



Laser Certification Review

Expanded Study Guide – Module I

Certified Laser Hair Removal Specialist

National Council on Laser Certification

www.LaserCertification.org

Not All of these Slides are Narrated, but many are.

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Handout Material

The pdf document that you should have printed from the link on the first slide is a condensed version of this review. It contains the Review Slides with the bullet points. These are what you should concentrate on to “cram” for the exam itself.

This expanded version offers some additional narrated slides from our Computer Based Learning programs just for clarification of content.

Review Format

This “Expanded” Laser Certification review is NOT intended to be a primary teaching program.

It is intended to review the key concepts covered in the NCLC Laser Certification examinations.

Those not having previous training in these areas are referred to outside courses & home study programs.

See www.LaserTraining.org



Review Format

Following each numbered “Review” slide with the “bullet list” of key points that will appear on the test, this expanded review will elaborate with a few slides from the teaching program to clarify those points.

Concentrate on each numbered “Review” slide with the bullet lists for the exam – that best reflects questions on the exam. There may be content in those expanded slides that are NOT on the exam.



Narration and “Browsing”

None of the numbered “Review” slides are narrated, but most of the following expanded slides are.

Remember that the purpose of this program is NOT as a primary teaching course, but as an expanded review of the subject matter. With that in mind, if you’re listening to narrated slides where you’re already very familiar with content, you might want to browse through those without hearing the full narration for the sake of time.



Review Format

Each numbered “Review” slide in this review will relate to the “Content Area” classification of a specific question on the exam, but will not be specific about the question asked, although the answer to a question will be on that slide.

Each slide will note the category of the content area covered, and it is possible that more than one question is asked within that slides content area.

Laser Certifications



These are voluntary Professional Credentials that provide recognition to the holder of a high level of academic knowledge in that area of Certification.

Some States may require such a National Certification as part of that State's licensing process for various levels of providers.
(Florida and Texas as of July 2015)



The Certified Laser Hair Removal Specialist certification is offered jointly by the NCLC & IALA (International Aesthetic & Laser Association)

See www.LaserCertification.org for complete certification requirements. Download the Handbook.

Successful completion of either of these Laser Hair removal or Aesthetic Laser Operator courses will qualify the participant to make application for and sit for the appropriate written NCLE examination. Additional qualifications apply for full Certification and applicants should review the Candidate Handbook on the website.

Written Examination

- 100 (CLHRS) Multiple Choice Questions
 - 1 Correct (Best) Answer
- 70% Required for Passing
 - can miss up to 30 Questions
- 3.0 Hours allotted for completion
- Closed Book. “Controlled” breaks allowed.
- A 25 question “incremental” test may be taken at a later date (or at the same time) to add the Certified Aesthetic Laser Operator designation.

Certification Status

- Full Certification requires successful completion of the proctored examination, plus the experience and background/case requirements.
- Course participants may submit the additional materials at a later time, and have up to 5 years to complete the experience/case requirement.
- Those passing the exam but still awaiting completion of other requirements are designated a “Certification Candidate” and will receive the appropriate Certificate.



Exam Content Areas

The examination tests for a knowledge of medical laser and energy concepts, and safety.

Specific clinical laser/IPL concepts will be tested.

Exam Content Areas

The areas of testing for various NCLC Laser Certifications basically boil down to the areas of:

- (1) Laser Concepts
- (2) Tissue Effects, and
- (3) Safety

- as defined by the American Society for Laser Medicine & Surgery, and ANSI in their recommendations.

Exam Content Areas

For the CLHRS Credentials:

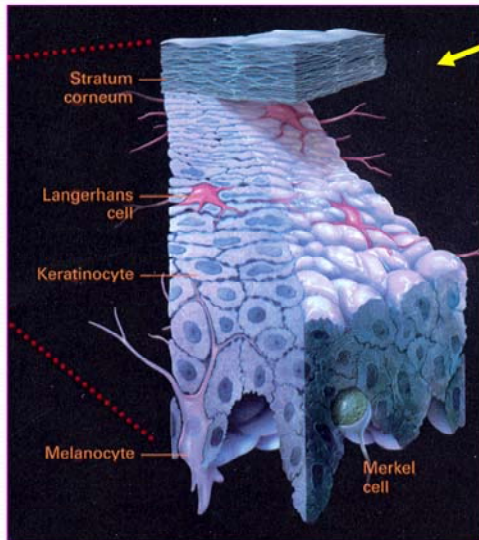
Safety –	40%	40 Q
Laser & Energy Concepts –	17%	17 Q
Tissue Interactions –	16%	16 Q
Aesthetic Questions	6%	6 Q
Anatomy & Physiology	21%	21 Q

1. Anatomy & Physiology

Skin Anatomy

- Epidermis – outer layer of skin
 - Stratum Corneum – the outermost layer of the epidermis
 - Melanin – contained within the epidermis and is a major absorber of laser light – competing with the hair follicle
 - Preventing excessive heating of the epidermis (mostly because of melanin absorption) is a critical consideration in all dermatological skin procedures including laser hair removal.
 - “Renews” itself every 3-5 weeks with migrations of new cells.

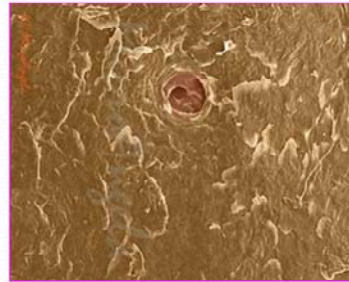
EPIDERMIS



Stratum Corneum

15-40 Layers of "flattened" cells that have migrated from below – our outer skin is renewed about once a month to two months.

