

# K-LASER CLASS IV THERAPEUTIC LASER CERTIFICATION COURSE NOTES

Updated February 23, 2016

## MODULE ONE

### COURSE OBJECTIVES

1. Historical Development of Lasers
2. Biophysics of Lasers including Dosimetry and Mechanisms of Action
3. Clinical Application and Effective Utilization of Lasers
4. Beam and non-Beam Hazards of Class III and Class IV Health Care Laser Systems(HCLS)
5. Control Measures for Each Hazard
6. Manage Compliance with Standards and Regulations in Order to Maintain a Laser Safe Environment

Light  
Amplification  
by Stimulated  
Emission of  
Radiation

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### LASER

\*Laser is any device which can be made to produce or amplify electromagnetic radiation in wavelengths ranging from 180 nm to 1 mm by the process of controlled stimulated emission.

\*Laser energy is considered as a stream of tiny particles of light called **PHOTONS**

\*Laser energy is absorbed by specialized receptors on the mitochondria called **CHROMOPHORES**

### HISTORY OF LASER

Used for over 40 years in Russia, Europe, etc.

Relatively new in the US-first therapy laser was cleared by the FDA in 2002

Class IV lasers received FDA clearance in Dec. 2003 and have been used in Europe for over 10 ten years

The first K-Laser model (called the D-series) was FDA cleared in March 2005.

EINSTEIN-developed laser theory in

1916 MAIMAN-first working laser in  
1960

ENDRE MESTER-"father of low level laser therapy"- In late 1960's his original device was made to attempt to cure cancer in rats. Was unsuccessful due to low doses but did heal superficial conditions faster.

Laser Therapy has many names.

**PHOTOBIO-MODULATION (PBM)** – term adopted in 2005 by the North American Association of Laser Therapy (NAALT) as the therapeutic utilization of light

### SURGICAL LASERS

- cut and destroy tissue by **excess heating**
- takes less time and less money than surgery

-seals BV's so less bleeding

-effect is **PHOTOTHERMAL**

-risks are hemorrhage, infection, perforation of organs

### THERAPEUTIC LASERS

-stimulate cell function

-effect is **PHOTOCHEMICAL and  
PHOTOBIOSTIMULATIVE**

-effect not thermal like surgical lasers

**Therapeutic Laser (photon)** causes **increased ATP production** which causes normalization of cell function which leads to pain relief and quicker healing.

\*Damaged and compromised cells are affected more by Laser Therapy than normal cells.

# LASER PHYSICS

## PROPERTIES OF LASER LIGHT

1. **Monochromatic**- One specific wavelength (measured in **nanometers**) therefore one color
2. **Coherent**- waves are synchronized in space and time
3. **Collimated**- narrow beam of light in a specific direction

LED's (Light Emitting Diodes) are **NOT COHERENT** and not true Laser Therapy Devices

\*Jan Tuner- 13 separate studies between Laser and LED's: laser therapy wins every time

## ELECTROMAGNETIC SPECTRUM

\*Entire range of light radiation from gamma rays to radio waves

\*Visible Light is from 400nm-700nm

\*K-Laser is visible AND infrared (invisible)

{Discussion of the Electromagnetic Spectrum}

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## SPECIFICATIONS OF DIFFERENT K-LASER MODELS

**K-SERIES LASERS** have 3 diodes with 3 separate wavelengths; 8 or 12 watts max CW power

1. **Aiming Beam- 660nm**, only 3 milliwatts therefore visible for **guidance and to assess patency of the fiber optic cable**
2. **Treatment Beam #1- 800nm** is absorbed least by **melanin (skin), hemoglobin, and water**. Therefore, **penetrates deepest** and is best for **deep tissue stimulation** such as trigger points, ligaments, joint capsules, and intra-articular surfaces; at peak of absorption for cytochrome-c oxidase enzyme in the mitochondria
3. **Treatment Beam #2- 970nm** is more absorbed by water, creating microscopic thermal gradients, responsible for warming effect

\***Treatment Beams #1 and #2** are invisible and **infrared** so can reach deeper targets. We can only feel their effects including a warm sensation.

