TREATMENT ATLAS

K·LASER™ USA

Version 2.0

TRAINING MANUAL & TREATMENT ATLAS

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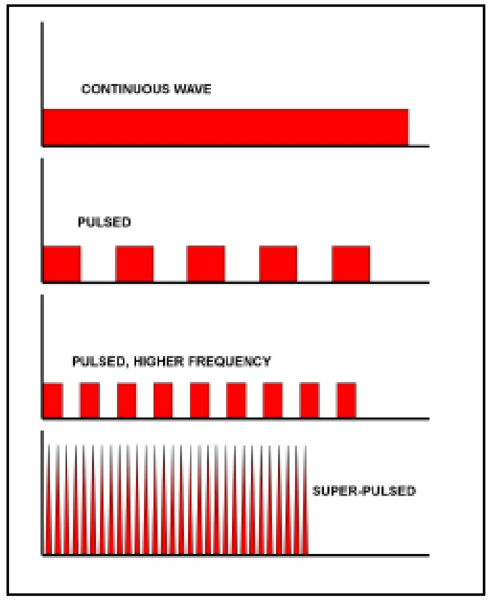
INTRODUCTION

Welcome to K-LaserUSA! Your K-Laser is the most advanced Class IV Therapy Laser available, with the power and versatility you need to treat a wide variety of conditions. The K-Laser has been designed for ease of use and maximization of your clinical results.

The K-Laser was the first Class IV Therapy Laser to deliver dual infrared wavelengths through a single fiber. Those wavelengths can be delivered in combination or you can choose to use the 790nm wavelength or the 970nm wavelength alone.



The K-Laser can also deliver therapeutic laser energy in a variety of modes: continuous wave; pulsed at a wide range of frequencies; or SuperPulsed. The therapy presets preprogrammed in the K-Laser can deliver a combination of pulsed frequencies and continuous wave that will be most beneficial for specific conditions.

You can also design your own presets and save your most-used settings into a 'Favorites' menu. Developing your own presets and giving single wavelength treatments should only be done after you have mastered the normal presets.

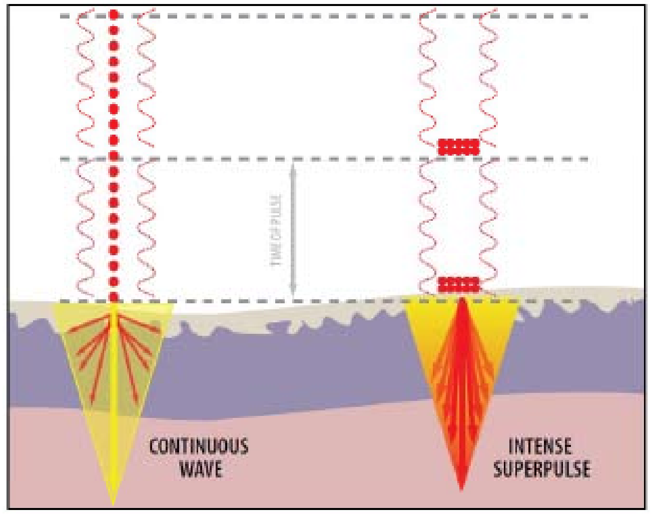
The K-Laser Training Manual and Treatment Atlas will give you a wealth of information. Each section of the Treatment Atlas will give you treatment suggestions and clinical pearls, as well as the lists of muscles that could be the location of myofascial trigger points that will be causing or contributing to pain in the area of complaint.

There are two types of treatment delivery, Scanning and Pushing. In the scanning technique, you will sweep the wand over the treatment area in a grid-like pattern. When scanning, have the treatment wand in contact with the skin if possible; this produces a consistent spot size, thus a consistent power density and in the end more consistent clinical results. But if going over broken skin, or for any other reason, you can also scan with the wand 1-2 cm off the skin. Do your best to maintain a consistent spot size and hold the wand perpendicular to the surface. You will always use the scanning technique when the K-Laser is in continuous wave mode, but you can also scan when in pulsed or superpulsed modes.
The pushing technique is used when the K-Laser has switched into pulsed mode. This means the laser light is flashing on and off between 2 and 20,000 times per second. The number of pulses per second is called the 'pulse frequency'. When operating in pulsed mode, the average power output is half that it would be in continuous wave mode, because the laser is effectively 'on' half the time and 'off' half the time. (The 'duty cycle' is 50%.) If indicated, you can pause for a few seconds on one spot when the K-Laser is in pulsed mode.

The pushing technique refers to using the treatment wand as a pressure treatment device. You can apply mild pressure to trigger points which enhances the treatment effectiveness. Using mild pressure also compresses superficial tissues, which forces blood out of the superficial capillary beds to facilitate deeper laser penetration.

The K-Laser Therapy Presets are arranged by body part, and subdivided by clinical indication. There are settings covering Head and Neck, Shoulder and Upper Extremity, Back, Hip and Lower Extremity. Within the Head and Neck division you will find settings for Headache, Cervical Pain and Jaw Pain. Under each of those you will find subdivisions for Acute Pain, Chronic Pain, Inflammation, and Edema (some areas do not have all four subdivisions.) The precision of the K-Laser Therapy Presets ensures that you are delivering the most effective treatment possible for each specific condition. Be sure to read the later section on the benefits of laser therapy pulse frequencies.

There also is a section of Miscellaneous settings, as well as a place for you to input your own ten Manual Settings. You can also save your top ten used treatments into the "Favorites" section



Once a preset is chosen, you have the option of using 'CW' mode or 'ISP' mode. While the abbreviation 'CW' does stand for continuous wave, please keep in mind that this option will deliver both normal pulsed laser and continuous wave during the course of the preset.

If the 'ISP' mode is chosen, the K-Laser will deliver Superpulsed laser energy only.

K-Laser Superpulse should be used for a variety of reasons: treating a patient with dark skin color, if the target tissues are very deep, if the body part is very thick, or as an alternative treatment in the event the condition does not respond to 'CW' mode. This is covered in more detail in a later section.

Once a preset is chosen, you have the option to increase or decrease the power. The power of the K-Laser determines the brightness of the laser light emitted, just as with an ordinary light bulb. Lower power produces dimmer laser light and would be used on superficial targets, thinner body parts and more acute conditions. Higher power means brighter laser light, and would be used for deeper targets, thicker body parts and more chronic conditions.

The K-Laser is a powerful tool and you should resist the temptation to increase the wattage for every patient. There are certainly times when it is clinically indicated to use high power, but in many cases using too much power can unnecessarily exacerbate the patient's condition, and they may drop out from care. Use the chart of suggested power settings which is found in a later section.

Remember that K-LaserUSA has experienced clinicians available for free telephone support if you need advice on the specific settings to use.

LASER THERAPY GLOSSARY OF TERMS

Aperture: Any opening through which laser radiation can pass. A variable aperture has the capability to produce a variable output laser spot size. The K-Laser Zoom Handpiece is an example of a variable aperture.

Arndt-Schulz Law: According to the Arndt Schultz Law, substances vary in action depending on whether the concentration is high, medium, or low, and in general states that weak stimuli accelerate physiological activity, moderate stimuli inhibit and strong stimuli halt activity. It has been applied to homeopathic doses, antibiotic dosage, laser therapy dosage and other fields. Biostimulation with therapy lasers has been reported with dosages from 0.001 to more than 10 J/cm2. K-LaserUSA recommends a dosage of 2-10 J/cm2 for most conditions. (See section on Laser Therapy Dose, p. 21)

Average Power: The total energy (in Joules) imparted during a laser session divided by the total time (in seconds) of the exposure duration. Average power is measured in Watts, and is displayed on the K-Laser as "Wm".

Aversion Response: Movement of the eye, eyelid or head to avoid an exposure to a noxious stimulant or a bright light. It can occur within 0.25 seconds, including the blink reflex time. (ANSI)

Biomodulation: The process of changing the natural biochemical response of a cell or tissue within the normal range of its function, stimulating the cell's innate metabolic capacity to respond to a stimulus. A cell can heal itself by this stimulation mechanism.

Chromophore: Part of a molecule responsible for its color. In biological molecules that serve to capture or detect light energy, the chromophore is the component that causes a conformational change of the molecule when hit by light. The primary chromophore involved in laser therapy is cytochrome-C Oxidase, the rate-limiting enzyme in the electron transport system.

Class 3A Lasers: Generally have an output of 0.005 Watts (5 milliwatts). Class 3A lasers can cause eye injury and have wavelengths in the visible range only. It takes 3 1/3 minutes for a 5mW laser to produce one Joule of energy. (Examples: Erchonia, laser pointer)

Class 3B lasers: May have an output power of up to 0.5 watts (500mW) per emitter. There may be multiple emitters contained in one applicator, thus allowing total powers in excess of Class 3B limits without actually requiring the device to be reclassified as Class 4. Class 3B lasers are capable of injuring eyes from direct viewing or reflection of the beam. Class 3B lasers are used as therapeutic devices and are generally safe for skin exposure. However, patients may feel discomfort with darker skin or if areas of dark pigmentation (birthmarks, tattoos) are irradiated. (Examples: Chattanooga, Apollo)

Class 4 lasers: The output power of a single emitter exceeds 500mW. Class 4 lasers are capable of causing both optical injury and thermal injury to the skin, but in the hands of a trained clinician, class 4 therapy lasers are a very powerful and effective and safe therapeutic tool. In the laser classification scheme, Class 4 is the highest, so all lasers above 500mW are Class 4. (Examples: K-Laser, LiteCure, Avicenna)

Coherence: A property of monochromatic electromagnetic waves that are synchronized so that all 'crests' and 'troughs' are aligned. Laser light has the special quality of coherence. Light produced by light emitting diodes (LEDs) or super-luminous diodes (SLDs) is not coherent.

Cold Laser: A nickname given to early low-level lasers that were used in therapy. In contrast with high-powered lasers at the time that were used for surgical procedures, hair removal or cosmetic procedures, these low-level lasers did not impart a thermal effect to the skin. Their extremely low power earned the nickname "cold". This term could also be applied to the K-Laser: it is 'cold' in the sense that the intended outcome is pain relief and tissue stimulation, and not cutting or hair removal.

Collimation: A property of light commonly associated with lasers and accomplished with focusing lenses to maintain the beam in a tight focus. True laser systems focus all of their energy in one direction in a very concentrated line. Diode lasers do not emit collimated light, and therefore collimation into a beam requires a collimating lens.

Continuous wave (CW) emission: Energy emitted in a continuous manner, as in a light that is constantly 'On'. In continuous wave emission the average power is equal to the peak power.

Cythochrome C Oxidase: A large protein complex found in the walls of the mitochondria. It is the terminal enzyme in the respiratory electron transport chain. It has recently been discovered to be the chromophore responsible for the upregulation of ATP output as a result of laser therapy.

Divergence: The increase in diameter of the laser beam with propagation distance from the exit aperture. (ANSI)

Dosage: See energy density

Duty cycle: For modulated laser emission, it is the fraction of time that the laser is 'On' and is usually expressed as a percentage. When operating in Pulsed mode, the K-Laser is at a 50% duty cycle which means over any given period of time, the laser light is "on" half the time and "off" half the time.

Electromagnetic Spectrum: The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. The sun, earth, and other bodies radiate electromagnetic energy of varying wavelengths. Light is a particular type of electromagnetic radiation that can be seen and sensed by the human eye, but this energy exists at a wide range of wavelengths.

Energy: The capacity for doing work, and is measured in Joules (J). Can be calculated by multiplying power (watts) by time (seconds), $E = P \times t$.