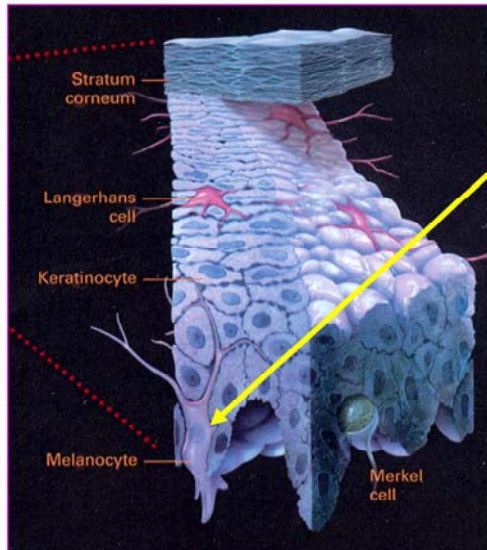
This is our waterproof protective covering.



We can divide the skin into the outmost Epidermis, deeper Dermis and then subcutaneous tissues.

The outermost layer of the Epidermis is the Stratum Corneum which are flattened cells that have migrated to the surface. They continuously flake off as they age and this layer is renewed once every month or two. This is where we target microdermabrasion procedures to remove this dead skin and polish the appearance of it. It can be useful for lasers and IPL procedures as well because aged skin here can behave like a "frosty window pane" not allowing the light to penetrate as deeply as it otherwise might. Non-particulate microdermabrasion prior to laser or IPL treatments can enhance the effectiveness of the treatment.

EPIDERMIS



Melanocyte

These cells produce the melanin pigment that give our skin color.

Melanin is one of the major absorbers of laser light, and is called a "target chromophore"

Melanin is an intended target for removal of pigmented lesions, but an unwanted obstacle in treating vascular lesions.

Melanocytes are cells filled with smaller melanosomes which give our skin varying degrees of brown color created by the melanin which they produced. They are critical to most light based procedures because they absorb so much light and then generate heat. They are ordinarily contained at the junction of the dermis and epidermis. Melanin is the intended target when you're trying to remove brown spots or laser hair removal, but it becomes a big problem when treating darker skin types. It also becomes a problem with laser treatments when clients have had recent sun exposure – whether the tan is immediately obvious or not.

EPIDERMIS



Melanocytes

Located at the epidermal-dermal junction – they are superficial compared to hair follicles and blood vessels.

Dark skin contains many melanocytes as shown here.

www.LaserTraining.org

Dark skin contains many more melanocytes than light skin, so care must be taken both with laser wavelengths and applied energies to avoid creating excessive heat in dark skinned clients. This can result in burns or in long lasting pigmentary changes. In ablative skin procedures it is critical to avoid any deep ablations on dark skinned clients which would remove this layer of melanocytes, which you otherwise could do safely in light skinned clients.

2. Anatomy & Physiology

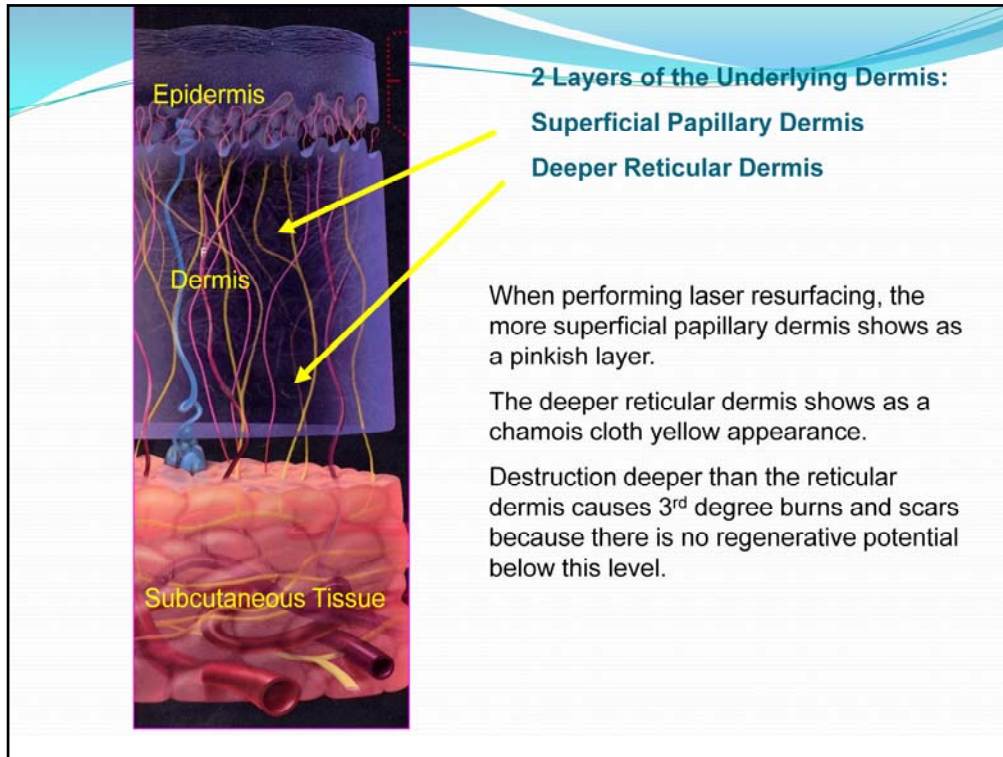
Skin Anatomy

- Dermis – deeper middle layer of skin
 - 2 Layers to the Dermis:
 - Papillary Dermis – the first layer of the dermis – looks pink when doing ablative resurfacing
 - Reticular Dermis – the deepest layer of the dermis – has a yellowish “chamois cloth” appearance when doing ablative resurfacing. Never “lase” deeper than this level.

3. Anatomy & Physiology

Skin Anatomy

- Dermal/Subcutaneous Fat Interface
 - below Dermis
 - separates the reticular dermis from underlying subcutaneous tissues. Ablating past this level in ablative resurfacing, or lethally heating it in laser hair removal or other procedures, causes a third degree burn and possible keloid scars since the dermis cannot regenerate.

