ = 810 nm, Light beam diameter = 10 mm and skin type 2



Luminous flux in the tissue at an intensity distribution for λ = 980 nm, Light beam diameter = 10 mm and skin type 2



Luminous flux in the tissue at an intensity distribution for λ = 1064 nm, Light beam diameter = 10 mm and skin type 2

Thermal effect

Absorption of the laser radiation in water and blood

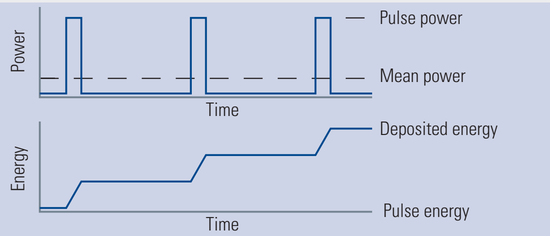
Wavelength	Absorption coefficient		Depth of penetration	
	Water	Blood	Water	Blood
10,600 nm (CO_2 laser)	10^3 cm^{-1}	10^3 cm^{-1}	0.001 cm	0.001 cm
1060 nm (Nd:YAG laser)	0.1 cm^{-1}	4 cm^{-1}	10 cm	< 0.2 cm
514 nm (argon-ion laser)	0.001 cm^{-1}	330 cm^{-1}	10,000 cm	0.003 cm

Various thermal conductivity coefficients

	Thermal conductivity (L) [W/(cm·K)10^3]
Fat tissue (human)	3.00
Heart (human), 81% water	5.87
Kidney (human), 84% water	5.45
Liver (human), 77% water	5.66
Water	5.59
Blood	6.20
Copper	4180.00
Air	0.20

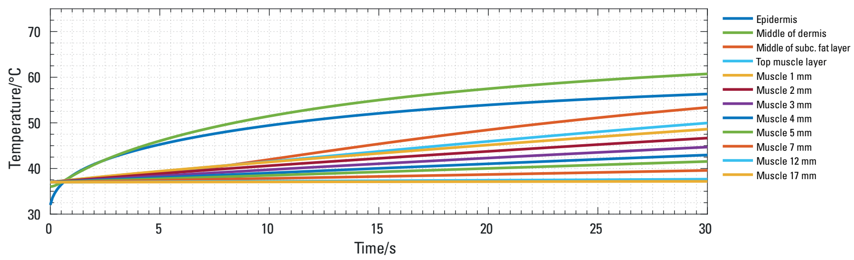
Source:
Einführung in die Lasermedizin [Introduction to laser medicine], Institute for Laser Medicine, Heinrich Heine University, Ed.: Hering P; H.-J. Schwarzmaier

The therapeutic effect of the Opton/Opton*Pro* laser is crucially dependent on the thermal component of the energy transfer and on the thermal properties of the tissue which depend on the thermal conductivity and the temperature conductance of the respective tissue.
In physical medicine, therapeutic heat effects in the temperature range up to approx. 43°C are sought. Higher temperatures, with corresponding application times, can potentially damage tissue and will definitively damage tissue starting at approx. 50°C. Therefore, at the same laser power, more energy is effective in the fat tissue in the form of heat than in tissues containing water. The temperature conductance describes the amount of heat which is conducted through a tissue at a constant temperature gradient. This allows conclusions to be drawn regarding the time which a tissue needs to reduce the temperature increase generated along a temperature gradient. This is known as the thermal relaxation time. The thermal relaxation time is very important for the therapy since it helps to determine the pulse intensity and the subsequent pause, particularly at high doses in pulsed operation, in order to avoid tissue damage.