Energy density: The total energy in Joules is divided by the total area treated, in cm2. A measure of the amount of energy being delivered to a particular area on a surface, stated in Joules per square centimeter (J/cm2). The energy density given during a Class IV laser therapy treatment is typically between 2 and 10 J/cm2. Also referred to as radiant exposure and dosage.

Frequency: In relation to light and lasers, the term "frequency" is used in two different ways – be aware of the distinction.

1. The frequency of light is inversely proportional to its wavelength, and is dependent upon the energy value of the individual photons being emitted. The shorter the wavelength of light, the higher its frequency and the higher the energy of the photons. Ultraviolet light has a higher frequency than infrared light. Ultraviolet photons carry more energy than infrared photons; and ultraviolet light can ionize molecules, whereas infrared light cannot.
2. Frequency can also be used to describe the pulse repetition rate of a pulsed or superpulsed laser. It gives the number of pulses per second (the number of flashes 'on' and 'off'), and is measured in Hertz, Hz. The K-Laser has a pulse range from 2 to 20,000Hz.

Grotthus-Draper Law: "Only that light which is absorbed by a system can bring about a photochemical change." It was first proposed in 1817 by Theodor Grotthuss and John W. Draper, and is also called First Law of Photobiomodulation or the Principle of Photochemical Activation. Cells must "see the light" to be affected by laser therapy, there must be interaction between photons and target cells for photobiomodulation to occur.

Infrared radiation: Non-ionizing electromagnetic radiation within the wavelength band from 700 to 1000nm.

Joule: A unit of energy. Joule = Watt x second

Laser: A device that emits electromagnetic radiation through a process called stimulated emission.

Laser Safety Officer: The laser safety officer (LSO) is the person responsible for the laser safety program in the facility. This individual has the training and experience to administer said program. (ANSI)

Laser diode: A semiconducting device that emits monochromatic non-ionizing radiation by a process of stimulated emission. A laser beam has a number of unique properties, such as coherence, polarization and directionality, and the beam is divergent unless manipulated with additional optical devices such as lenses.

Light Amplification by Stimulated Emission of Radiation: The production of electromagnetic radiation via the process by which an electron, perturbed by a photon having the correct energy, may drop to a lower energy level resulting in the creation of another photon. The second photon is in phase spatially and temporally with the first, which produces coherent light.

Light emitting diode (LED): A semiconducting device that emits non-coherent, narrowband, non-ionizing radiation at wavelengths from 400nm to 700nm by a process of spontaneous emission. LEDs are used in multiple-emitter clusters.

Low-level Laser: A term used to describe therapeutic lasers that do not cut, cauterize or destroy human tissue. See cold laser.

Low-level laser therapy (LLLT): An emerging medical and veterinary technique in which exposure to low-level laser light stimulates cellular function leading to beneficial clinical effects; also known as photobiomodulation, cold laser therapy, and laser biostimulation. Even though some warming is felt with K-Laser treatment, it is still considered low-level laser therapy.

Maximum Permissible Exposure (MPE): The level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eye or skin. (ANSI)

Monochromatic: Monochromatic light is of a single wavelength (i.e. one specific color) though in practice it can refer to light of a narrow wavelength range. Because the wavelength of laser light determines its effect on tissue, the monochromatic property of laser light allows energy to be delivered to specific tissues in specific ways.

Nanometer (nm): Unit of measurement for wavelengths of light. One billionth of a meter (1 x 10-9m). Visible light has wavelengths from 400 to 700 nm.

Nominal Hazard Zone (NHZ): The space within which the level of direct, reflected or scattered radiation during normal operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the appropriate MPE level. (ANSI)

Nominal Ocular Hazard Distance (NOHD): The distance along the axis of the unobstructed beam from the laser to the human eye beyond which the irradiance or radiant exposure during normal operation is not expected to exceed the applicable MPE. (ANSI)

Penetration: Penetration refers to the distance an energy wave travels into the tissue before it is absorbed or dissipated as heat or molecular vibration. Penetration of laser light is dependent on many factors, but the primary determinant is wavelength. Lower wavelengths are absorbed by hemoglobin and melanin, and higher wavelengths are absorbed by water in the tissues. (See: Therapeutic Window)

Photobiomodulation: (See Low-level laser therapy). Photobiomodulation is the term that was agreed upon by the laser therapy community at the North American Association of Laser Therapy (NAALT) meeting in June 2003. When biomodulation occurs from a photon transferring its energy to a chromophore it is referred to as photobiomodulation.

Power: The rate at which energy is emitted, transferred or received. The standard international unit of power is the Watt. One Watt is equal to one Joule per second, W = J/s.

Power Density: A measure of the amount of radiation being delivered to a particular area on a surface, stated in watts per square centimeter (W/cm2). A consistent power density correlates into more consistent clinical results. K-Laser treatments have a power density around 2 W/cm2. Also known as irradiance.

Pulsed lasers: In the pulsed mode of operation, the output of a laser varies with respect to time, typically taking the form of alternating 'on' and 'off' periods (see Duty Cycle). From research we know that various pulse rates elicit different physiological responses from the tissues. Low pulse rates are analgesic, mid-range rates are biostimulatory, higher rates are anti-inflammatory and highest pulse rates are antimicrobial in nature. The body's sensitivity to any steady stimulus diminishes over time. Varying the pulse rate helps to ensure a better response.

Figure 1: Physiological Effects of Laser Pulse Frequencies
Source: Laser Therapy-Clinical Practice and
Scientific Background, p. 78.

Pulse rate, Hz	Indication
2-50	Pain
500-700	Biostimulation
> 2,500	Inflammation
> 5,000	Antimicrobial

Retracing: The conversion of condition from chronic back to acute. From time to time, a patient will experience an increase in pain following treatment. It is NOT an adverse reaction, but indicates that the laser treatment is working. Patients will frequently observe improvement once this pain subsides within 24-hours. This is a normal process. Always advise the patient in advance of the possibility of the pain response or they may assume that the laser has caused them harm.

Super-luminous light emitting diode (SLD): Super-luminous light emitting diodes generally emit at a lower optical power than LED's, but in a narrower spectral range. Radiation emitted by SLDs has a much shorter coherence length than that produced by lasers. Despite the widespread use of the term by manufacturers, SLDs are NOT used in multi-emitter clusters as they are too expensive and convey no greater therapeutic benefit than LED's.

Super-pulsed emission: Energy emitted in a single pulse, or train of pulses, in which the duration of each pulse is less than 25 milliseconds. The average power of a super-pulsed emission is calculated by multiplying the peak power, pulse duration and frequency of pulsation. The K-Laser superpulse has a peak power of 15 Watts, and when pulsing 20,000 times per second has an average power output of 6 Watts.

Therapeutic Window: Therapeutic laser light is primarily absorbed by the hemoglobin, melanin and water in human tissue. These three components each have a unique absorption curve that is dependent on the wavelength of the laser light. Hemoglobin and Melanin absorb more at the shorter wavelengths, around 630 nanometers. Water absorbs more of the laser light above approximately 960 nanometers. The three absorption curves have a relative minimum around 800 nanometers. Laser light in the range of 780nm to 810 nm penetrates the deepest into human tissue.

Visible radiation: Non-ionizing electromagnetic radiation within the wavelength band from 400nm to 700nm that can be seen by the human eye.

Watt: The unit of power or radiant flux. Watt = Joule per second

Wavelength: The distance between two successive points on a periodic wave in the same phase. Due to the short wavelengths of light and infrared radiation, this is often expressed in nanometers. For laser light, wavelength is the prime determinant of tissue penetration.

LASER HISTORY AND SCIENCE

Albert Einstein (1879-1955) did not invent the laser, but his work laid the foundation for its invention by Theodore Maiman in 1960. In 1917 Einstein published an article that proposed the possibility of stimulated emission, the physical process that makes the laser possible. Credit for the invention of the laser is given to Theodore Maiman, a physicist who discovered a way to emit a short-lived, intense and powerful beam of red light from a ruby laser.

In 1967, Hungarian scientist Endre Mester experimented with the effects of laser on skin cancer in mice. He observed that shaved hair grew back more quickly on the mice treated with the Helium-Neon laser. He published multiple papers throughout the 60s, 70s, and 80s on scientific investigation and therapeutic application of ruby laser and helium neon laser and is now honored as "The Father of Laser Therapy".

Therapy lasers have been used in Europe and Russia since 1967, giving the Europeans and Russians a head start in laser therapy equipment development, laser therapy research, treatment techniques, and general knowledge of laser therapy. The first therapy laser gained FDA clearance in 2002 and the first Class IV therapy laser gained clearance in 2005.

More than 2000 research studies have been conducted to date demonstrating the various benefits of laser therapy. Cellular and tissue effects have been demonstrated across a wide range of wavelengths and dosages. The most common reason for a negative outcome in a laser therapy study is too low a dosage.

An appropriate dosage of laser therapy (2-10 J/cm2) has been shown to have no adverse effect on normal healthy tissue, and in fact the therapeutic laser photons tend to be more readily absorbed by weakened, damaged or diseased cells. Therefore, delivering a dosage of 2-10 J/cm2 over a broad area of tissue has no harmful effect; and it increases the likelihood of all the diseased tissue being treated. The only therapeutic laser that is capable of delivering the dosage necessary, in a time frame that is feasible in the clinic setting, is a Class IV therapy laser.

Therapy lasers supply therapeutic energy in the form of light, which is absorbed by chromophores in the cells. The primary chromophore is cytochrome c oxidase, the terminal enzyme in the respiratory chain. Activating this enzyme increases its rate of reaction, and more adenosine triphosphate (ATP, energy) is produced in weakened or damaged cells.
A cascade of beneficial effects is set off including the following: improved cellular metabolism, vasodilation and improved blood circulation, anti-inflammatory processes, reset resting potential of pain fibers, release of endorphins, stimulation of macrophages and fibroblasts and improved nerve function.

An appropriate dose of light can improve speed and quality of acute and chronic wound healing, soft tissue healing, pain relief, improving immune system function and nerve regeneration. Low-energy photon irradiation by light in the infrared spectral range with low-energy lasers has been found to modulate various biological processes in cell culture. This phenomenon of photobiomodulation has been applied clinically in the treatment of soft tissue injuries and the acceleration of wound healing. The mechanism of photobiomodulation by infrared light at the cellular level has been ascribed to the activation of mitochondrial respiratory chain components, resulting in initiation of a signaling cascade that promotes cellular proliferation and cytoprotection.

SUMMARY

- Chromophores are stimulated by light in the mitochondria, cell membrane and other organelles of the cell
- Positive Changes in pH
- Increased ATP production
- Increased mRNA- DNA/RNA
- Increased nitric oxide (NO) release
- Suppression of PGE2 production
- Causes vasodilation
- Increases nerve conduction velocity
- Improves lymphatic drainage
- Thermal fluid gradient pressures
- Reduction of spasm
- Angiogenesis
- Immune augmentation
- Antibacterial
- Reduction in pain

PHYSIOLOGICAL AND BIOLOGICAL EFFECTS OF LASER THERAPY

1. **Accelerated tissue repair and cell growth.** Photons of light from lasers penetrate deeply into tissue and accelerate cellular reproduction and growth. The laser light increases the energy available to the cell so that the cell can take on nutrients faster and get rid of waste products. As a result of exposure to laser light, the cells of tendons, ligaments and muscles are repaired faster.