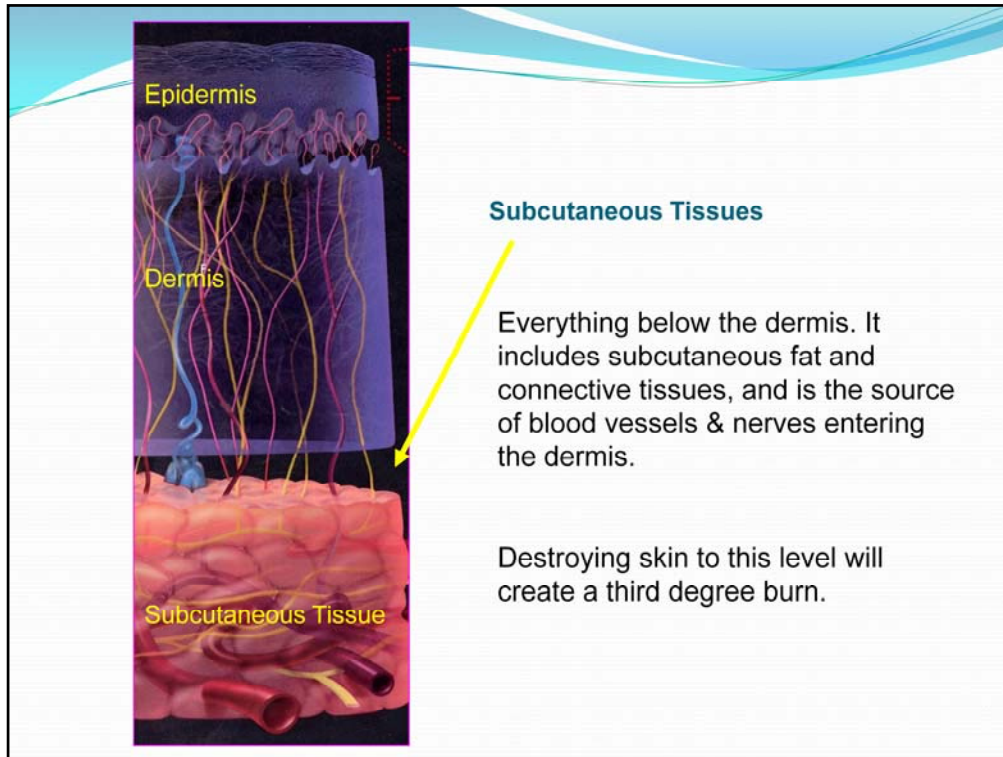


Our dermis lies between the outer epidermis and underlying subcutaneous tissues. It is in turn divided into the more superficial papillary dermis and the deeper reticular dermis. During ablative skin resurfacing performed by physicians the appearance of these levels is quite distinct and provides a guide to how deep you're ablating. The papillary dermis has a pinkish color to it, while the deeper reticular dermis has a yellow chamois cloth type appearance – NOT to be confused with the yellow fat underlying it. One can ablate or heat into this deeper reticular dermis but not deeper.

4. Anatomy & Physiology

Skin Anatomy

- Subcutaneous Tissues
 - Everything below the dermis. Includes subcutaneous fat and is the source of blood vessels & nerves entering the dermis. Destroying skin to this level will create a third degree burn and possible Keloid scars.



Below the reticular dermis lies the subcutaneous tissues with fat, connective tissues, and the nerves and blood vessels that feed the skin. Skin loses its ability to regenerate below the level of the reticular dermis, so excessive heating of the skin past this dermal / subcutaneous interface, or physically ablating skin past this point, will result in burns and third degree scars.

5. Anatomy & Physiology

Skin Color

- The primary determinant is skin melanization
- Skin vascularity and thickness also serve to determine general skin color

6. Anatomy & Physiology

Skin & Hair Biology - HAIR TYPES

- Terminal Hairs – Course hairs found on the scalp, eyebrows, armpits & bikini area. (this is the usual target for laser hair removal).
- Velus Hairs – fine “peach-fuzz” hair covering most of the body
- Hair growth from either arises within the hair follicle.

DERMIS & HAIR FOLLICLE



HAIR FOLLICLE

Velus Hairs: This is the “peach fuzz” type of fine hair throughout our body. It can be transformed into coarser hairs. Requires shorter pulse widths for laser hair removal.

Terminal Hairs: These are the coarser, thicker hairs on our scalps, armpits, etc. Requires longer pulse widths.

Hair & Skin color will be a major factor in Laser Hair Removal, when that topic is covered.

Hair can be divided into two main types:

The fine hairs which are called the velus hairs, are the short peach-fuzz type of hair that is common all over our bodies. These can be very difficult to treat, especially if they are light in color, and generally require shorter pulse widths from the laser than larger hairs.

The more coarse hairs are called terminal hairs and are common on our scalp, armpits and bikini areas. These are the hairs that are usually targeted in laser hair removal procedures.

DERMIS & HAIR FOLLICLE



BULB

This is where hair growth starts & is targeted in Laser Hair Removal. It is surrounded by a vascular and neural network called the "matrix".

Melanin is also produced in the bulb.