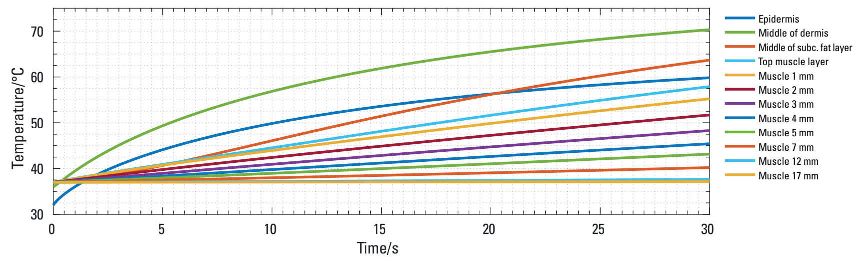


Chronological sequence of pulse energy, mean power, pulse energy and deposited energy from a pulsed laser

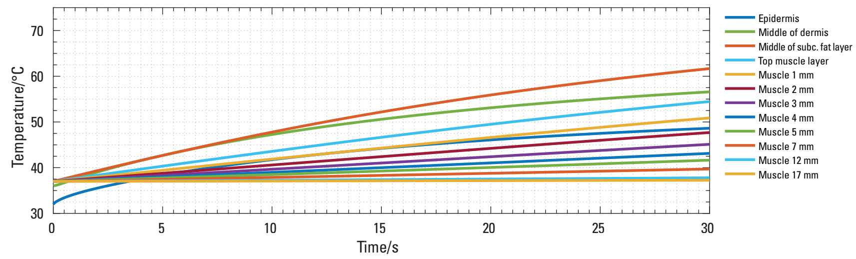
Power 7 watts



Wavelength: 810 nm Skin type: II Diameter: 10 mm
Absorption spectrum



Wavelength: 980 nm Skin type: II Diameter: 10 mm
Absorption spectrum



Wavelength: 1064 nm Skin type: II Diameter: 10 mm
Absorption spectrum

In addition to conduction (heat carryover), the heat is also conducted in the tissue via convection. The temperature distribution therefore also depends on the degree of perfusion of the respective tissue. The better perfused the tissue is, the more heat convectively dissipates.
Muscle tissue needs comparatively more laser energy to become steadily heated at a certain temperature than fat tissue. If there is an appreciably thick layer of fat over the muscles, surface cooling, for example using cold air, is therefore frequently recommended in the case of laser therapy. The scatter of the laser light in the superficial layers leads to a higher temperature increase under the skin, as can be clearly seen in the examples below. For this reason, cooling is recommended in the case of higher doses and a correspondingly longer radiation time.
Note: Cooling is not necessary in the case of dynamic beam guidance.

Biostimulation

The stimulation of the energy metabolism in the respiratory chain of the cells is manifested in faster healing of tissue lesions. This happens independently of the thermal effects of the laser light.

Mechanisms of laser therapy

The therapeutically usable mechanisms described below are not highly dependent on the deep action of the laser light but rather on the localisation and intensity of the stimulus.
In addition to treatment in the affected segment, the dose administered which must be effective – without causing thermal damage – is crucial.
The therapist determines the necessary therapeutic dose with the test described later to determine the thermal threshold.
In the case of deep treatment sites, a high dose is occasionally necessary, with the risk of thermal damage to the skin. In this case, surface cooling with cold air is recommended.

Analgesic mechanisms

Laser light is scattered and absorbed in the skin and thus largely converted to heat.
A weak thermal stimulus on the nociceptors of the skin triggers the known segmental pain-inhibiting reflexes via the first and second neuron, as described with the gate control theory.
Strong thermal stimuli activate the endorphinergic neural and humoral pain inhibiting system.
Both mechanisms are suitable for the therapy of pain of the musculoskeletal system.

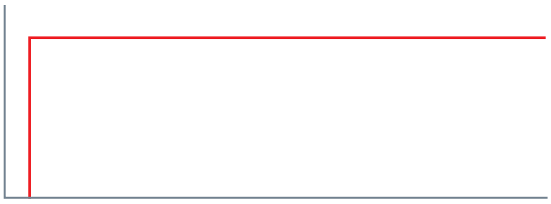
Reflexive effects

Segmental reflexes activated with laser light also trigger muscle relaxation, in addition to pain inhibition. This requires strong thermal stimuli.