2. **Faster wound healing.** Laser light stimulates fibroblast development (fibroblasts are the building blocks of collagen, which is predominant in wound healing) in damaged tissue. Collagen is the essential protein required to replace old tissue or to repair tissue injuries. As a result, laser therapy is effective on open wounds, scars, and burns.

3. **Reduced fibrous tissue formation.** Laser therapy reduces the formation of scar tissue following tissue damage from cuts, scratches, burns or surgery. Scar tissue is the primary source of chronic pain.

4. **Anti-inflammation.** Laser light has an anti-edemic effect as it causes vasodilation, but also because it activates the lymphatic drainage system (drains swollen areas). As a result, there is a reduction in swelling caused by bruising or inflammation.

5. **Analgesia.** Laser therapy has a high beneficial effect on nerve cells which block pain transmitted by these cells to the brain and which decreases nerve sensitivity. Also, due to less inflammation, there is less edema and less pain. Another pain blocking mechanism involves the production of high levels of pain killing chemicals such as endorphins and enkephalins from the brain and adrenal gland.

6. **Improved vascular activity.** Laser light will significantly increase the formation of new capillaries in damaged tissue that speeds up the healing process, closes wounds quickly and reduces scar tissue. Additional benefits include acceleration of angiogenesis, which causes temporary vasodilatation, an increase in the diameter of blood vessels. More blood flow equals faster healing and less pain.

7. **Increased metabolic activity.** Laser therapy creates higher outputs of specific enzymes, greater oxygen and food particle loads for blood cells. The damaged cells can repair and regenerate faster.

8. **Improved nerve function.** Slow recovery of nerve functions in damaged tissue can result in numbness and impaired limbs. Laser light will speed up the process of nerve cell reconnection and increase the amplitude of action potentials to optimize muscle action. Reduce nerve pain.

9. **Immunoregulation.** Photons are absorbed by chromophores (molecule enzymes) that react to laser light. The enzyme is activated and starts the production of ATP, which is the major carrier of cell energy and the energy source for all chemical healing reactions in the cells. Long lasting pain relief occurs

10. **Trigger points and acupressure points.** Laser therapy reduces muscle trigger points and stimulates acupuncture points on a non-invasive basis providing musculoskeletal pain relief.

TIPS TO IMPROVE YOUR K-LASER TREATMENT RESULTS

Proper diagnosis: In most cases, you should notice a positive clinical response (i.e. decreased pain, increased range of motion) within three K-Laser treatments. If not, reassess your patient and review the Training Atlas for possible compensation patterns. It may take 3-20 visits to significantly improve a physical condition. Be realistic in your treatment parameters and what you promise to the patient.

Line of Drive: Aim the laser with the line of drive to the intended target tissue. Make sure the wand is perpendicular to the skin and not treating at an angle. Holding the wand perpendicular decreases the amount of reflection and increases the amount of energy delivered into the tissue. If possible, maintain contact with the end of the treatment wand to the patient's skin. This ensures a consistent output spot size, and a consistent power density, and therefore more consistent clinical outcomes. If there is a reason why you cannot maintain contact (ticklish patient, broken skin), then do your best to maintain a consistent distance from the skin surface and hold the wand perpendicular to the skin surface.

Range of motion during K-Laser treatment: Have the patient move the affected area through gentle active range of motion while you laser. For example: While treating the cervical spine, the client rotates left and right, flexion and extension. This is a very effective way to stimulate mechanoreceptors in the stabilizer muscles and joint structures. It is interactive and the perceived value is higher from the patient. Active ROM during K-Laser Treatment also helps break up adhesions in soft tissues. In very acute cases, you may want to assist the patient through passive ROM during K-Laser treatment.

Treat from proximal to distal: Laser therapy stimulates blood and lymphatic vessels to dilate. If you treat distally first, fluids that are stimulated may have nowhere to escape if flow is blocked in the tissue above. The can lead to severe inflammation and pain. Always treat proximal to distal from the center of the body towards the periphery. For example: In carpal tunnel cases, treat the cervical spine, brachial plexus and Stellate Ganglion before treating the carpals and nerves of the wrist/hand.

Pressure technique: During individual point selection use the end tip of the wand as an acupressure device when the laser is in pulsed mode (not CW mode). Don't be afraid to push into the affected area, especially muscles. The added pressure pushes away the vascular beds, giving you a greater depth of penetration. You can do trigger point work with the K-Laser wand and the guiding hand. Pay attention to the power level and don't leave it too long on one spot, or you risk burning the patient.

Treat the nerve roots: For extremity cases, always treat the nerve roots that supply the area in question. For the lower extremity, recall that the cell bodies for those nerve roots lie in the conus medullaris, which is at the T12 spinal area. Laser stimulation of the nerve roots will 'energize' those nerve roots, and most often leads to better pain management and injury healing. Apply the same treatment preset that you plan to use on the extremity, as well as the same guidelines for dosage. For example, if it is an acute extremity problem, put a lower dosage (about 200J and 4 J/cm2) into the nerve roots. Whereas if it is a chronic extremity problem, give a higher dosage (about 800J and 8 J/cm2) to the nerve roots.

Treatment schedule: There is no 'cookbook' for successful K-Laser treatments. In general, acute conditions should be treated with a lower dose and can be treated more often, even 2-3 times per day. Chronic conditions respond to a higher dose, but can be successfully treated once or twice a week. Example - Acute sprained ankle: use pulsed mode only, dose about 2-4 J/cm2, total dose around 200-400J, treat twice a day for 3 days, then once a day for 3 days. Example – Chronic ankle pain: use continuous wave + pulsed modes, dose about 6-8 J/cm2, total dose around 600-800J, treat every other day.

Ramp up the dosage: If you are too aggressive with the dosage on the first or second visit, the dosage may be too high and the patient may experience increased pain and soreness. This is typically not a bad reaction to the K-Laser treatment, but is a result of the vasodilatory and hormone-releasing effects of the K-Laser treatment. It is better to start treatment with a moderate dose, and increase as needed; than to start too aggressively and have the patient drop out of care. For most cases, we recommend that you do not exceed a dosage of 10 J/cm2.

K-Laser, heat and ice: Heat applied in the form of short wave diathermy, ultrasound, hydrocollator packs, or other ways increases the local population of red blood cells (RBC), which are very potent photoacceptors. Therefore, we recommend that you perform K-Laser Treatment before application of heat. Ice, vapocoolant spray or other tissue coolants can decrease the amount of hemoglobin and water, thus decreasing the amount of laser energy lost in superficial tissues before hitting the target tissue. Therefore, in most cases you will want to K-Laser after ice.

Skin type: Skin color affects treatment parameters. Darker skin types absorb more laser energy in the superficial tissues. Be aware that darker skin types will get warm more quickly as the melanin absorbs laser energy. You may need to increase the treatment time, to give a higher dose to account for the loss of laser energy in the superficial tissues. Be sure to use K-Laser SuperPulse (if so equipped) on your patients with darker skin types. The SuperPulse will drive laser energy deeper into target tissues without heating the surface as much as continuous wave would.

K-Laser before adjustment/manipulation/soft tissue work: Using K-Laser prior to manipulation and soft tissue work increases your success rate. Laser decreases the natural 'splinting' and 'guarding' associated with underlying stabilizer support muscles during injury. Your adjustment will be more effective, less painful for the patient, last longer and prevents the natural 'rebounding muscle memory' phenomenon. Patients will get better faster and require fewer visits to get the desired response.

K-Laser and Decompression: Doctors have reported improved clinical outcomes using the K-Laser before decompression, as well as using it after decompression. There are arguments to be made for using it in either before or after a decompression session. The main point is that whether used before or after, your patients will receive a higher standard of care with the K-Laser incorporated into their decompression plan.

Nutrition: Laser therapy enhances circulation and draws nutrition into the area. Patients with poor general nutritional status may not benefit as much from K-laser Treatments. Laser therapy is biostimulatory – it enhances the production of ATP from cells in affected tissues. One crucial nutrient for the production of ATP is Co-Enzyme Q10. This is especially true if the patient is also taking a statin drug for cholesterol reduction; statins deplete the body's supply of CoQ10. If a patient is not responding to K-Laser treatments, consider supplementing the patient's diet with at least 100mg CoQ10.

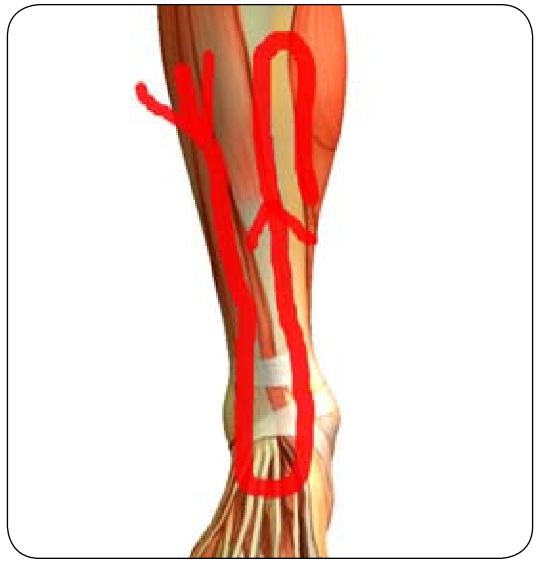
Geriatric Patients: Keep in mind that some geriatric patients may have increased sensitivity to K-laser treatments, and may have reduced temperature sensation. Give geriatric patients a lower dose on the first visit than you would with a younger patient. Monitor them on subsequent visits – if they are feeling no affect, gently increase the dose and if they are experiencing increased pain and soreness, decrease the dose. Use the "trailing finger technique" to assess skin temperature during the treatment.

Metal Implants: It is safe to deliver K-Laser Treatment directly over metal implants, whether they be knee or hip joint replacements, rods in the spine, or other metal implants. First, any heating that does happen during a K-Laser Treatment is minimal. Second, the tissue components are absorbing the laser energy and heating. There is no heating of the metal in the implant. Patients with joint replacements are often in chronic pain due to the altered threshold of their pain fibers. K-Laser Treatment can usually give these patients substantial pain relief.

K-LASER DELIVERY TECHNIQUES

There are two basic ways to deliver the K-Laser treatment: scanning and pushing.
This section will discuss the two delivery methods.

'Pushing' is normally done when the K-Laser is in the pulsed mode. You can pause and hold the K-Laser treatment wand in one place for a few seconds, if clinically indicated. You can also use the treatment wand as a pressure device to work on trigger points, giving the combined benefit of pressure with K-Laser energy.
Do not use pushing when the K-Laser is operating above 3 Watts in continuous wave mode.



The scanning technique means that you are moving the wand at a constant speed, sweeping it over the treatment area. When doing this, you are painting the treatment area, giving it a dosage of laser energy. Scanning is usually done when the K-Laser is producing continuous wave laser, but you can also scan when in pulsed or superpulsed modes.
When scanning, be sure to cover the entire area and do not focus on just one tiny spot. All conditions benefit from treating the surrounding healthy tissues, through vasodilation, improved vascular activity, biostimulation, and release of endogenous hormones. Healthy tissues can absorb a great deal of laser energy without any deleterious effect.
Scan the treatment area in a back and forth, up and down motion to make sure that all tissues are receiving beneficial K-Laser energy.

Be sure to hold the treatment wand perpendicular to the surface you are treating. This minimizes reflection from the skin surface and ensures the maximum penetration of beneficial K-Laser energy.