The bulb is part of the hair follicle

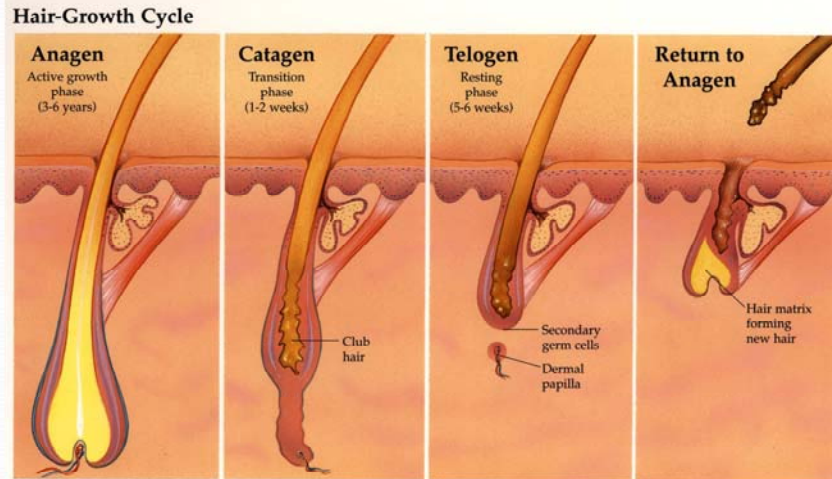
The hair bulb is where we want to target laser treatments, and at 4 mm or lower in the skin is one of our deeper targets.

7. Anatomy & Physiology

Skin & Hair Biology Hair Growth Phases

- Anagen – Growth phase where it is most susceptible to laser treatments
- Catagen – Regression/atrophy phase where nourishment is cut off
- Telogen – Dormant phase where the follicle falls out (sheds at end of growth cycle). The hair bulb can survive laser treatments in this phase.

Stages of Hair Growth



The Anagen phase is the active phase where Laser or IPL hair removal is the most effective. It's also the time when the hair bulb is the deepest in tissue. The Catagen phase is a regressive phase where the hair bulb starts to pull away from its supporting papilla, nourishment is shut off, and is a transition to dormancy. The telogen phase is the final stage where the follicle becomes essentially dormant and the bulb can survive laser treatment in this phase. It will finally shed its hair shaft and then turn back to the anagen phase for regrowth.

8. Anatomy & Physiology

Skin & Hair Biology Hair Growth Phases

- Different body areas have differing time periods for growing & dormant stages. These vary from 2-6 years (growth cycle) for the scalp, to 3-4 months in the bikini or axillary (armpits) area. Most are 4-12 months.

9. Anatomy & Physiology

Skin & Hair Biology
Hair Growth Phases

- Not all of the hairs in any given area are in the same phase at the same time. That is why multiple laser treatments are required. If they were all in the same phase, then we would completely shed hair in that area at certain intervals.



Hair Growth Phases

Not all hairs in any given area are in the same phase at the same time, which is why multiple treatments are required.

If they were all in the same phase then we'd routinely shed all of our hair in that area.

If all of our hair was in the same phase at the same time, we would periodically shed all of our hair and become bald, until hair growth returned. Instead our hair is in different phases in the same area, which is why multiple treatments are required. Hair is most susceptible only in the Anagen phase.

Hair Growth Phases

- Different body areas have different periods for growth & dormancy
- Most areas have growth cycles that are 4-12 months
- Range from 2-6 years for the scalp, to 3-4 months for bikini & armpit.

Different areas of our body have varying growth and dormancy times. You can ballpark that most areas have growth cycles from 4-12 months, but those might range from 2-6 years for the scalp, to 3-4 months for the bikini and armpits. On an unshaved body just look at those areas that can grow the longest hair – these represent the longest growth cycles.

Treatment Schedule

- For a simplistic approach, many centers simply schedule their patients for treatment every 6-8 weeks, even though this does not necessarily coincide with new growth cycles.
- Scheduling according to the body area treated is more efficient, but more complex administratively.

Once could customize a treatment plan according to the growth times of various body areas, but for the sake of expediency most practices simply reschedule a patient once every 6-8 weeks, or just wait until the hair starts regrowing in that area.

10. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- The higher the number, generally the darker the skin, but is primarily an indication of how one burns in the sun (sunlight sensitivity). The darker the skin, the harder it is to treat by laser without burning.
- This scale is the primary determinant of choice of laser type and settings for laser hair removal
- Darker skin types generally require longer wavelengths (and pulse widths) to prevent skin burning (i.e. diode or Nd:Yag lasers), and type IV skin is where this transition starts.

11. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- I – Fair Transparent Skin that always burns in the sun – never tans.
- II – Fair Skin that always burns, but sometimes tans with difficulty
- III – Fair to light olive Skin that sometimes burns mildly, and tans slowly

11. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- IV – Olive to light brown Skin that rarely burns and tans easily
- V – Dark brown Skin that very rarely burns and always tans
- VI – Black Skin that never burns and always tans (hardest to treat because of melanin)

Skin Color & Types



General Rule

The darker the skin, the longer the laser wavelength required to prevent skin damage.



The pictures of these children show a wide spectrum of skin and hair color – much more so than the Fitzpatrick scale we'll discuss takes into account. It's interesting to note that skin color has evolved based on the amount of Ultraviolet (UV) Radiation present where that ethnic group geographically originated. UV Radiation is highest around the equator. That's why the Aborigines in Australia are the darkest skinned peoples, and also why the skin cancer rate for Caucasians is the highest in the world there. Don't confuse the Fitzpatrick scale with ethnicity however. Fitzpatrick will be used to classify skin color and sun sensitivity which may or may not correlate with all ethnic groups, described by the Lancer Ethnicity Scale.




This graphic represents the amount of time that was required to create a sunburn in these skin types – from a short 14 minutes from very light skin to almost 2 hours for the darkest skin – with the same sun exposure.

Type I

Never Tans
Always Burns

Any wavelength works, provided that they're not sun sensitive

Skin Type Photos
Courtesy Radiancy



Provided that they are not sun sensitive, Type I light skin is the easiest to treat with lasers. Virtually any laser wavelength will work, at high treatment doses.

Type II

Occasionally Tans
Usually Burns



Type II skin is also very easy to treat, and is generally not as likely to be sun sensitive as type I skin.