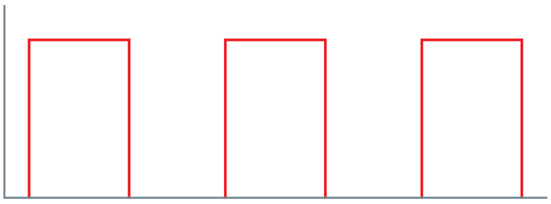
Regeneration of tissue

The acceleration of healing processes described has an effect above all in the activation of fibroblasts. The non-thermal nature of the activation should be pointed out and for this reason only small amounts of energy from the laser light are necessary.
The weakening of the laser light in the tissue determines the necessary laser power, depending on the location of the lesion, and thus in the case of deeper structures, such as tendons or joint capsules, high surface doses may be necessary.

Emission modes



Pulsed mode (continuous wave)



Serial pulses

Recommended area of application

Continuous Serial pulses – 0.5 Hz Serial pulses – 1.0 Hz Serial pulses – 2.0 Hz	Stimulation of trigger points
Single pulses – 0.25 sec. Single pulses – 1.0 sec.	Stimulation of acupuncture points
Continuous/ Serial pulses 1.0 Hz Continuous/ Serial pulses 0.5 Hz	For the combined treatment: - Trigger points, static - Dynamic for the muscles in the treatment area
Serial pulses – 25 Hz, Duty cycle 1:1 Serial pulses – 4 Hz, Duty cycle 1:2	For the dynamic surface treatment in the case of painful conditions: - Duty cycle 1:1, In the case of light skin and a chronic disease stage - Duty cycle 1:2, In the case of darker skin and a subchronic disease stage

The Opton/Opton*Pro* laser, depending on the model and setting, emits laser light with one, two or three wavelengths simultaneously. The total power is divided in equal parts on the wavelengths or is adjustable.

The various laser light emission modes

Which laser light emission mode is used and when depends on various factors:
On the depth of the site of disease on the one hand, and on the therapeutic objective on the other hand (see also instructions for use):

- Analgesia
- Promotion of circulation
- Muscle relaxation
- Acceleration of healing

Pulsed mode

The steady emission of light, also known as continuous wave, is the most frequently used working mode. In the case of high power emissions, attention should be paid to the possible overheating of the tissue during lengthy treatment times.

Serial pulses

In this mode of operation, the continuous wave is automatically briefly interrupted at regular intervals.
This is recommended particularly for the treatment of deep sites to avoid overheating of the skin. The discontinuous emission of the laser light allows the surface tissue to cool during the pauses.
In this way, the risk of overheating of the tissue is significantly reduced, particularly in the case of dark skin and also in the case of a high transfer of energy in the deeper layers.

Single pulses

Single pulses are suitable for the transfer of large amounts of energy which are administered to treat specific points, for example, in the treatment of trigger or acupuncture points.
Single pulses are applied statically.

Application techniques

There are three options available:

- a static application,
- a dynamic application,
- a combined application – static and dynamic.

The high output power of the Opton/Opton*Pro* enables the use of the static application to treat specific points and the dynamic therapy for larger areas.
The spacer holds the applicator at a defined distance from the skin. Because of the spread of the laser beam – 35°/32° – the therapy field is larger than in the case of direct skin contact. In the types of application shown above, the applicator/spacer should always be placed perpendicular on the area to be treated since otherwise only part of the power will have an effect and reflections of the invisible laser beam can endanger the patient and user.

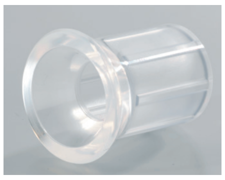
Static application

In the static application, the applicator/spacer is placed on the area to be treated and is not moved. After the treatment, erythema may occur locally. The static application is always used if the area to be treated is small (for example, in the case of tendinitis, if a tendon attachment point is to be treated). Trigger points and acupuncture points in particular are suited to the static application of the laser light. For the static application to treat specific points, the use of the spacer 1 is recommended (3.1 cm^2 treatment area).
In the case of static treatment, at least 10-20 joules per treated point are recommended.

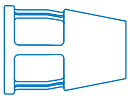
Dynamic application

In the case of dynamic application, it should be ensured that the applicator/spacer is always at a right angle to the surface of the skin in order to avoid causing hazards due to scattered laser light on the one hand and to maintain an effective irradiation angle on the other hand. In the case of small areas to be treated, the applicator is moved back and forth or in circles. In the case of larger areas, it is recommended to divide them into several regions. Dynamic treatment is performed when the treatment area, such as in the case of a pulled muscle or at a joint, is relatively large.