CLASS IV THERAPY LASERS: MAXIMIZING THE PRIMARY EFFECTS OF LASER THERAPY

by Dr. Julian Vickers, DC, DABCO, DACAN and Dr. Phil Harrington, DC

A rapidly growing number of progressive health care providers are adding Class IV therapy lasers to their clinics. By maximizing the primary effects of the photon-target cell interaction, Class IV therapy lasers are able to produce impressive clinical results and do so in a shorter period of time. A busy office interested in providing a service that helps a variety of conditions, is cost-effective, and is being sought out by an increasing number of patients should give a serious look at Class IV therapy lasers.

First theorized by Albert Einstein in 1916, and invented by Theodore Maiman in 1960, the laser has become one of the most beneficial inventions used in modern society. For the clinician, the most exciting use was first discovered by Hungarian physician Endre Mester, who performed experiments on cancerous tumor in rats. He found the laser didn't kill tumor cells because it was underpowered for that purpose, but rather it accelerated wound healing in the surgical sites of the experimental rats, as well as causing the shaved hair to regrow more quickly.

Therapy lasers have been used and researched extensively in Europe for more than 30 years. However, the United States Food and Drug Administration (FDA) only cleared a low level laser in 2002, and the first class IV therapy laser in 2003. Low Level Laser Therapy (LLLT) and it's known effects have already been reviewed extensively in this journal. The most important clinical and therapeutic difference between Class IV Laser therapy and LLLT is that the Class IV is able to produce a primary biostimulative effect on deeper tissues than lower powered lasers while also producing substantial secondary and tertiary effects.

The FDA approved indications for use of Class IV laser include the following: relief of muscle and joint aches, pain and stiffness; relaxation of muscles and muscle spasms; temporary increase in local blood circulation; and relief of pain and stiffness associated with arthritis.1

Lasers are classified by output power and hazard to the eye, with the potential for thermal injury being the guiding mechanism. The Maximal Permissible Exposure or MPE is the level of laser radiation to which a person may be exposed without hazardous effects in the eye or skin. A system of hazard classification has been developed and is part of the ANSI Standard and State Regulations, however it is usually more convenient to establish safety controls based on the laser class than use of the exposure limits. In general, Class IIIa lasers have power output of 1 to 5 milliWatts (1-5mW), Class IIIB includes those up to 500 mW, or 0.5 Watts, and Class IV lasers include all of those above 0.5 Watts.

The classification scheme makes no distinction between the Class IV therapy lasers, cosmetic and hair removal lasers, surgical lasers, and the military laser capable of shooting down a satellite. All of theese are greater than 500 mW, and therefore all of them are Class IV. Lumping together every laser with power output greater than 500 mW is somewhat unfortunate, and has led to misunderstandings and discussions on several state physician licensing boards. One state chiropractic board first balked at the notion of its members using Class IV lasers, assuming that the intended usage was hair removal or a cosmetic procedure. However, after proper education and demonstration with a Class IV Therapy Laser, the board unanimously approved the use of such devices when used in a manner consistent with the scope of practice.

The most common Class IV therapy laser uses a Gallium-Aluminum-Arsenide (GaAlAs) semiconductor diode to produce infrared laser beams capable of deep penetration into tissue. The diodes may produce continuous wave, or pulsation frequencies of 2-10,000 Hz with a 50% duty cycle. Typically the laser diodes are housed in a control unit, and the infrared laser beams are carried by a fiber optic cable, through which coherence is maintained. The beam produced by a Class IV therapy laser is not collimated; it is allowed to naturally diffuse at a 10-12º angle. Spot sizes will range from 10 to 25 millimeters in diameter, giving spot areas of 0.8 to 5 cm2. Common power densities will range from 0.4 to 3 W/cm2.

Wavelength is the main determinant of the laser's depth of penetration into the tissue. Hemoglobin and melanin absorb photons at lower wavelengths and water absorbs those of higher wavelengths. There is an optical window around 790 nm, where the laser photons are absorbed least by these three components and penetrate the deepest. These deep penetrating infrared lasers are ideal for pain management therapy. Other factors affecting the depth of penetration are the technical design of the laser device and the treatment technique used.

There is no exact limit with respect to the penetration of the light, as the laser light gets weaker the further from the surface it penetrates. There is a point at which the laser photon density is so low that no biological effect of the light can be measured. The biologically effective depth of an infrared therapy laser – for primary photon-tissue interactions – is conservatively stated as four centimeters. Secondary and tertiary photobiomodulation effects will be observed much deeper, as well as systemically.

To summarize, the primary response is elicited when photons emitted by the laser reach the mitochondria and cell membranes of low lying cells such as fibroblasts where the energy is absorbed by chromophores and is converted to chemical kinetic energy within the cell. These primary effects are very predictable and are produced only by phototherapy.

Secondary reactions lead to the amplification of the primary actions. A cascade of metabolic effects results in various physiological changes at the cellular level such as changes in cell membrane permeability. Calcium is released from the mitochondria triggering changes in intracellular calcium levels which stimulates cell metabolism and the regulation of signaling pathways responsible for significant events required for wound repair such as cell migration, RNA and DNA synthesis, cell mitosis, protein secretion and cell proliferation.

Tertiary effects are induced at a distance from the cells in which the secondary events occur. Energized cells communicate with each other and with nonirradiated cells through increased levels of cytokines or growth factors. This results in intercellular communication and an increase in the immune response with the activation of T-lymphocytes, macrophages and number of mast cells. An increase in the synthesis of endorphins and decrease in bradykinin results in pain relief. The tertiary effects are the least predictable because they rely on intercellular interactions and a number of environmental variables.6

Chromophores absorb laser photons with wavelengths between 400 and 1100 nanometers, with those in the 790 nm neighborhood being the deepest penetrating, as discussed earlier. Photons incident on tissue will reflect, absorb, transmit or scatter. With a Class IV infrared laser, the scattered photons create an egg-shaped volume of treated tissue. The effective depth of penetration is roughly four centimeters, meaning that the primary interaction of photon with target cell will occur through that depth.

Dosage refers to the amount of energy per unit area applied to the tissue surface. Energy is measured in Joules, the area in square centimeters and thus the dosage in Joules per square centimeter, J/cm2. The power of a laser is the rate of energy delivery and is measured in Watts, or milliwatts, and one Watt equals one Joule per second. Class IV therapy lasers have power output from 0.5 to 10 Watts. As an example, a laser operating at 6 Watts continuous wave would deliver 360 Joules in one minute, and 180 J/min in pulsed mode. If the treatment area was 50 cm2, the dosage would be 360 J / 50 cm2, or 7.2 J/cm2 in continuous wave, and 3.6 J/cm2 in pulsed mode.

Biostimulation has been reported with doses from as low as 0.001 J/cm2 to as high as 10 J/cm2. This wide range is explained by the vast differences in irradiating tissue cultures in a laboratory and treating a deep-lying condition in a clinical setting. The matter of correct dosage is very complicated, as a number of factors must be taken into account including wavelength, power density, type of tissue, condition of the tissue, acuteness or chronicity of the problem, pigmentation, treatment technique, etc. Nonetheless, there is a dosage window below which no biostimulation will occur and above which it is inhibited, most easily demonstrated in wound healing and stimulation of hair growth.7

Numerous studies have supported the use of higher doses of laser irradiation. In one study, irradiation of in vitro rabbit articular chondrocytes with 4-6 J/cm2 demonstrated substantial biostimulation compared to control cultures8. In another, 13 J/cm2 increased the number of chondrocytes and the thickness of the articular cartilage in immobilized rabbit knees9. Another study supports a dosage as high as 24 J/cm2.10

Substantial amounts of the laser energy applied at the surface will be reflected, absorbed and scattered in the superficial tissues. If the target of laser therapy is several centimeters deep, a high dose at the surface will be reduced to a moderate dose in the zone of concern. At least 50% of the surface-applied energy will be lost, so a dosage of 10 J/cm2 would be diminished to 5 J/cm2 or less at a deep target.

Critics of high-powered laser therapy claim damage will occur in the overlying healthy tissue. It is said that surface doses of 10 J/cm2 or more will be harmful. However, "(i)n the treatment of healthy, optimally working tissue, almost any dose can be used without noticeable macroscopic negative effects. This is the case in the use of surgical lasers cutting, evaporating and coagulating tissue, using very high power and energy densities. Right outside the destructive zone, very high levels of power density and dose occur, but this is not found to be negative."11 In daily practice, hundreds of clinicians are safely treating thousands of patients every day with Class IV therapy lasers.

The current accepted dosage for deep-lying pain is 4-10 J/cm2, when treated with a GaAlAs diode laser12. Simple calculations show that if the condition being treated is lumbar pain, the area being treated could be 100 to 400 cm2, and even more if it is accompanied by radiculopathy. This equates to a total treatment dosage of 400 to 4000 Joules. If the treatment device was a 500 mW laser, it would take anywhere from 13 to 133 minutes to administer this dosage. However, a Class IV therapy laser could accomplish this task in less than 10 minutes.

The output wattage used with a Class IV therapy laser depends on a number of factors. A deeper target calls for a higher wattage, so that a sufficient number of photons produce the desired primary effects of photobiomodulation. For example, 2 Watts would be used for lateral epicondylitis, 5 Watts for cervical pain, or 7 Watts for lumbar pain. Clinical judgment would prompt the laser therapist to adjust these numbers higher or lower.

Class IV laser treatment is best delivered in a combination of continuous wave and various frequencies of pulsation. The human body tends to adapt to and become less responsive to any steady stimulus, so varying the pulsation rate will improve clinical outcomes14. In pulsed, or modulated mode the laser operates at a 50% duty cycle and frequency of pulsation can be varied from 2 to 10,000 times per second, or Hertz (Hz). The literature has not clearly distinguished which frequencies are suitable for various problems, but there is a substantial body of empirical evidence to support them. Differing frequencies of pulsation produce unique physiological responses from the tissue. Lower numbers, from 2-10 Hz are shown to have an analgesic effect. Mid-range numbers around 500 Hz are biostimulatory, with pulse frequencies above 2,500 Hz having an anti-inflammatory effect, and those above 5,000 Hz being anti-microbial and anti-fungal15.

An excellent treatment with a Class IV therapy laser would utilize several of these pulsation frequencies to produce a combination of analgesia, inflammation reduction and biostimulation. Effective clinical results come from finesse, rather than simply dumping high doses of continuous wave energy on the tissue.

During a Class IV laser treatment, the treatment wand is kept in motion during the continuous wave phase, and is pressed into the tissues for several seconds during laser pulsation. Patients feel a mild warmth and relaxation. Since tissue warming occurs from the outside-in, Class IV therapy lasers are safe to use over metal implants. After treatment, a clear majority of patients feel some change in their condition be it pain reduction, improved range of motion or some other benefit.

Since it is a powerful device certain safety precautions must be employed when using a Class IV therapy laser, with primary potential damage to the eyes. Infrared lasers are outside the visible spectrum so the blink reflex will not engage to protect the eyes thereby increasing the potential for damage. The Nominal Hazard Zone (NHZ) is defined as "the space within which the level of the direct, reflected or scattered radiation during normal operation exceeds the applicable MPE16." The NHZ for Class IV therapy lasers is about 21 feet. Treatment with a Class IV therapy laser should never be performed in the open.

Safe operation is not difficult when the laser therapist has basic training in laser safety. Proper training and the use of wavelength specific protective goggles by everyone in the treatment room are required by the FDA. Also, one person must be designated the Laser Safety Officer for the facility. When these simple guidelines are followed the use of a Class IV therapy laser is extremely safe.

Therapy lasers have been an exciting addition to the health care treatment arsenal. The development of Class IV therapy lasers represents the next generation of light therapy. By maximizing the primary effects, Class IV therapy lasers are able to induce extremely rapid clinical responses. Progressive health care providers wanting to offer the latest technology to their clientele should investigate Class IV therapy lasers.