Type III

Tans on average
Sometimes Burns

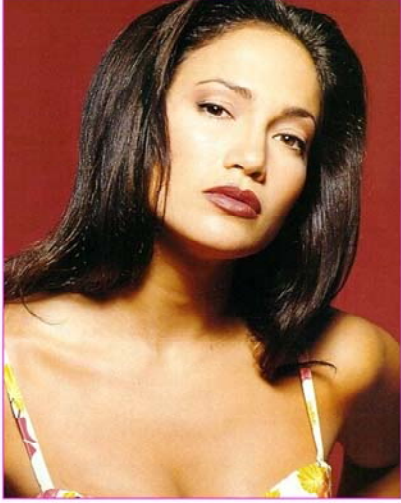


To me, type III skin represents a typical Caucasian. For the most part any of the laser wavelengths will work on skin types I-III, and test shots become more important on the higher class III types, but they're still usually easily treated with any light source.

Type IV
Usually Tans
Rarely Burns

At Type IV, start think 810nm diodes or longer wavelengths.

It's possible to use the shorter 755nm Alexandrite, but with great care and cautious testing.



Skin type four is typical of Latinos, Asians or Mediterranean skin. It isn't really a dark brown yet, but is darker than most caucasians – ignoring suntans. This skin type is the swing point on the choice of laser or even IPL wavelengths, because shorter wavelengths can burn the skin – most particularly the green wavelength range. Here one could consider the 755nm wavelength of the alexandrite laser as a possibility, but only with caution and observation. Better would be the 810nm diode laser or even the 1064nm Nd:Yag laser. IPL's could also be used cautiously on skin type IV if the appropriate cutoff filter were chosen, but go slowly and watch for adverse reactions.

Type V

Mostly Tans

Almost Never Burns

"Maybe" an 810nm Diode
with care, but preferably a
1064nm Nd:Yag.



Skin type V is the darker brown color and one should not consider a laser below 810nm in wavelength, or the 1064nm Nd:Yag would be much safer. Although some practitioners do use IPL's on type V skin with extreme caution, we do not recommend this.

Type VI

Never Burns

1064nm Nd:Yag

Don't even THINK about
an IPL



Type VI is the darkest black skin. The longer wavelength 1064nm Nd:Yag laser is the only reasonable choice here, and IPL's should never be used on type VI skin. Black skin presents the greatest challenge to be safe with any light based treatment and aggressive cooling techniques are critical.

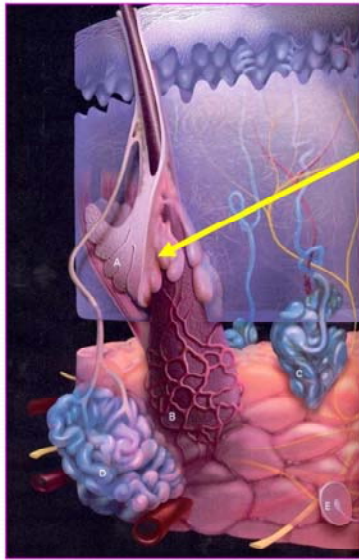
12. Anatomy & Physiology

Skin Anatomy

Sebaceous Glands:

Glands in the skin responsible for production of oils for lubrication of the skin and help retain fluids. They are also the site of the P. Acne bacteria responsible for Acne.

Sebaceous Glands



SEBACEOUS GLANDS (OIL GLANDS)

Help lubricate the skin and retain fluid.
Site for bacterial infections resulting in
ACNE, and the target of ACNE laser
treatments.

The sebaceous glands, which are the oil glands, help us retain fluid and lubricate the skin. This oil, or sebum, is waste that lubricates our skin. It consists of waxes, cholesterol, fatty acids and triglycerides, all of which are synthesized from fat globules and cellular debris. It is secreted along the same channel as the hair follicle. This is also the site where the P Acne bacteria breeds and is the target for Acne treatments.

13. Anatomy & Physiology

Hair Shaft & Follicle Anatomy

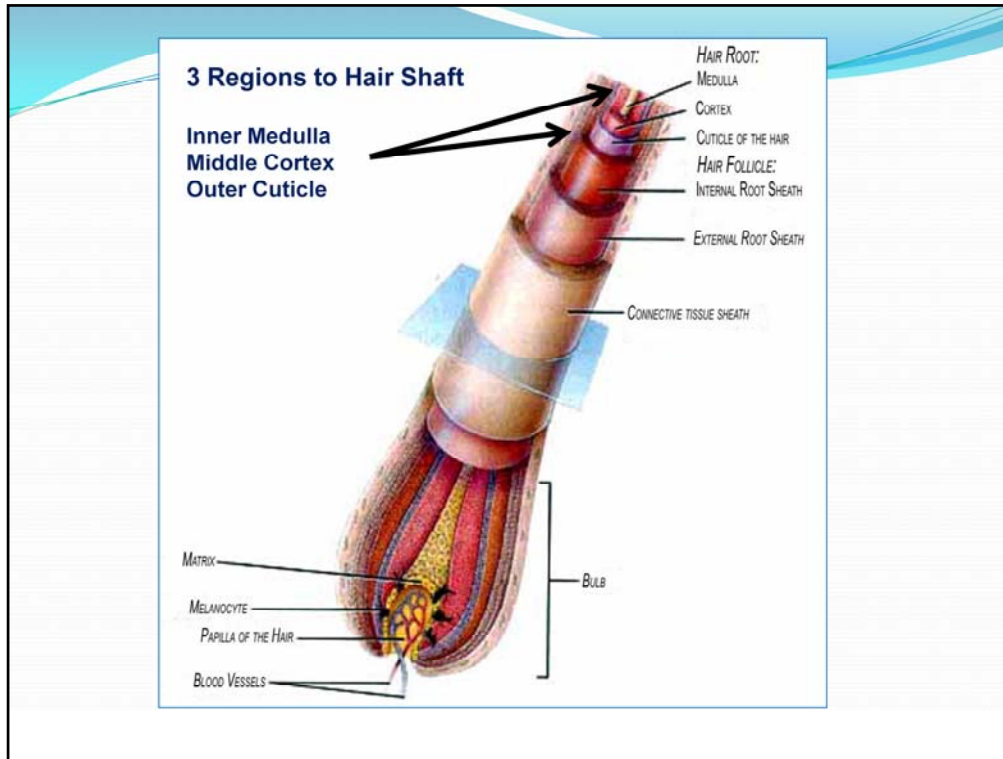
The hair shaft has 3 Regions:

- Inner Medulla
- Middle Cortex (contains Melanin)
- Outer Cuticle

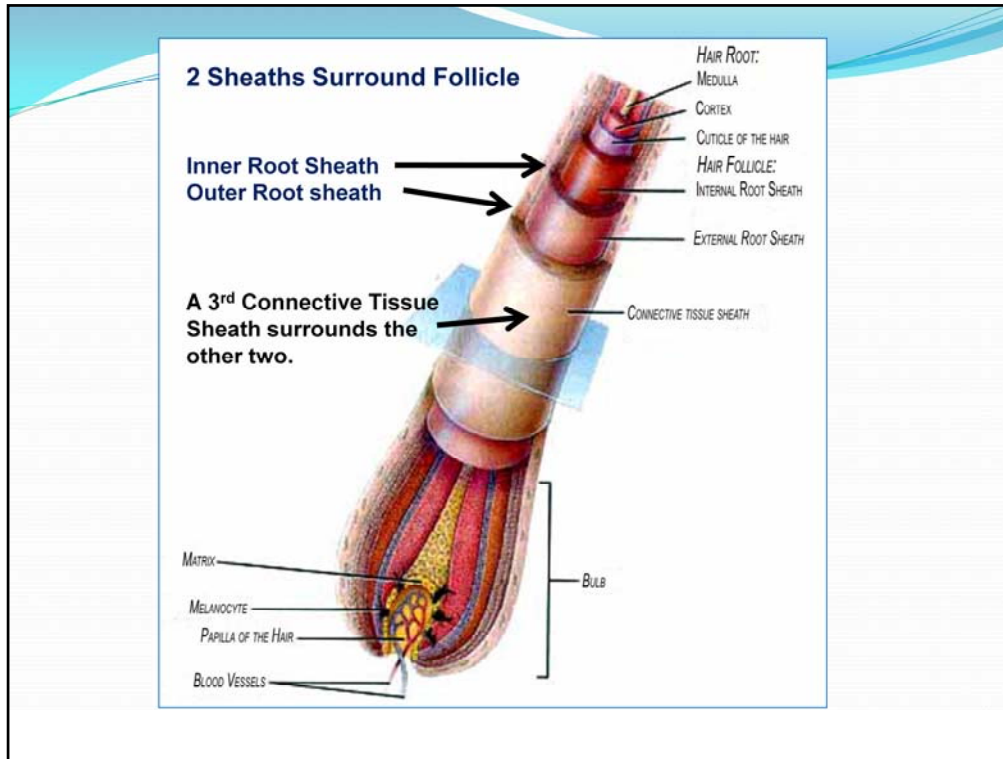
There are two sheaths to the Hair Follicle:

- Inner root sheath
- Outer root sheath

Hair shaft is comprised of dead Keratin Strands.



The hair shaft itself is comprised of three regions; the inner Medulla, middle Cortex, and outer Cuticle. The Cortex contains melanin which will be a target for laser hair removal



There are two sheaths surrounding the hair follicle; the inner root sheath and the external root sheath. The inner sheath protects the hair and molds the shaft to help determine the hair shape. There is an additional 3rd sheath of connective tissue that encapsulates the other two.

HAIR SHAFT



- Grows from the “bottom – up” from the bulb as a helical protein of KERATIN
- 4 helical protein twists for a PROTOFIBRIL
- 11 protofibrils twist together as a MICROFIBRIL
- microfibrils twist together as a MACROFIBRIL
- macrofibrils form the dead HAIR SHAFT

The actual hair shaft is an intricate spiral of protein call Keratin. As these cells are produced in the hair bulb they first spiral together as protofibrils, then twist even more as microfibrils, continue this process until larger macrofibrils are formed, and finally exhibit themselves as the dead hair shaft as more macrofibrils merge.

14. Laser & Energy Concepts

LASER ACRONYM

L IGH T
A MPLIFICATION, by the
S TIMULATED
E MISSION of
R ADIATION

15. Laser & Energy Concepts

Wavelength Identification

(several (not all) wavelength questions asked)

CO ₂ – 10600nm	Er:Yag – 2940nm	Ho:Yag – 2100nm
Nd:Yag (harmonic) 1380nm	Nd:Yag – 1064nm	Krypton – 647, 568, 531
Diodes – 810 nm is typical, <i>but available ~ 530-1500nm</i>	Ruby – 694nm	Copper Bromide 577,510
Alexandrite – 755nm	Gold Vapor – 632nm	Pulsed Dye, 578-600nm (Vascular)
Helium Neon (HeNe) 632	CW Dye (PDT) 630	Pulsed Dye, 504nm (Lithotripsy)
KTP (& KDP) – 532nm	ArFl Excimer 193nm	
Argon – 488, 515nm	XeCl Excimer 308nm	

Also know visible color bands to make it easier to remember:

Blue ~ 488nm, Green ~ 504-532nm, Yellow ~ 568-585nm,
Orange ~ 585-595nm, Red ~ 632-694nm

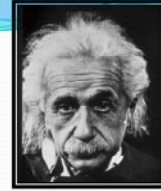
16. Laser & Energy Concepts

HISTORY

- Albert Einstein – theory of stimulated emission based on photovoltaic cells
- Schawlow / Townes – theoretical paper on “Optical Masers” (a laser)
- Ted Maiman – First Laser – Ruby, 1960
- Dr Leon Goldman – father of lasers in medicine & co-founder of the ASLMS

Laser History

Einstein – Theory of Stimulated Emission of Radiation. c1917



Arthur Schawlow and Charles Townes Nobel prize for theory on “Optical Maser” based upon this theory of Stimulated Emission. c1958
(also two Russians simultaneously)

Theodore Maiman invented the 1st Laser – a Ruby Laser - in 1960 based upon Schawlow & Townes theory.