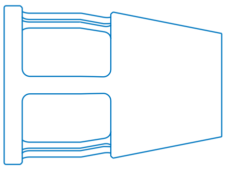
For the dynamic treatment, the spacer 1 is recommended. (Treatment area approx. 3.1 cm^2).



Spacer for wound treatment for use on injured skin, mucous membranes, wounds or infectious skin



Spacer 1
1.2 cm in length, with a treatment area of 3.1 cm^2



Spacer 2
4.5 cm in length, with a treatment area of 9 cm^2

Reference points for the dosage:

- Acute pain conditions 10 joules/cm^2
- Subacute pain conditions 20 joules/cm^2
- Chronic pain conditions 50 joules/cm^2

The dosage information in joules/cm^2 should be understood as the minimum amount of energy which is to be transmitted.

Combined application – static and dynamic

Pain is frequently not homogeneously distributed in the treatment area. In many pain syndromes, maximum points, such as trigger or pain points, are within a painful area. The trigger points which cause pain are very often also outside of the area of pain since they generate radiating pain.
Trigger and primary pain points are treated statically; the remainder of the area of pain is treated dynamically.

Duration of treatment

The duration of treatment is longer in the case of dynamic application than in the case of static application.
If, during the static treatment of points, the desired energy dose is reached after just a few seconds, the surface to be treated in the case of dynamic therapy is significantly larger and this results in a longer treatment time. For this reason, it should be ensured that the treatment area selected is not too large.

High-dose laser treatment

If very high doses are to be administered, the skin can be cooled during the treatment using cold air.
The cooling should be started about 1–2 minutes before the laser therapy.

Dosage and power

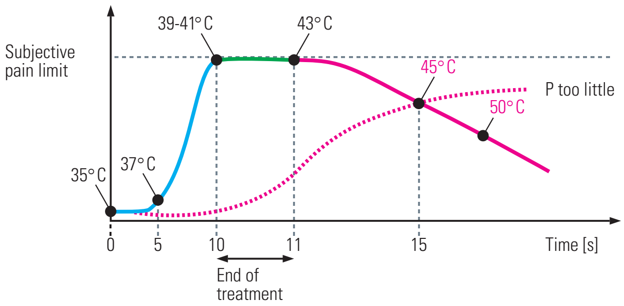
Here, the skin type is of crucial importance, as is whether the application is performed in a static or dynamic manner.

In both cases, the laser is applied until the patient indicates a clear feeling of warmth. The development of heat-related pain is a sign of an overdose.
To avoid skin damage, the affected area should be cooled immediately.

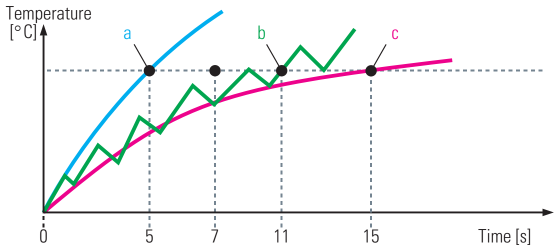
Determining the thermal threshold

To determine the power needed in each individual case, it is recommended to conduct a thermal threshold test prior to each treatment.
The laser energy is scattered in the skin and absorbed to a large extent. As a result, pain-inhibiting reflexes are also triggered. The skin can therefore be overheated before the pain perception indicates the impending tissue damage. This primarily concerns the static form of application. If the power emission is too weak (dotted red line in the diagram), the sensitive thermal threshold is only reached after 12 seconds. By contrast, the temperature in the tissue may already be so high that damage occurs.
If the emission of power is too high, the thermal threshold is reached too early before a sufficiently large and effective amount of energy is introduced into the tissue.
A precondition for the thermal threshold test is intact thermal sensitivity. If this is locally disrupted, the test should be performed at a heat-sensitive site. If there is a generalised reduction in temperature sensitivity, the test cannot be performed.