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Dr. Julian Vickers (dec), DC, DABCO, DACAN graduated Palmer College of Chiropractic in 1978. In addition to caring for patients at the Laguna Beach Chiropractic Office, Dr. Vickers is an adjunct professor at the Southern California University of Health Sciences, and is the vice-president and educational chairman for the International Academy of Chiropractic Neurology. He has taught postgraduate classes in the US, Canada and Japan.

Dr. Phil Harrington, DC graduated Palmer College of Chiropractic in 1996. He had previously earned a BS in Physics from Iowa State University and taught high school physics for three years. Dr. Harrington is the Senior Vice-President and Training Supervisor for K-LaserUSA. He may be reached at pharrington@k-laserusa.com, or 866-595-7749 ext 104.

CALCULATING THE ENERGY DENSITY OF A THERAPY LASER

This article will help you calculate the energy density of a therapy laser. The pertinent physical quantities and associated units are as follows:

Before performing any calculations of energy density, be sure that all quantities are expressed in their proper units; i.e., convert time in minutes to time in seconds. The power of a therapy laser is measured in watts, and one milliwatt is one-thousandth of a watt: 1 mW = 0.001 W. Lasers used by chiropractors range in power from 5 mW up to 10 W. Convert the milliwatts to watts before doing any calculation (i.e., 5 mW = 0.005 W). You can think of the power of a laser just like the brightness of a light bulb: the higher the wattage, the brighter the laser light. Power is the time rate of delivery of energy, and the three are related by the following equation:

Power = Energy/Time

Therefore, you can calculate the energy delivered by a therapy laser by multiplying the power times the time. For example, the energy delivered by a 100 mW laser in three minutes would be (converting the 100 mW to 0.1 W and the three minutes to 180 seconds):

Energy = Power x Time = 0.1W x 180 s = 18 J

To calculate the energy density, simply divide the energy in joules by the area in square centimeters as follows:

Energy Density = Energy/Area

For example, let's say the 18 J from the previous calculation is delivered to three different areas: 100 cm2 (the area of a man's palm), 5.5 cm2 (the area of a postage stamp) and 0.4 cm2 (the area of a pencil eraser). As you can see from the chart [at right], 18 J of energy can produce widely varying amounts of energy density, depending on the size of the area being treated.

Quantity	Unit of Measurement (Abbreviation)
Power	Watts (W)
Area	square centimeters (cm2)
Energy	Joules (J)
Energy Density	Joules per centimeter squared (J/cm2)

If the laser probe is held in one spot during treatment, you will need to determine the area of the laser-output spot size. When treating a larger area, you will need to measure and calculate the area in square centimeters. One way to estimate the area is to measure the area of your palm and count the number of "palms" treated on the patient. Then multiply this number by the area of your palm.

Energy density can also be called treatment dose or fluence. 1 I prefer the term energy density to make sure it is distinct from simply "energy." Energy measures the ability to do work, whereas energy density measures the concentration of that energy over a specific area. As the chart above shows, an amount of energy can produce significantly different values of energy density. The two are not equivalent.

Area	Energy Density of 18 J
100 cm2	0.18 J/cm2
5.5 cm2	3.3 J/cm2
0.4 cm2	45 J/cm2

If the energy density is too low, it will not biostimulate tissue, but if it is too high it will inhibit healing or even cause damage. An analogy: If you spread a gallon of water over an entire parched football field, you would have very few blades of green grass, and if you dumped that entire gallon onto a very small spot, you would have mud. The key to watering grass is getting the right amount of water per unit area, and the key to laser therapy is delivering the proper amount of laser energy per unit area.

What is the right amount? "Biostimulation has been reported in the literature with doses from as low as 0.001 J/cm2 to 10 J/cm2 and more. There is a great difference between irradiating naked calls in the laboratory and treating a deep-lying pain condition. In fact, a 'dose' is a very complicated issue. It is a matter of wavelength, power density, type of tissue, condition of the tissue, chronic or acute problem, pigmentation, treatment technique and so forth. However, there is certainly a 'therapeutic dose window.'"2 In their text, Tuner and Hode suggest an energy density of 2-4 J/cm2 for superficial pain and 4-10 J/cm2 for deep-lying pain.3

The primary goal of this article is to help physics-challenged chiropractors calculate the energy density of a therapy laser. Further discussion of appropriate energy densities will be left for another column.

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EYE SAFETY FOR CLASS IV THERAPY LASERS

[Note: This article is a summary of eye safety for Class IV Therapy Lasers. It is not intended to be a substitute for the K-Laser Safety Manual. Please read the K-Laser Safety Manual in its entirety.]

Class IV therapy lasers are being used by a growing number of Chiropractors. High-powered therapy lasers have the ability to deliver a therapeutic dosage in less time, but the potential risk for injury is greater. This column will address laser eye safety in the use of Class IV therapy lasers.

All therapy procedures carry with them an element of risk, either through carelessness or by accident. Periosteal burns and cavitation are possible with ultrasound; surface burns can result from improperly used hot packs or electric muscle stimulation. Safety procedures should be in place for all therapies used in a chiropractic office.

Laser safety guidelines must be followed primarily due to the risk of eye injury. Direct exposure or reflected laser light can be focused by the lens causing damage to the retina resulting in scotoma, a blind spot in the fovea. Light incident on the eye is magnified over 100,000 times by the lens.

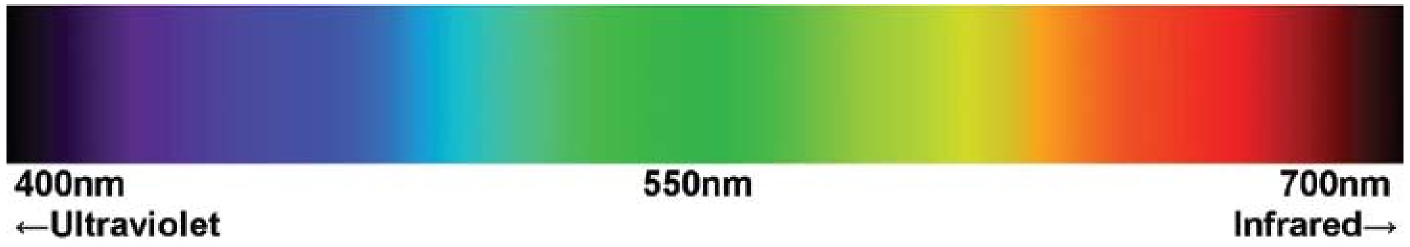

Figure 1: Visible light ranges from 400-700nm. Ultraviolet wavelengths are shorter than 400nm, and infrared wavelengths are longer than 700nm.

Visible light (see Fig.1) has wavelengths between 400-700 nanometers (nm), and therapy lasers use wavelengths between 635 and 980nm. Class IV therapy lasers use wavelengths in the near infrared so they are invisible to the human eye, but can be visualized using a digital camera (Fig. 2). Wavelengths from 400 to 1400 nm are focused by the cornea and lens and are absorbed by the retina.

Figure 2. Class IV Lasers use infrared wavelengths which are invisible, but can be photographed with a digital camera.

Power is the rate of energy delivery and is measured in Watts, equivalent to a Joule per second. Class IV lasers have power output greater than 500 milliwatts (mw), and the highest powered FDA-cleared therapy laser has a maximum power of 12 Watts (12,000mw). Just as with household light bulbs, a higher wattage indicates brighter light.

The blink reflex is "lid closure associated with the involuntary upward movement of the eye, triggered by an external event"1 such as a bright flash of light. The aversion response is "movement of the eye, eyelid, or the head to avoid an exposure to a bright light"2, and can occur in one-fourth of a second which includes the blink reflex time. Since Class IV therapy lasers use invisible infrared wavelengths, they do not trigger the blink reflex or aversion response. This is a crucial point to emphasize with those new to high-powered therapy lasers.

The maximum permissible exposure (MPE) is “the level of laser radiation to which a person may be exposed without hazardous effects…in the eye or skin”3. In the MPE calculation, the worst-case scenario is assumed, in which the eye lens focuses the light into the smallest possible spot size on the retina for the particular wavelength and the pupil is fully open. Exposure to direct or reflected laser light above the MPE can result in injury.

The nominal hazard zone (NHZ) is “the space within which the level of the direct, reflected or scattered radiation during normal operation exceeds the applicable MPE.”4 The NHZ for most Class IV therapy lasers is 21 feet. This means that all persons within a radius of 21 feet must be wearing appropriate eye protection when the laser is in operation.

Eye protection must be that supplied by the laser company. Normal sunglasses do not provide adequate protection. Laser safety eyewear is marked with the optical density (OD) – a measure of the ability to block out specific wavelengths of laser light to a safe level below the MPE5. Laser manufacturers and distributors should provide information on the MPE, NHZ and OD in the safety manual supplied with the laser equipment.

The beam from a surgical laser is tightly collimated, whereas the beam from a high-powered therapy laser is divergent. Class IV therapy lasers use diodes as the lasing material, which consists of at least two layers of a semiconductor material sandwiched together. Unlike other types of lasers (gas, solid state, metal vapor or dye), diode lasers have beams with a large divergence.6

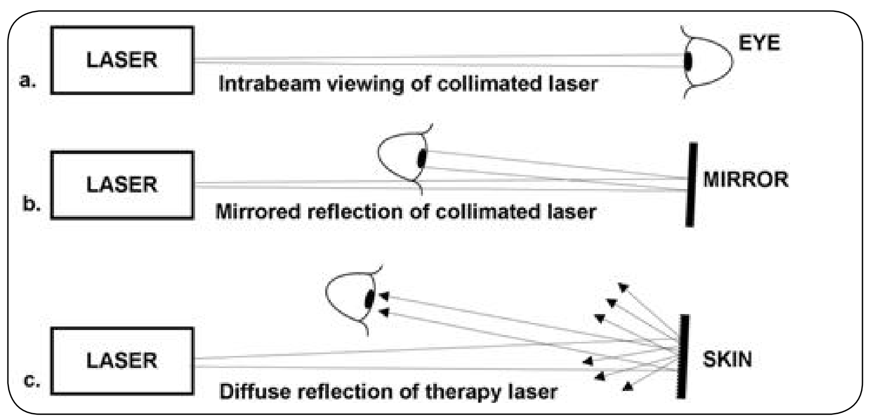

Figure 3: Conditions of ocular exposure to direct or reflected laser beams.6

When a collimated beam bounces off a highly reflective surface (Fig. 3b), the reflected beam maintains a high energy density and the possibility to cause eye damage is very high. The beam from a high-powered therapy laser is normally reflecting off a rough surface (the skin, Fig. 3c), so the reflected beams have a much lower energy density and carry a significantly reduced risk of eye injury. The mirrored reflection of a collimated laser can cause immediate blindness, whereas the diffuse reflection of a therapy laser is comparable to looking at the sun through a layer of thin clouds (see Fig. 2).

To summarize, an increasing number of chiropractors are discovering Class IV therapy lasers to be an effective modality for pain management and injury healing. They have the ability to deliver a therapeutic dosage in less time but also carry an increased risk of eye injury, and must be used in a closed room with everyone wearing laser-specific eye protection.

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LASER THERAPY DOSE CALCULATION SIMPLIFIED

The palm of the average sized hand is about 100 square centimeters. Measure yours, and remember where the 100 cm2 area compares to the actual size of your palm.