Dr. Leon Goldman began encouraging medical laser research in the early 60's and was a co-founder of the American Society for Laser Medicine & Surgery about 1981. (visit www.ASLMS.org)



Einstein developed the theory of stimulated emission in the early 1900's as a way of explaining how photovoltaic cells work – electricity generated from sunlight – although he did not propose the idea of lasers. In the 50's Schawlow and Townes (working at Bell Telephone), who had already worked with microwave amplifiers, or masers, developed the theory of Optical Masers, or LASERS, and they received the Nobel prize for this theoretical physics paper. Theodore Maimon (working at Hughes Aircraft) developed this first Optical Maser in 1960 as a Ruby Laser. Other lasers began springing up immediately after this, with the CO2 laser being developed in 1964 by Patel. It was Dr. Leon Goldman, a dermatologist at the University of Cincinnati, who began investigating and promoting the use of lasers in medicine by the mid 60's. He wrote the first textbook on the subject in 1966 as “The Biomedical Laser” and later went on to co-found the American Society for Laser Medicine in Surgery whose first annual meeting was in 1981. (see www.ASLMS.org)

17. Laser & Energy Concepts

- Power Density (PD) effects on Tissue
- Power Density Parameters
 - Spot Size (Rapid Change in PD)
 - Power (Slower Change in PD)
- Techniques of changing Power Density with different delivery devices (i.e. focusing or collimated handpieces, bare fibers, waveguides)
- In aesthetics too High a PD can create burns & blistering. (also applies to excessive fluence)
- In aesthetics too Low a PD is generally safe, but ineffective for the treatment. (low fluence too)

ENERGY TERMS

Watts/CM²

- **IRRADIANCE** is the correct term, but commonly called the **POWER DENSITY**.
- This shows the concentration of power in space (spot size of the beam)
- This is the intensity of the delivered beam.
- Once you add the time component (i.e. a 40 millisecond pulse) it converts this into the treatment parameter of Joules/cm² – this is done automatically by the laser.

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The Power Density (properly called Irradiance) of any laser determines the intensity of its effect. This is what most people react to when they talk about “turning the power down” in order to better control the laser. What they’re reacting to is not the power itself, but the combination of the power into the size spot where it is concentrated, or the power density. It is the single most important factor in medical laser applications. Most aesthetic lasers though are set by the JOULES/cm² parameter, rather than Watts’cm². We have to start with the concept of Watts/cm² before we add the time of the pulse to come up with the Joules/cm². You don’t have to calculate anything. You just set the laser directly with these parameters.

Irradiance (Power Density)

- Spot Size & Power (Watts/cm²)
- Spot Size creates the most rapid change
- Power Density is primarily changed by altering spot size – which depends on the delivery system – focusing handpieces, bare fibers, collimated aesthetic handpieces, etc.
- In aesthetics, too high a power density leads to burns and blistering
- In aesthetics, too low a power density does no harm, but is just not effective

Spot size is the most important parameter between power and spot size that affect Power Density. A small change in spot size results in a large change in power density. For surgical lasers that focus from handpieces or diverge from fibers this means that the distance away from the device primarily controls power density because of the rapid spot size changes. In aesthetic devices the spot size is usually, but not always, fixed by each handpiece. In aesthetic procedures too high a power density can lead to burns and blistering, while too low of a power density does no harm – it's just ineffective.

18. Laser & Energy Concepts

Physics:
Radiant Exposure

This is a measurement of the “dose” of light in energy per surface area, or Joules/cm². This is the correct term, but in medicine / aesthetic laser use it is more commonly referred to as “Energy Density” or “Fluence” of the laser spot.

ENERGY TERMS

Joules/cm²

- **RADIANT EXPOSURE** is the correct term, but **FLUENCE** or **ENERGY DENSITY** commonly used
- Energy per unit area (Larger spots require more Energy)
- Treatment parameter for Aesthetic Procedures
- Aesthetic device settings are in J/cm²
- Technicians use protocols as guidelines for treatment parameters, which are supplied by the manufacturers, and generally reviewed by a Medical Director.