Experience gained from clinical practice indicates that the subjective thermal threshold must be reached after 7-11 seconds. In this way, the correct emission of power for the treatment (green section of the curve) can be determined. The amount of energy (without cooling) should not be too high, in order to avoid thermal damage.
The laser treatment is performed until the desired amount of energy for each point is reached. To avoid thermal damage, whenever the heat/pain threshold has been reached, the power is reduced in each case until the pain disappears or a brief pause is taken.



Point a) in the graph: Power too high, pain threshold is reached => decrease power!
Point b) in the graph: Power is correctly selected, heat is felt, no heat-related pain occurs.
Point c) in the graph: Power too weak, thermal threshold reached too late or not reached => increase power!



The thermal threshold test provides a useful indication of the dose of energy to be adjusted in the case of dark skin. Independent of this, it should be ensured during the treatment that no heat-related pain occurs. If this should be the case, a greater distance to the skin can be selected (spacer!) while keeping the dose the same, or the applicator can be moved more quickly over the treatment area. The power output can also be reduced – possibly as an additional measure.

The selection of the mode depends on the patient's skin type. Since the laser energy is heavily absorbed by melanin, the temperature in the skin increases very quickly especially in the case of dark skin types and can thus be damaging. In pulsed operation, the laser energy is emitted with interruptions and this delays the temperature increase in the skin.

- In the case of pale skin, the unpulsed mode is selected (phototypes I, II)
- Serial pulses for tanned or olive-coloured skin (phototypes III, IV) and for dark or black skin (phototypes V, VI). The greater the pigment density, the lower the laser energy should be selected.

Selection of treatment parameters

- Laser power [W]
- Surface of the treatment area in the case of dynamic radiation [cm^2]

Transfer of laser energy with the use of spacers

For a better understanding, the power densities are defined here once again.

$$\text{Power density } [W/cm^2] = \frac{\text{Laser radiation power } [W]}{\text{Beam cross-section } [cm^2]}$$

This is determined by the parameters

- Output power of the laser head [W] and
- Beam cross-section [cm^2];

The laser beam of the Opton/Opton*Pro* laser spreads at an angle of 35°/ 32°, therefore the power density decreases proportionally to the square with the distance of the applicator to the skin.
The maximum energy transfer takes place in the case of direct contact between the applicator and the skin. This form of therapy requires a careful approach to prevent thermal damage to the skin.
The power density on the skin may vary through variation of the two parameters mentioned above: output power and distance to skin.

Procedure for a single session with the Opton/Opton*Pro* laser

As already indicated, the laser therapy with the Opton/Opton*Pro* laser can be administered statically or dynamically. The purely static therapy focuses only on trigger or isolated pain points as well as on acupuncture points; the dynamic therapy focuses on an area of pain.
It is recommended that both methods be used in succession during a session.

1st step: Targeted radiation of the pain and trigger points until the pain threshold has been reached
2nd step: Dynamic laser treatment in the therapy area

Combined treatment, static and dynamic

In the case of the combined treatment, it should be ensured that the static application is performed first at pain and trigger points. The procedure is described under "static treatment". Then the therapy with the dynamic application is continued over larger areas.