For a surface wound, biostimulation occurs when 0.5-1 J/cm2 is delivered to tissue. For our example, let’s use 1 J/cm2.

Most laser therapy experts agree that pain control requires 4-10 J/cm2, we can use 5 J/cm2 for our example.

A superficial wound about 6 cm in diameter will require treating a total area of 100 cm2 to include a small amount of healthy surrounding tissue.

Most K-Laser wound protocols are programmed to deliver 2 watts with variable frequencies to stimulate a proper tissue response. (Average 1 watt) This delivers 1 Joule/second. We would need about 100 seconds to treat this area if it were a single cell layer.

Wounds are multiple cell layers thick. Therefore, we usually would double the dose and treatment time for a wound of this size. For example, you would treat this wound for 1.5 to 2 minutes maximum. You can extrapolate this same dose by imagining how many “palms” large each wound is.

This same calculation works for deeper pain management. Let’s say you are working on the lumbar spine, treating an area two palms large. You would need 200 cm2 X 5 Joules/cm2, or 1000 Joules. In this case we recall that about half of the energy delivered penetrates below the dermis - we should multiply the dose by 2 to account for this. We need to deliver at least 2000 Joules to the area for deep pain control.

DOSAGE DISCUSSION AND EXAMPLES

Delivering the appropriate dosage to the target tissues is a key to success with K-Laser Treatments. As indicated in previous sections, laser therapy dosage is measured in Joules per square centimeter, J/cm2. It is a measure of the amount of energy per unit area that is being administered by the K-Laser.

A dosage too low will have no effect, while too much dosage will inhibit healing and may exacerbate the patient’s condition. It should also be noted that healthy cells and tissues can be treated with almost any dosage of laser therapy without noticeable negative effects. Injured and damaged cells absorb laser photons much more readily than healthy cells.

This does not mean that you should “blast away” with the highest wattage possible for all conditions. Use the suggested wattages by body part as well as the dosage suggestions so you can deliver the most effective K-Laser Treatments to your patients. The chart below is a guideline for appropriate dosage for K-Laser Treatments.

Condition	Dosage, J/cm2
Superficial wound	1-2
Superficial pain	2-4
Acute deep pain	4-6
Chronic deep pain	6-10

This chart is a guideline for dosage. With laser therapy, the practitioner has some leeway in the dosage they can deliver and still have an effective outcome. Doses with laser therapy do not have to be as exact as they do for prescription drugs. A dosage of 4.2 J/cm2 may produce a very similar effect in a patient that a dosage of 6.7 J/cm2 would. (The point is – you would not give this patient a dose of 0.3 J/cm2, or 30 J/cm2. Keep it in the ballpark of recommended dosages for best results.)

You could measure the area you area treating, but this would create an unnecessary slow-down in your treatment delivery. Estimating the area will be sufficient – the area of an apple cut in half is about 50cm2, or the area of the palm is roughly 100cm2 (measure yours to be sure.) Then you could estimate the number of apple- or palm-sized areas you are treating.

As a beginner, do your best to achieve the target dosages listed in the table, and with clinical and treatment experience you will gain knowledge and skills to deliver dosages appropriate to the patient’s condition. A few examples of dosages follow:

Example: Ankle
The treatment area encompasses the entire ankle joint complex. Apply knowledge of ankle anatomy to direct therapeutic laser light into inter-joint spaces. Improper direction will result in the laser energy being absorbed and blocked by the bone. Size of treatment area will be roughly 200 cm2, so your dosage should be about 400-800 J for acute conditions and 800-1600 J for chronic conditions.

Initiate treatment slightly proximal to the area of complaint, and work distally. Application of laser energy to proximal nerve tissues will have an analgesic effect. Have the patient dorsiflex and plantar flex during the laser treatment. Motion in a joint will aid fluid motion, remove tissue adhesions and enhance proprioceptive effects. Wattage should be set at 4 to 6 Watts for initial treatment, lower for acute conditions and more for chronic conditions.

Example: Foot
The treatment area encompasses the dorsum of the foot. Apply laser light, pausing for 3-5 seconds when in pulsed mode and sweeping over entire area when in continuous wave mode. Have patient wiggle toes during the laser treatment. Start laser treatment slightly proximal to area of complaint and work distally. Dosage should be 2-4 J/cm2 for superficial conditions and 4-6 J/cm2 for deeper conditions.

Example: Leg/Calf
Start laser treatment slightly proximal to area of complaint and work distally. Pause on tender points for 3-5 seconds when laser is in pulsed mode and sweep over area when in continuous mode. Dosage should be 4-6 J/cm2 for acute conditions, and 6-8 J/cm2 for chronic conditions. Have patient plantar and dorsiflex foot during laser application.

Acute conditions should be treated with a slightly lower dosage, and can be treated more often. For example, an acute sprained ankle could be treated 2x or 3x per day – but the dosage with each treatment should be at the lower end of the recommendations, about 2 J/cm2. Chronic conditions can be treated with a higher dosage, with more time in between visits. For example, a patient with chronic foot pain could be given a dosage of 10 J/cm2, and a high overall dosage (1000-2000 J), but they would only need to be seen 1-2x per week.

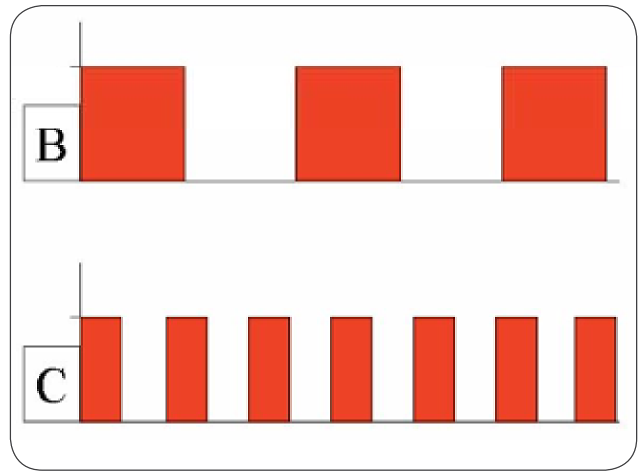
WARNING! More is not better! You can inhibit the healing process, and in some cases exacerbate the patient’s pain by applying too much laser dosage! Follow the dosage guidelines outlined in this book.

Apply laser energy from proximal to distal. This is especially true for acute / inflammatory conditions, i.e. sprained ankles with swelling. You must apply laser energy from proximal to distal, to open up the proximal vascular and lymphatic channels. Application of laser directly over the swelling site only will result in increased swelling and pain.

PULSE FREQUENCY DISCUSSION

Your K-Laser has the capability to deliver therapeutic laser energy in three modes: continuous wave, pulsed, and superpulsed. This section will discuss the benefits and indications for various frequencies of pulsed laser.

When the K-Laser is operating in pulsed mode, it is operating with a 50% duty cycle. This means the laser light is 'On' half the time and 'Off' half the time. The pulse rate can be varied from 2 to 20,000Hz.



The picture at right depicts two different laser pulse frequencies. The pulse rate of 'C' is faster than the pulse rate of 'B', but in both cases the laser light if effectively 'On' half the time and 'Off' half the time.

When operating in pulsed mode, the average power output is one-half the peak power. For example, if the K-Laser was set at 6W, the average power output in pulsed mode would be 3W.

The therapy presets in your K-Laser will start with pulsed mode. This type of laser delivery is a gentle start to the treatment; it prevents the tissue being 'overloaded' with therapeutic energy. If clinically indicated, you can use the K-Laser Zoom Handpiece as a manual pressure device, using it to apply pressure to trigger points or other areas that would benefit from a combination of manual pressure together with therapeutic laser energy.

The various pulse rates elicit a different response from the tissue. Although the literature in this field has not yet made clear which frequencies are particularly suited to which treatments, the many users of laser therapy have still produced a large body of empirical evidence. The table below gives the frequencies that are considered suitable for certain types of problems.

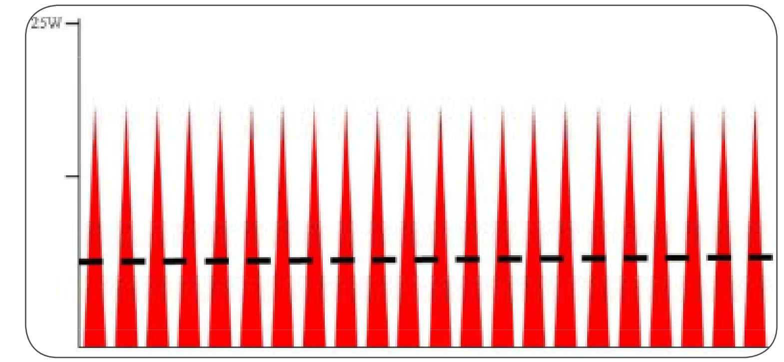
Indication	Pulse Frequency, Hz
Pain, neuralgia	2-100
Biostimulation	500-700
Inflammation	2500-5000
Infections	10,000

When treating a patient, the pulse frequency should be varied to deliver several different frequencies and thus several different benefits. Also, the human body has a tendency to adjust to any outside stimulus, so varying the pulse frequency during the K-Laser Treatment will produce better results.

For beginner users, we suggest sticking with the K-Laser presets. The pulse frequencies that will be most beneficial for each specific condition have already been built into the K-Laser. Having a general knowledge of the various effects of different pulse frequencies will make you a more educated provider, and once you have achieved a level of proficiency, you may choose to set your own pulse frequencies.

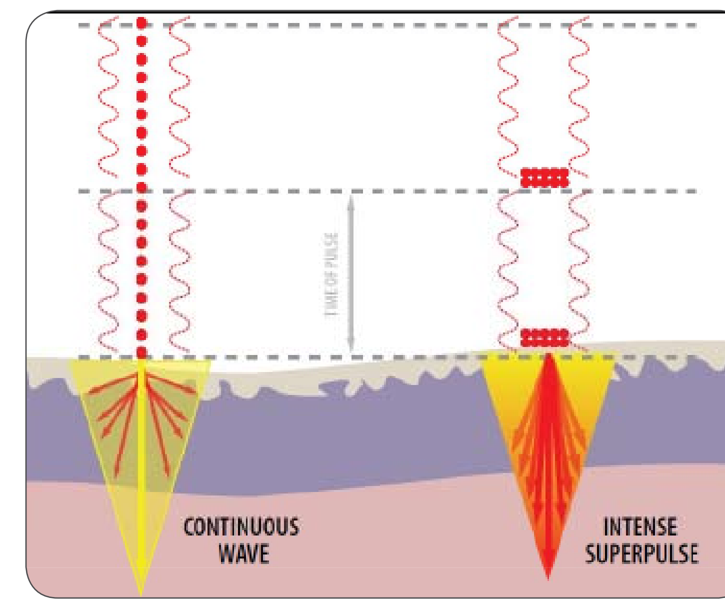
SUPERPULSE DISCUSSION

Your K-Laser has the capability to deliver therapeutic laser energy in three modes: continuous wave, pulsed, and superpulsed. This section will discuss the benefits and indications for various frequencies of superpulsed laser. As noted in a previous section when your K-laser is operating in the normal pulsed mode it is at a 50% duty cycle, with the laser light being 'On' half the time and 'Off' half the time. In superpulsed mode, the K-Laser is producing a very bright light for a very short period of time.



The peak power of each pulse is always 15W. This will be indicated on the K-Laser display as Wp = 15W.
The average power is indicated on the display as Wm, where the 'm' stands for 'mean. At it's maximum, the superpulse mode produces an average of 6W of power, producing 20,000 pulses per second.