**CUBE3 LASER** has 4 diodes; 8 or 12 watts max CW power

1. **Aiming beam - 660nm**, only 3 milliwatts therefore visible for **guidance and to assess patency of the fiber optic cable**
2. **Treatment beam #1 Visible red treatment beam – 660nm**, 100 milliwatts; absorbed in top 2-4 millimeters of skin; best for superficial conditions
3. **Treatment Beam #2- 800nm** is absorbed least by melanin (skin), hemoglobin, and water. Therefore, penetrates deepest and is best for deep tissue stimulation such as trigger points, ligaments, joint capsules, and intra-articular surfaces; at **peak of absorption for cytochrome-c oxidase enzyme in the mitochondria**
4. **Treatment Beam #3- 970nm** is more absorbed by water, creating microscopic thermal gradients, responsible for warming effect

**CUBE4 LASER** has 5 diodes; 15 Watts max CW power

1. **Aiming beam - 660nm**, only 3 milliwatts therefore visible for **guidance and to assess patency of the fiber optic cable**
2. **Treatment beam #1 Visible red treatment beam – 660nm**, 100 milliwatts; absorbed in top 2-4 millimeters of skin; best for superficial conditions
3. **Treatment Beam #2- 800nm** is absorbed least by melanin (skin), hemoglobin, and water. Therefore, penetrates deepest and is best for deep tissue stimulation such as trigger points, ligaments, joint capsules, and intra-articular surfaces; at **peak of absorption for cytochrome-c oxidase enzyme in the mitochondria**
4. **Treatment beam #3 – 905nm** is at peak of absorption by hemoglobin; causes release of oxygen, increased tissue oxygenation
5. **Treatment Beam #4- 970nm** is more absorbed by water, creating microscopic thermal gradients, responsible for warming effect

**CUBE PERFORMANCE LASER** has same wavelengths as CUBE4; max 18watts CW for Veterinary models, 15W for human models

## FOR THERAPEUTIC EFFECTS TO BE REALIZED

1. Energy must penetrate deep enough to reach the **target tissue**
2. Enough energy must be present at the desired tissue depth to stimulate a physiological effect and promote healing.

\*Therefore multiple wavelengths are ideal when injury has affected a region of the body at various depths

\*Some Laser Therapy is ineffective due to using inappropriate wavelength or **too low dosage**.

Things that inhibit photons:

1. Reflection
2. Absorption
3. Scatter

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\*Only 20-40% of light is absorbed in the treated area-therefore a higher dosage is needed for deeper targets

\* **This means over 50% is absorbed by the skin and subcutaneous tissue**

## MOST COMMON PAIN GENERATORS IN THE SPINE

C-spine      Facet joints (zygapophyseal)

e.g. Neck pain and HA's – C2-C3 facet      neck and shoulder pain – C5-C6 facet

\*zygapophyseal joint dysfunction is the number one cause of chronic neck pain

L-spine      Intervertebral Discs (annulus fibrosis and P.L.L.)

-most common cause of low back pain

## COMMON TERMS with regard to Laser Physics

Power	Energy Density	Pulse Frequency
Energy	Fluence (Dosage)	Average Power
Joules	Wave Emission	Peak Power
Wavelength	Continuous and Pulsed Wave	
Power Density	Pulse Width	
Surface Area	Duty Cycle	

POWER (Measured in WATTS)

ENERGY (Measured in JOULES) Power=Energy/Time      1 Watt=1 Joule/1 Second

\*Energy = power x time

\***Trend in laser therapy has been to increase power** and dose for better results

## WAVELENGTH

\*Wavelength is measured in nanometers (nm) from crest to crest

\*There is no point in increasing dose or power with a short wavelength because it will not penetrate deeply

\*the best penetration is reached with 800nm wave

**K-Laser** models use **GaAlAs** (GalliumAluminumArsenide) **Diodes**

## POWER DENSITY

\* The degree of concentration of power output

\* Determines the nature of the laser-tissue interaction, i.e. photochemical vs. photothermal

$$\text{Power Density} = \text{Power (watts)} / \text{Area (cm squared)}$$

## ENERGY DENSITY

$$\text{Power x Time} / \text{Area [P x T / A]} \quad \text{or} \quad \text{Joules / Square centimeter squared J/cm squared}$$

\***Energy Density** is the most important factor in determining tissue reaction

## WAVE EMISSION

1. Continuous Wave (CW) – the laser light is on continuously

\*No change in intensity

\*greatest energy in least time

2. Pulsed Mode
  - \*Pulsing is on/off and is referred to as the **DUTY CYCLE** e.g. 50% Duty Cycle is alternate half on/ half off
  - \* Average power is equal to half the peak power.
  - \***Frequency is the number of pulses/second and is measured in Hertz** 100 Hz=100 pulses/sec
  - \***2Hz has an analgesic effect**
  
3. Intense Super Pulsed (ISP)
  - \*60% duty cycle
  - \* ‘thermal relaxation time’ between the pulses – delivers more light deep into the body without overheating the skin surface
  - \***K-Laser models run in continuous wave, pulsed and intense super pulsed modes**