Static treatment

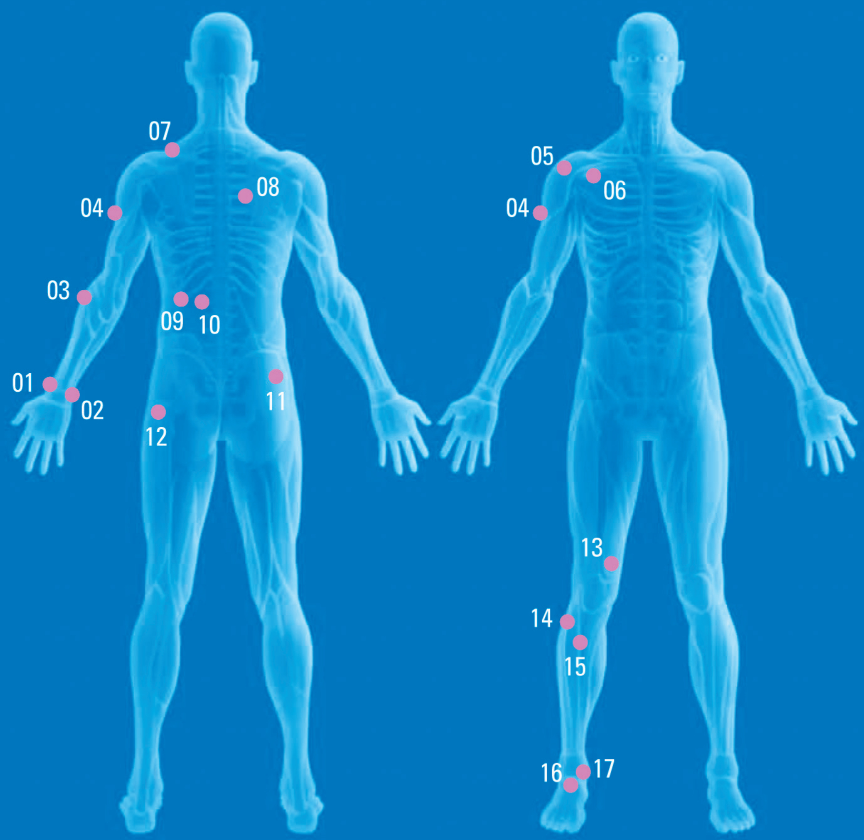
First the pain and trigger points are palpated for static treatment.
Then the thermal threshold is determined according to the above criteria with a starting dosage of 2 watts.
The treatment is then performed with the output power determined in the test.
Each pain point and trigger point is treated.
In doing so, it should be noted that trigger points are frequently outside of the area of pain.
Attention should be paid to skin types, even in the case of static treatment.

Point treatment technique

A pain or trigger point should now be irradiated until a total energy level of 10-20 J is reached, depending on tolerance (pain threshold).
In doing so, serial pulses are used, depending on skin type; irradiation is performed until the patient perceives a noticeable level of heat. Heat-related pain should not occur.
If excessive heat is felt, the laser power is reduced until the feeling of excessive heat disappears.
In doing so, a short break can be taken.

Dynamic treatment

The treatment should be divided into cycles whereby a cycle should be ended in each case if heat-related erythema occurs. In this case, the distance between the applicator and the skin should be increased or the power output should be reduced. If there is significant redness of the skin and/or heat-related pain, a break should be taken to cool the skin and the treatment should thus be divided into cycles.
Therefore the treatment time corresponds to the power density and the treatment area, whereby 1 joule is transmitted per second and watt.
Daily treatments are recommended.
In acute stages, the series should consist of at least five treatments and in chronic stages, experience has shown that it should consist of ten treatments.
The minimum is two sessions per week.



01 Thumb extensor tendons
02 Between the 5th metacarpal and the hamate bone
03 Extensor carpi radialis longus muscle
04 Deltoid muscle at the insertion at the humerus
05 Fossa between anterior and medial deltoid
06 Pectoralis minor muscle
07 Trapezius muscle
08 Rhomboid muscles
09 / 10 Quadratus lumborum muscle
11 Gluteus medius muscle
12 Piriformis muscle
13 Vastus medialis muscle
14 Peroneus longus muscle
15 Tibialis anterior muscle
16 Dorsal foot
17 Approx. 2 cm medial to the medial malleolus (tendon of the ant. tibialis muscle)

Contraindications

Caution
Thermal skin damage frequently occurs if the dosage is too high. If there are any local or generalised sensitivity disorders present, the thermal threshold test cannot be performed. In this case, the skin should be regularly inspected for redness or other signs of a thermal reaction.

- Fresh haematomas
- Malignant, semi-malignant and benign tumours
- Treatments in the area surrounding the eye
- Pregnancy
- In the region of the abdomen and lower back during menstruation

Particular caution is required when administering treatment near the ear, nose, mucous membranes and blood vessels. Direct radiation must be avoided.

If there are skin diseases, metabolic diseases or inflammatory diseases, the physician should be consulted prior to treatment.