If the average power is reduced, the peak power will still be 15W but the pulses will be spaced farther apart. In superpulse mode, the peak power is always 15W. When the average power is 3W, the K-Laser would be producing 10,000 pulses per second.

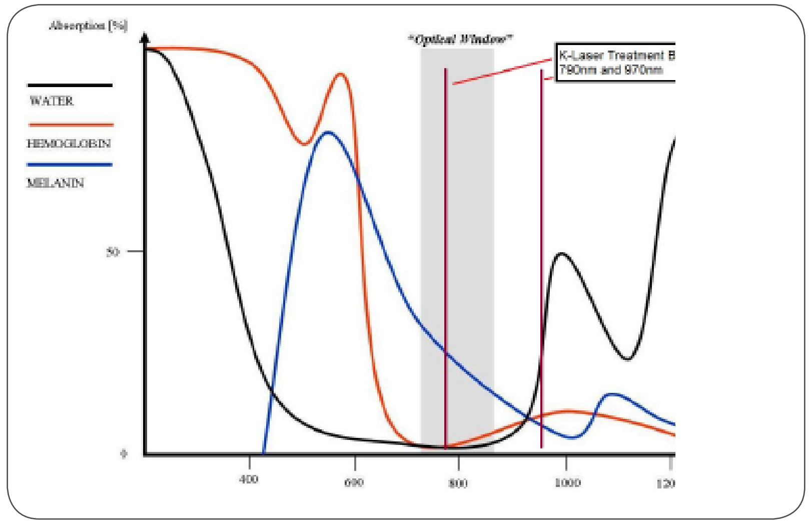


Superpulse mode has the advantage of driving laser energy deeper into the tissues, without heating the superficial tissues as much. An easy demonstration you can do yourself is to run the K-Laser at 6W continuous wave on your forearm, then run the superpulsed mode, set at Wm=6W. The K-Laser is producing an average power output of 6W in both cases, but you should notice that the superpulse mode does not heat your skin as quickly.

Superpulse has three distinct advantages over continuous wave and regular pulsing: when targeting deeper conditions; when treating patients with a dark skin type; and as a different mode of laser delivery. As you can see by the diagram above, the superpulse mode can deliver laser energy deeper, so if the target is a lumbar disc, hip joint or some other deep target, the patient may benefit from superpulse laser. Melanin absorbs laser energy, and the darker the skin type, the more melanin there is at the surface. Continuous wave laser will heat dark skin very quickly, and much of the therapeutic benefit is lost. Superpulse will drive laser energy deeper without heating the skin as much. And the superpulse gives you one more mode of delivery – if using the standard presets of continuous wave + pulsed is not producing the results you would like, try adding superpulse to the K-Laser treatment plan.

WAVELENGTH AND TISSUE PENETRATION

Wavelength of light is a measure of the distance between successive points on the light wave, and is typically expressed in nanometers. The color of light is determined by its wavelength, i.e. blue is 400nm, green is 500nm and red is 650nm. The K-Laser produces three beams: the visible red aiming beam is 650nm, the infrared treatment beams are 790nm and 970nm. The treatment beams are in the infrared region of the spectrum and are invisible to the human eye.



Wavelength is the primary determinant of tissue penetration for a therapy laser. Three components in tissue will absorb laser photons: water, melanin and hemoglobin. As you can see by the figure at left, these three components have a slightly different absorption curve.

There is an "optical window" around 800nm where the absorption of the three components is lowest, which means the laser energy will penetrate the deepest.

The goal with a therapeutic laser is to drive laser energy deep into the tissues to biostimulate the deep tissues and enhance the repair and regeneration processes. Red wavelengths of light are absorbed by the hemoglobin and melanin and get absorbed in the superficial tissues. Red lasers may be effective for surface conditions, but are very ineffective for deep-seated conditions.

The K-Laser typically delivers dual infrared wavelengths of 790nm and 970nm. Referring to the figure, you can see that the 790nm wavelength penetrates more deeply, while the 970nm wavelength is absorbed by the water in tissues. The 970nm wavelength will not penetrate quite as deep as the 790nm wavelength. Since it is absorbed more by water, the 970nm is more responsible for the mild heating that patients feel during K-Laser Treatment.

The K-Laser has the capability to deliver both 790nm and 970nm together, or one of those wavelengths individually. It is generally thought that the 790nm has a more 'biostimulative' nature, while the 970nm wavelength is more "analgesic".
Note: Since it was introduced on the market in March 2005, the K-Laser has operated with dual-infrared therapy laser beams. It has helped a large number of patients with a wide variety of conditions being used in the dual-beam mode, with the 790nm and 970nm beams operating at the same time. Beginner users of the K-Laser should stay with the dual-beam mode until they have gained a level of clinical dexterity and scientific knowledge before attempting K-Laser treatments with the 790nm or the 970nm beams alone.

HOW OFTEN SHOULD YOU TREAT?

A laser therapy treatment plan should be designed with the desired clinical outcome in mind, for each individual treatment and for the entire course of care. This will guide you in the choice of K-Laser treatment parameters: power, energy, energy density, and therapy preset.

You will also need to determine the frequency of K-Laser treatments - although this is also influenced by the progress of the patient toward the desired outcome - and will take into account the effects of the various mechanisms of action and the condition of the tissues that are to be treated.

For example, a patient presents with an acute musculoskeletal injury, indicated by pain and inflammation due to soft tissue damage. The primary desired outcome of the initial stage of treatment is pain relief. A proposed mechanism for pain attenuation involves a nerve block effect. For chronic pain, it has been shown that treatment should be repeated every two days because the effect only lasts for about 48 hours.

For acute pain, you could treat more frequently, even multiple times per day. However, it should be noted that the underlying injured tissue within the treated area may be over-treated by this regimen if it were to be maintained beyond the first few days post-injury.

Once the pain is at a tolerable level (usually after 2-3 days) treatment frequency can be reduced to daily. The primary desired outcome during this period is the reduction of inflammation.

Once the inflammation is under control healing of the injured tissues can begin. The cells of injured tissue are more sensitive to K-Laser therapy than are the cells of intact tissue, and K-Laser treatment that is repeated too frequently can lead to an accumulation of effects in the local tissues and, therefore, an over-stimulation that subsequently leads to bio-inhibition.

The dose could be reduced by a third at this point, and the frequency of treatment should also be reduced, perhaps initially to once every 2-3 days for a week or two, then every 3-4 days for another week or two, and then once a week throughout rehabilitation.

If the patient suffers a flare-up in pain and/or inflammation in the injured area as they progress through their rehabilitation and return to full function, treatment frequency can be temporarily increased as the condition can again be considered acute albeit usually at a lesser severity than the original injury.

This discussion has been presented in distinct steps in the treatment process, e.g., pain relief, inflammation reduction, and tissue healing. But a real treatment plan will actually be a continuum of activity.

During the initial period of treatment, which could involve treating multiple times per day to optimize pain relief, there will also be some effect of that K-Laser therapy upon inflammation. And, as inflammation resolves, healing will begin even before this becomes the primary targeted outcome.

The outcome of each treatment session and the patient's overall progress should be continuously monitored and the treatment plan adjusted accordingly.

ATLAS OF K-LASER TREATMENTS

The K-Laser has built-in therapy presets that are broken down by body part and clinical indication. This unique capability sets it apart from other Class IV therapy lasers. Therapy presets create an ease of use and treatment consistency that will further enhance your clinical results with the K-Laser.

Keep in mind that different pulse frequencies elicit a different response from the tissues, refer back to the section on Pulse Frequencies. You should have a general knowledge of the benefits of the various pulse frequencies, but in the clinical operation of your K-Laser it is more important to focus your attention on the patient.

The K-Laser Therapy Presets will start in the pulsed mode, and then automatically progress through various pulse frequencies and the preset will end with continuous wave. Remember that in pulsed mode you can hold the treatment wand in one place for a few seconds, and use the 'pushing' technique to apply mild pressure to trigger points, or areas where you want deeper laser penetration. When delivering continuous wave, be sure to use the scanning method.

Most of the K-Laser Therapy Presets are broken down into four subcategories: acute, chronic, edema and spasm. Based upon your clinical judgment, use the preset the most closely matches the patient's condition. But please do not let the choice between the 'acute' or the 'spasm' subcategory be a hindrance in your patient care. Do not spend half the day deciding whether the patient will get more benefit from you applying one over the other. These subcategories are meant to refine your K-Laser Treatment delivery. Use the subcategory that best matches your clinical goal for that treatment, and proceed.

Cervical Acute Pain	Hz	Watt	Sec
	2	6	30
	5	6	30
	10	6	30
	500	6	30
	2500	6	30
	5000	6	30
	CW	6	60
900J , 240s – 4:00min			

Cervical Chronic Pain	Hz	Watt	Sec
	2	6	30
	5	6	30
	7	6	30
	10	6	30
	500	6	30
	2500	6	30
	CW	6	60
900J , 240s – 4:00min			

(Note: The pulse frequencies, wattages and time duration may differ from the therapy presets in your K-Laser. With the K-Laser's upgradable software, minor adjustments can be made to these settings.)

Examine the preset settings above, comparing the presets for acute and chronic cervical pain. Notice they both deliver the same amount of energy, 900J, when set to the same wattage, 6W. The key difference is in the pulse frequencies, with the acute pain setting using more higher frequencies (anti-inflammatory) and the chronic pain setting using more low frequency (analgesia).

Would your clinical outcome be significantly different if you used the acute setting versus the chronic? It may – but once again do not let the choice of a therapy preset slow you down. Choose the one that fits best, then focus your intention on the patient and deliver the best K-Laser treatment you possibly can.

The following pages contain treatment suggestions and Clinical Pearls for delivering K-Laser Class IV Laser Therapy Treatments to your patients. We encourage you to read the preceding sections of this Manual, especially the sections on K-Laser dosage, treatment tips to improve your clinical results, and delivery techniques.

The Treatment Atlas is broken down by body part, in much the same way that the K-Laser Therapy Presets are. The sections in the Treatment Atlas and the presets on the K-Laser may not necessarily match up with each other on a one-to-one basis. This Atlas is not meant to be a 'cookbook' from which to deliver treatments, but rather a resource of clinical suggestions to assist you in your K-laser Treatment delivery.

Each section of this Atlas is broken down into subsections. For example, under Headache you will see Crown, Frontal and Temple Headaches listed. Under each of those subsections you will find a list of muscles that are those muscles that may have myofascial trigger points that are causing and/or contributing to the patient's condition. Under Crown Headache you will see sternocleidomastoid (SCM), splenius capitis, medial and lateral pterygoids and scalene. If a patient presents with Crown Headache, you should first examine the SCM, then the splenius capitis and on down the list.

Laser therapy for the treatment of myofascial trigger points is a very effective method at managing pain syndromes and addressing numerous neuromusculoskeletal complaints. The lists of muscles are based on the work of Travell and Simons. Persons needing a reference source for the locations of the muscles listed are encouraged to acquire an anatomy text that lists muscles by their origin, insertion, action and nerve innervations.

The anatomy figures shown in this Atlas are for preliminary guidance only. It is very difficult to represent a 3-dimensional, active laser therapy treatment on a static 2-dimensional picture. You should also have a copy of the K-Laser Instructional and Training DVD for reference.

CHART OF SUGGESTED AVERAGE POWER SETTINGS

The chart above gives suggested power settings for various body parts on an "average" sized person. It is meant to give you the basic idea behind K-Laser Treatment delivery; it is not meant to be a definitive statement on what power to use with all patients. The big picture is that you would not use 10 Watts on a TMJ (too much power, causing inhibition of healing, possibly increasing the patient's pain); and you likewise would not use 2 Watts on a large patient's lumbar disc (too little power, ineffective dosage at target tissues).