## MODULE TWO

**K-Laser USA (866-595-7749)** is the exclusive distributor of **K-Laser**

\*email available through website which is [www.k-laserusa.com](http://www.k-laserusa.com)

\*Fax is 615-261-3535

\*Either call, email, or fax with service questions

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### LASER SAFETY

\***ALL** personnel should read the K-Laser safety manual

#### BACKGROUND/HISTORY

\*330 accidents from 1964-1996

\*73% Eye Exposures

\*68% Permanent Injury

#### ACCESSIBLE EMISSION LEVEL (AEL)

\*magnitude of radiation of a specific wavelength

\* sets limit on the power levels that can be emitted

\* determines ‘class’ of the laser

#### MAXIMUM PERMISSIBLE EXPOSURE (MPE)

\*allowed exposure without adverse biological changes to the eye or skin

#### NOMINAL HAZARD ZONE (NHZ)

\*area in which laser energy either from direct, reflected, or scatter source exceeds the MPE

\*21 feet in any direction for the K-Laser

\***ALL PERSONNEL IN THIS ZONE SHOULD WEAR K-LASER SPECIFIC EYEWEAR!**

#### LASER SAFETY OFFICER (LSO)

\*person responsible for monitoring, evaluating, and controlling potential hazards

#### PRECAUTIONS FOR PERFORMING K-LASER THERAPY

1. Authorized personnel only should use the laser
2. ALL in treatment area (NHZ) must wear K-Laser specific eyewear
3. Must display “LASER IN USE” signs
4. Laser should be placed in the STANDBY Mode or OFF position when not delivering treatments
5. NEVER put the laser in Standby Mode when unattended
6. Laser can run in ‘idle’ for several hours, so it is on and ready to use
7. Never press the finger switch without checking the settings and the position of the hand piece

#### EYE PROTECTON

1. Never point the laser directly at the eyes even if eyewear is in use
2. ALL present must wear K-Laser specific eyewear
3. Don’t use eyewear from other companies, or sunglasses
4. Only remove eyewear after unit is placed in Standby or Off mode
5. Corneal and Retinal areas are most susceptible to injury

## **LASER SAFETY OFFICER (LSO)**

1. Should have an ongoing safety program which is regularly reviewed
2. Should classify all lasers in the facility
3. Should give proper training to all personnel and continuing education
4. Should install safety controls and regulate maintenance needs
5. ALL PERSONNEL SHOULD READ SAFETY MANUAL

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## **K-LASER SAFETY FEATURES**

1. Emergency power on/off switch
2. Electronic access key- prevents unauthorized use
3. Safety Interlock- must be engaged before laser will power on
4. Power On/Off Visual Indicator
5. Laser Emission Indicator- optional alert tone
6. Internal Laser Energy Monitor
7. **ALL present should wear K-Laser specific eyewear**

## **K-LASER OPERATIONS**

1. Never operate with non-grounded circuit or wet area
2. Never open the device (warranty will be voided)
3. Never operate around flammable gases (due to high temperatures involved)
4. Never use laser until disinfectants are allowed to evaporate

## **ABSOLUTE CONTRAINDICATIONS FOR HUMAN PATIENTS**

1. **Never point directly into the eyes even with eyewear**
2. **Never laser directly over the thyroid gland**
3. **Never use K-Laser on a patient with a spinal cord stimulator (SCS) implanted**
4. **Never use K-Laser on a pregnant patient (medico-legal, in the event of miscarriage)**
5. **Never use K-Laser on a cancer patient (medico-legal, in the event of cancer worsening)**

## **RELATIVE CONTRAINDICATIONS FOR HUMAN PATIENTS**

Don't apply laser therapy over:

1. Pacemaker or other electronic devices but OK on other body parts
3. Patient using photosensitizing drugs such as steroids
4. Recent cortisone injections, wait seven days after steroid shot
5. When intolerance is noted
6. Areas of recent hemorrhage as they may worsen initially
7. Patient using immunosuppressant drugs
8. Tattoos as they will heat up faster
9. Area with decreased sensory perception

## **ABSOLUTE CONTRAINDICATIONS FOR ANIMAL PATIENTS**

1. **Never point directly into the eyes even with eyewear**
2. **Never laser directly over the thyroid gland**

## **RELATIVE CONTRAINDICATIONS FOR HUMAN PATIENTS**

1. Do not laser directly over the gravid uterus
2. Do not laser directly over cancer tumors

## **ADVERSE EFFECTS OF LASER THERAPY (are rare and temporary)**

1. Temporary increase in pain during application
2. Mild pain the day after treatment
3. Mild bruising from direct pressure of tip
4. Temporary dizziness
5. Skin reaction especially when using photosensitizing meds