Therapy methods with the Opton/Opton*Pro* laser

To determine the suitable power for each skin type, a thermal threshold test should be performed before any therapy.

Overview table for Caucasians

Static method	Single pulse	For pulse parameters, see below Spacer 1: 3.1 cm^2	
	Serial pulse	For pulse parameters, see below Spacer 1: 3.1 cm^2	Radiation until a noticeable level of heat develops
Dynamic method	Continuous	Spacer 2: 9.0 cm^2	Patient should perceive warmth during the entire radiation
Semi-static method	Continuous	Spacer 1: 3.1 cm^2 Spacer 2: 9.0 cm^2	The treatment is performed with this laser power at each point until a noticeable feeling of heat develops, then switch to the next point

Maximum pulse width limits depending on skin type

	Pale skin	Brown/olive-coloured skin	Black skin
Skin type	I/II	III/IV/V	V/VI
Single pulse	1 s	0.5 s	0.1 s
Serial pulse	0.5 Hz	1 Hz	1 Hz

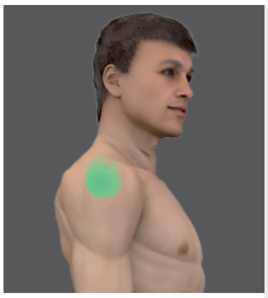
Laser therapy guidelines:

Skin types (Caucasian) I – IV			Skin types V – VI
Orthopaedic indications			Dosage following the thermal threshold test; specifications cannot be given
Subacute/acute	Dynamic	30 J/cm^2 max 50 J/cm^2	
	Static	10 J/cm^2 max 30 J/cm^2	
Chronic	Dynamic	50 J/cm^2 max 100 J/cm^2	
	Static	20 J/cm^2 max 80 J/cm^2	
Dermatological indications			
With skin lesion (blister, ulcer)		10 J/cm^2	
For intact skin		20 J/cm^2 max 50 J/cm^2	

Myopathy, tendinopathy

The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

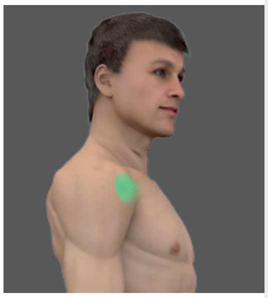
Humeroscapular periarthritis ("frozen shoulder")



Dynamic surface treatment of the acromion:
50 J/cm^2

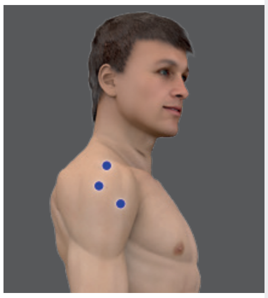
Infraspinatus muscle and insertional tendinopathy

Static trigger point treatment:
20 J per point

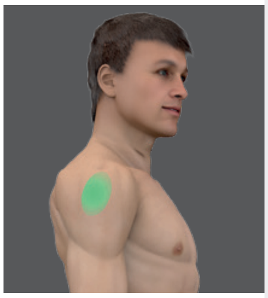


Combined local treatment of the insertion of the infraspinatus tendon, static and dynamic:
50 J/cm^2

Supraspinatus muscle and insertional tendinopathy



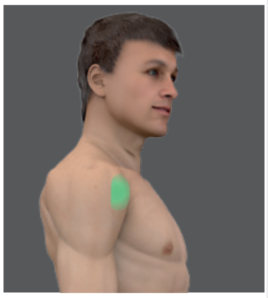
Static trigger point treatment:
20 J per point



Combined local treatment of the insertion of the supraspinatus tendon, static and dynamic:
50 J/cm^2

The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

Biceps longus tendon



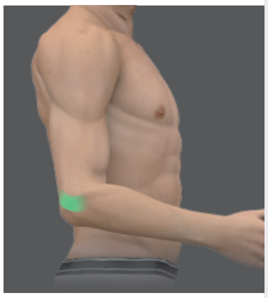
Combined local treatment, static and dynamic:
50 J/cm²