Acute conditions should be treated with slightly less power, whereas chronic conditions can be treated with slightly higher power. Be sure to read and understand the sections on laser therapy dosage along with understanding this chart. If you have specific questions on K-Laser Treatment Power and Dosage, be sure to use the free Clinician Telephone Support supplied by K-LaserUSA at 866-595-7749.

KNEE PAIN

TRIGGER POINTS:

Inner Knee Pain
- Vastus medialis
- Gracilis
- Rectus femoris
- Sartorius
- Adductor longus

Outer Knee Pain:
- Vastus lateralis
- Tensor fascia latae/ Iliotibial band

Front of Knee Pain:
- Rectus femoris
- Vastus medialis
- Adductor longus

Back of Knee Pain:
- Gastrocnemius
- Biceps femoris
- Popliteus
- Semitendinosus
- Semimembranosus
- Soleus
- Plantaris
- Vastus lateralis (posterior edge)

Numbness of the Thigh
- Sartorius
- Psoas
- Gluteus minimus
- Tensor fascia latae

CLINICAL PEARL

Weak quadriceps increase eccentric load to the patellar tendon. Tight hamstrings create posterior pelvic tilt and a functional leg length difference. Biceps femoris becomes overactive with a weak gluteus maximus (tight psoas) and creates a proximal tibio-fibular joint dysfunction. This effects sagittal plane dorsiflexion. Tight adductors cause myokinematic inhibition of the gluteus medius causing compensations of the TFL. Overuse of the gluteus minimus as a synergist can lead to superior gluteal nerve entrapment, which can mimic lateral knee pain.

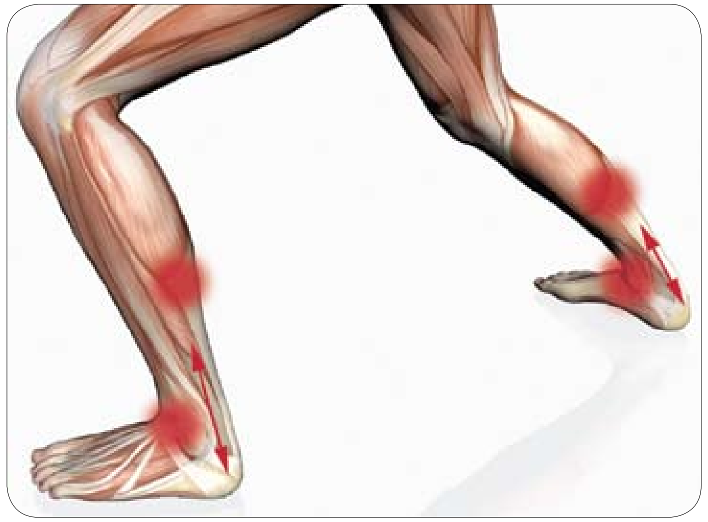
Kinetic Chain Distortion Patterns:

Lower Crossed Syndrome pattern. Dysfunction of this joint usually results from tightness in the biceps femoris, soleus, peroneals, or iliotibial band complex, ankle sprains, weakness in the gluteus medius and maximus. The iliotibial band sends fascial slips into the proximal tibio-fibular joint and results in altered arthrokinematics. The gluteus maximus attaches to the ITB and provides lateral support to the knee via fascial attachments, weakness in the GM results in decreased eccentric control of hip flexion, hip internal rotation, and anterior rotation of the ilium.

Muscle Release Techniques:

Use your thumb and elbow pressing into the TFL and gluteus minimus. These will be very tender in patients with hip problems and will take about six visits to resolve. Laser the primary trigger points for one modulation cycle then restrip the muscle. Knee problems ALWAYS involve a muscular component.

ANKLE PAIN



TRIGGER POINTS:

Front of Ankle Pain
- Tibialis anterior
- Peroneus tertius
- Extensor digitorum longus

Back of Ankle Pain
- Soleus
- Tibialis posterior

Outer Ankle Pain
- Peroneus longus
- Peroneus brevis
- Peroneus tertius
- Abductor digiti minimi

Inner Ankle Pain
- Abductor hallucis
- Flexor digitorum longus

CLINICAL PEARL
Weak anterior tibialis creates eccentric overload to the posterior tibialis, soleus, and flexor hallucis longus causing increased hip flexor activity during the swing phase of gait cycle. This leads to loss of calcaneal eversion during early heel strike increasing foot pronation and obligatory internal rotation of the tibia and femur. A history of ankle sprains is a KEY to understanding chronic injuries. It is imperative that you incorporate NMR on the Rocker Board to re-educate the mechanoreceptors in the ankle ligament structure.

Kinetic Chain Distortion Patterns:
Talotibial joint distortion. Usually results from ankle sprains, compressive pathology, or tightness in the soleus/gastrocnemius complex. Loss of normal sagittal plane dorsiflexion results in increased frontal and transverse plane compensation in the tibia, femur, and lumbopelvic hip complex. Decreased neuromuscular control of the foot and ankle complex during closed chain activities leads to chronic pain and lack of support to the kinetic chain foundation.

Muscle Release Techniques:
Start at the flexor hallucis and work your way up the chain. The medial side of the soleus will be knotted at the distal end just above the Achilles tendon. Tibialis posterior can be very painful. Strip the peroneals to relieve compensatory rigid foot and increase compressive forces in the lumbar and sacroiliac spine.

FOOT PAIN/HEEL PAIN/PLANTAR FASCITIS

TRIGGER POINTS:

Under Big Toe
- Flexor hallucis longus
- Flexor hallucis brevis
- Tibialis posterior

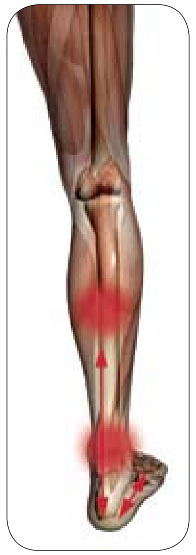
Under Little Toe:
- Flexor digitorum longus
- Tibialis posterior
- Head of Metatarsal Pain
- Flexor hallucis brevis
- Flexor digitorum brevis
- Adductor hallucis
- Flexor hallucis longus
- Abductor digit minimi
- Flexor digitorum longus
- Tibialis posterior
- Flexor digiti minimi brevis

Arch and Midfoot Pain:
- Gastrocnemius
- Flexor digitorum longus
- Adductor hallucis
- Soleus
- Tibialis posterior
- Interosseous

Heel Pain:
- Soleus
- Quadratus plantae
- Abductor hallucis
- Tibialis posterior
- Abductor digiti minimi

Top of Foot Pain
- Extensor digitorum brevis
- Extensor hallucis brevis
- Extensor digitorum longus
- Extensor hallucis longus
- Flexor hallucis brevis
- Interosseous
- Tibialis anterior

Top of Big Toe Pain
- Tibialis anterior
- Extensor hallucis longus
- Flexor hallucis brevis



CLINICAL PEARL
Always check the soleus, gastrocnemius, tibialis posterior, tibialis anterior, peroneals and flexor hallucis in a foot problem. Heel spurs and fasciitis do not simply appear out of nowhere, there is chronic microtrauma involved with these conditions. If the biomechanical and muscular components are not corrected, short term healing will occur. Check neuromuscular sufficiency by doing the single leg standing balance test with eyes open and then eyes closed.

Kinetic Chain Distortion Patterns:
Pronation distortion syndrome. Individuals with pronation syndrome usually have excessive foot pronation, knee flexion, internal rotation, and valgus during movement. This individual's feet pronate and the knee collapses during squatting. Functionally tight muscles include peroneals, gastrocnemius, soleus, iliotibial band, hamstrings, adductor complex and psoas. Functionally weak muscles or inhibited muscles include posterior tibialis, vastus medialis, gluteus medius, gluteus minimus, and hip external rotators.

Muscle Release Techniques:
Have patient roll foot over a cold ball or frozen bottle of water to release adhesions. Have the patient scrunch up a towel under their toes/foot. Incorporate the Rocker Board after laser therapy with shoes off. The patient may roll their calf muscle on a tennis ball to alleviate tightness and stress on the plantar surface. Apply deep pressure to the tibialis posterior.

HOW TO WRITE A CASE STUDY

If you would like to share an interesting case, we encourage you to prepare a Case Study Report and submit it either to K-LaserUSA, or to a Chiropractic Research Journal. Class IV Laser Therapy will continue to be a rapidly growing field in the years ahead. You will benefit professionally, and patients around the world will benefit clinically from the effort you put into a Case Study.

The case study could include the following headings and or categories:

1. Abstract
2. Introduction
3. Case report
4. Discussion
5. Conclusion
6. References

Abstract

The abstract or synopsis summarizes the main points of the case study including 1) the purpose of the case report, 2) the basic procedures followed, 3) the main findings and 4) the principal conclusions. The abstract might include the following headings and content:

- Objective: Why is the case study being presented?
- Clinical features: A brief overview of the patient's presentation and diagnosis.
- Intervention and Outcomes: An overview of what was done and what happened as a result.
- Conclusions: This is a brief statement of what you feel the significance of the case is.

Introduction

This discussion should give the reader a general overview of the topic you are about to discuss relative to your case presentation. It could consist of one to two paragraphs as to why this case is important. If you were writing about the effects of laser therapy on a patient with diabetic neuropathy, for instance, you might want to discuss the condition in general. The same would be true with more mundane topics as neck pain, headaches and other neuromusculoskeletal conditions. Keep in mind that a case study does not have to involve a dramatic life-threatening illness. Case studies are needed on K-Laser care for a wide variety of conditions.

Case Report

This section should detail the pertinent history, chief complaint and exam findings regarding the case under discussion. You should discuss what type of care was instituted and the results of that care. This is one of the most important parts of a case report. Document the care in such a way that the procedures performed are readily identifiable. Describe progress from one visit to the next.

Give biographical information about the patient if appropriate. Be sure to document the total number of Joules delivered, as well as the approximate area in square centimeters that you treated. From that you can calculate the energy density in Joules per square centimeter (J/cm2).

Discussion

This section could include a more detailed discussion of the condition under investigation. A review of the literature would be appropriate as well as a review of the literature relative to common treatment protocols. Review any chiropractic or laser therapy literature related to this condition. Perhaps others have written on the topic and have seen similar results as you. You could conclude this section by making hypotheses regarding the literature and your experience with this case.

HOW TO WRITE A CASE STUDY (CONTINUED)

Conclusion

This should be a concise discussion of what you concluded as a result of your review of literature and your experience in this case as well as the significant features of the case. Discussion of the clinical importance of the case can also be presented here. A statement regarding limitations of your study and the prospect for future research could be included here.

References

List all relevant references that support your case study report and the statements made in it. Although this process may appear tedious, guidelines exist on how to list the references and, once you get going, it's pretty simple and straightforward. You can also look at examples of case studies from JVSR, www.jvsr.com, and other health-related in libraries to get ideas and guidance on how to organize and write your case study.

Also, it's very important for you to remember that your case study can be solely about the reduction pain, muscle spasm or improved range of motion in your patient and does not have to be about the amelioration of some other disease or condition.

We encourage you to take time to pick one of your patients who has experienced a positive benefit from K-Laser Treatments and go through this process.

K·LASER™ USA 1106 Harpeth Industrial Court Franklin, TN 37064 • 866-595-7749 • www.k-laserusa.com