## PHOTOSENSITIVITY

- \*some patients may develop a temporary rash after treatment
- \* body detoxification reaction – no tissue damage

## SLEEVE TEST

- \*to determine photosensitivity and to regulate laser dosage
  - \*increasing doses are applied to an area of the body to see reaction
- 5 one-square inch openings in a piece of cardboard one inch apart over the abdomen Laser area #1 for 60 secs, #2 for 120 secs, #3 for 180 secs, etc. [takes 15 minutes to do]
- The patch where redness occurs after 8 hours and disappears in 24 hours is the minimum erythema dose
- \*General rule- dose can be increased 15 secs in each succeeding treatment

## CLASSIFICATIONS OF LASERS

- \*class number indicates the degree of hazard due to direct eye exposure, but in general can be categorized by power output
- Class I- From 0-0.4 microwatts such as **CD players and laser printers**. No known hazard.
- Class II- Up to 1 mW such as LED's and bar code scanners. Safe unless repeatedly shined into eyes.
- Class IIIA- From 1-5 mW such as Erchonia Lasers, laser pointers, and firearm sights. **Eye injury** is possible but not common.
- Class IIIB- From 5-**500mW** such as the lasers which were precursors to K-Lasers. **Can cause eye injury from the direct beam and beam reflections.**
- Class IV- **Greater than 500mW** with no upper limit. **Can be hazardous to eye, skin, and can be a fire hazard if left in one area for an extended period of time. \*ALL K-LASERS ARE CLASS IV**

## EMERGENCY ACTION PLAN

- \*Procedures should be established in order to minimize all hazards
  1. Signs and symptoms of exposure to laser light should be reported
  2. Determine events which could lead to possible exposure
  3. Should record and report exposures above the MPE limit
- \*K-LASER USE MAY HAVE TO BE REGISTERED IN SOME STATES
  - states included: FL, IL, TX, AZ (there may be others, check with your K-Laser Company Rep)

## MODULE THREE

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## PHYSIOLOGICAL EFFECTS OF K-LASER THERAPY

### CHROMOPHORES

- \*located on mitochondrial membranes which absorb light and when stimulated produce ATP
  - \*This leads to normalization of function and tissue healing
  - \*COMPROMISED CELLS ARE MORE READILY AFFECTED BY LASER THERAPY THAN NORMAL CELLS
  - \*1998- Takac and Stojanic- wrote on the biostimulating affect of Laser Therapy
- \*K-Laser Therapy treats the cause and not the symptoms and can be used immediately post-injury

1. Stabilization of Cell Membrane
2. Enhancement of ATP Production and Synthesis
3. Decreased C-Reactive Protein and Neopterin Levels
4. Acceleration of Leukocytic Activity{Discussion of Inflammatory Response}
5. Enhanced Lymphocytic Response
6. Reduction in Interleukin 1 (IL-1) Levels
7. Increased Prostaglandin Synthesis
8. Enhanced Super Oxide Dismutase (SOD) Levels
9. Stimulation of Vasodilation (increased histamine, nitric oxide, and serotonin)
10. Increased Angiogenesis
11. Temperature Modulation (Normalization)
12. Decreased Pain and Nociception

**Pain- subjective experience including the emotional response**

**Nociception- specific activity in neural pathways which does not include psychological pain BIOMODULATION**

**LEADS TO DECREASED PAIN BY:**

1. Ion Channel Normalization
2. Increase in Beta Endorphins
3. Increased Nitric Oxide Production (Vasodilation and Normal Nerve Cell Transmission)
4. Decreased Bradykinin Levels
5. Blocked Depolarization of C-Fiber Afferent Nerves
6. Normalization of Resting Action Potentials; Therefore compound muscle action potential (CMAP) values and nerve latency values show improvement
7. Increased Release of Acetylcholine

**TISSUE HEALING by:**

1. Increased Leukocytic Activity
2. Increased Macrophage Activity
3. Increased Neovascularization (Angiogenesis)
4. Increased Fibroblast Proliferation
5. Keratinocyte Proliferation
6. Early Epithelialization (early tissue repair)
7. **Increased Tensile Strength**

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According to the FDA, the K-Laser is intended to emit energy in the infrared spectrum to provide topical heating for the purpose of elevating tissue temperature for the temporary relief of minor muscle and joint pain, arthritis, muscle spasm, relieving stiffness, and promoting relaxation of the muscle tissue.

**Visit the K-360 Online Resource Portal for more information in the Advanced Webinar Series and Training Videos**