Insertional tendinopathy of the adductors

Dynamic surface treatment:
50 J/cm²

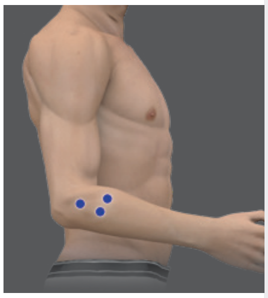
Static trigger point treatment:
20 J per point

Radial epicondylopathy



Dynamic surface treatment:
50 J/cm²

Combined local treatment, static and dynamic:
50 J/cm²



Static trigger point treatment:
20 J per point

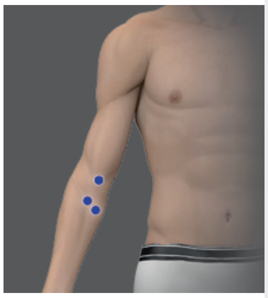
Myopathy, tendinopathy

The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

Ulnar epicondylopathy

Dynamic surface treatment:
50 J/cm²

Combined local treatment, static and dynamic:
50 J/cm²



Static trigger point treatment:
20 J per point

Patellar tendonitis

Dynamic surface treatment:
50 J/cm²

Tendinopathy of the greater trochanter

Dynamic surface treatment:
50 J/cm²

Achillodynia

Dynamic surface treatment:
50 J/cm²

The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

Plantar fasciitis

Dynamic surface treatment:
50 J/cm²

Insertional tendinopathy of the pes anserinus

Dynamic surface treatment:
50 J/cm²

Low back pain

Painful muscle tension

Dynamic surface treatment:
50 J/cm²

Static treatment of trigger and irritation points:
20 J per point

Sciatica

Static trigger point treatment:
20 J per point

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The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

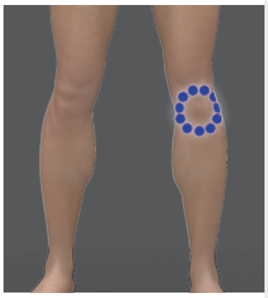
Facet syndrome

Combined local treatment, static and dynamic:
50 J/cm²

Osteoarthritis

Osteoarthritis of the knee

Dynamic surface treatment of the quadriceps tendon and at the joint space:
50 J/cm²



Static point treatment:
20 J per point

Osteoarthritis of the base of the thumb

Dynamic surface treatment:
50 J/cm²

Spondylarthrosis, cervical

Dynamic surface treatment:
50 J/cm²

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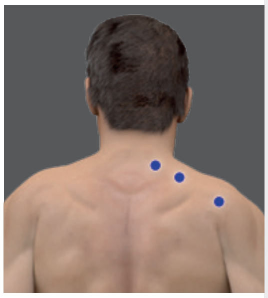
The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

Spondylarthrosis, cervical

Static treatment of the segmental irritation zones (C4 – C7):
20 J per point



Combined local treatment of muscular irritation points static and dynamic:
20 J per point

Traumatological diseases

Ankle sprain

Dynamic surface treatment:
50 J/cm^2

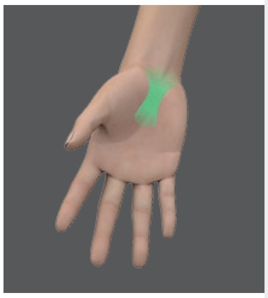
Pulled muscle, torn muscle

Dynamic surface treatment:
50 J/cm^2

The dosage information in joules should be understood as the minimum amount of energy which is to be transferred.

Impingement syndromes

Carpal tunnel syndrome



Dynamic surface treatment:
50 J/cm²

Morton's neuralgia

Dynamic surface treatment:
50 J/cm²

Skin diseases

Acne vulgaris

Dynamic surface treatment:
20 J/cm²

Herpes simplex

Dynamic surface treatment:
20 J/cm²

Plantar warts

Static treatment:
20 J per point

Anogenital warts

Static treatment:
20 J per point

Impaired wound healing

Dynamic surface treatment:
10 J/cm²

Venous ulcer

Dynamic surface treatment:
10 J/cm²

Decubitus ulcers

Dynamic surface treatment:
10 J/cm²

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For your notes

Laser therapy manual

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