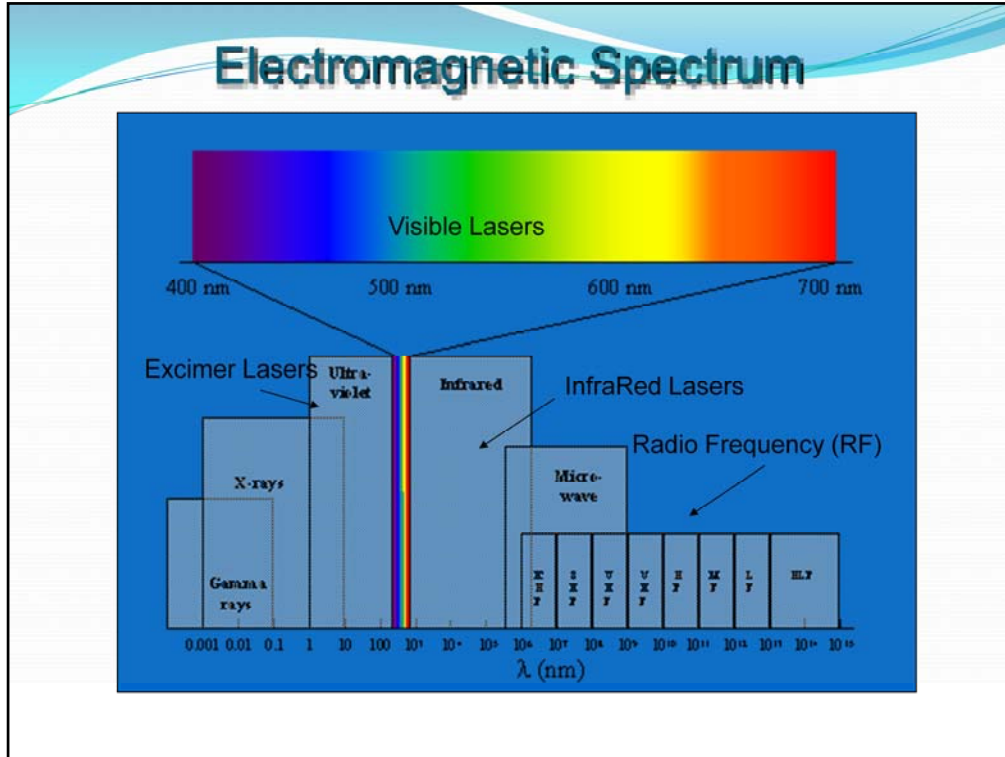
OK – here's our last energy concept, and it goes by different names. It's properly called Radiant Exposure, but is most commonly called Fluence or sometimes Energy Density. You won't see this used much if any for surgical lasers – mostly aesthetic.

The concept of Joules/cm² is similar to that of Power Density except it takes into account how much energy was actually delivered over time. Most surgical laser procedures that involve excision or ablation of tissues don't rely upon a defined "Dose" of Joules/cm² to perform the procedure – the physician stops when they've visually achieved the surgical effect they want. In most aesthetic and dermatological procedures however one does use this "dose" of light to obtain the desired effect and maintain consistency and patient safety from treatment to treatment. Initial starting parameters are usually determined by the "cheat sheets" provided by manufacturers. Patients are then given "test shots" in small obscure areas using bracketed doses to determine their best response, and the treatments are then carried out at these tested dosages. Time and experience with such laser treatments help refine each individual's practice of this "art" of laser procedures.

19. Laser & Energy Concepts

Physics:
Light Wavelengths

- Approx 400 (Blue) to 700+ (Red) nm Visible
- Infrared ~800+ nm
- Ultraviolet – below ~351nm



Electromagnetic energy is one of the four primary forces of Physics. Visible Light is only one portion of the Electromagnetic Spectrum but lasers span the range from Excimer lasers in the ultraviolet range, to CO₂ lasers in the far infrared range. At even longer wavelengths we get into radio frequencies, such as used by some of the cosmetic skin tightening devices. Each type of laser exhibits not only a unique wavelength of light, but frequently a characteristic way it delivers its energy. In many instances the way the energy is delivered is more important than the wavelength itself, especially for aesthetic laser applications. The shorter wavelengths of X-Ray and Cosmic rays do have ionizing radiation associated with them because of the very high energies of very short wavelengths, however the wavelengths used by medical & aesthetic laser systems are not in this range.

20. Laser & Energy Concepts

Equipment Considerations:
Laser Settings for patient treatment

- Lasers for most aesthetic procedures are set to a targeted energy density expressed in Joules/cm²
- This includes pulsed dye lasers for vascular; hair removal lasers such as alexandrite, diode or Nd:Yag; and others.

Radiant Exposure - Fluence

Joules/cm²

Most aesthetic laser equipment display their energy density in Joules/cm² as simply a “Joules” setting. Understand that these are really two different concepts.

It's relevant to note that even though most aesthetic lasers are set at the control panel with the desired Joules / cm², the manufacturers frequently abbreviate this labeling to simply “Joules” , instead of correctly calling it Joules / cm². Don't be confused by the two terms. For instance a 23 Joules/cm² setting does NOT mean that you are delivering 23 Joules of energy. It might be more or less than 23 Joules, and would only equal 23 Joules if you used exactly a 1 cm² spot size – which would be a typical 10mm spot handpiece. If your spot is smaller than this you would be delivering LESS than 23 Joules (because it becomes concentrated) and if the spot is larger than 10mm then the energy would be more than 23 Joules – all at the 23 Joules/cm² setting.

21. Laser & Energy Concepts

Pulsed Laser Emission

- A compression of laser energy which emits power (watts) at a higher rate than is otherwise attainable in CW (Continuous Wave) mode
- This is different than a simple “timer” on a CW beam, which is sometimes called a “Gated Pulse”
- Is more thermally “precise” on tissues than CW mode

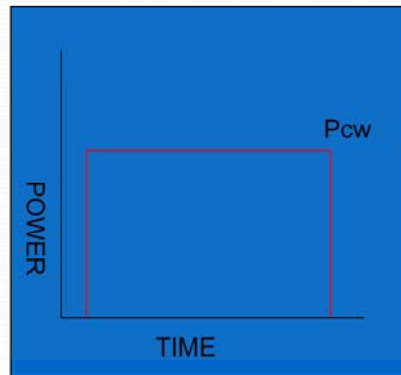
Modes of Laser Operation

- Continuous Wave emission (CW)
- Pulsed emission (and average powers)
This delivers high Flux energy delivery
- The Difference between true Mode of Operation and Control Panel labeling

Aesthetic Lasers are primarily PULSED LASERS

The modes of operation of any laser are basically divided into Continuous Wave versus Pulsed laser modes. This can be confusing because this is a different issue than this same terminology as used by many manufacturers to label the control buttons on the laser panel. Sometimes they coincide and other times not – you just have to know your laser. On a control panel the word Continuous might mean that the beam is emitted continuously as long as the foot pedal is depressed. Or it might be a very rapid series of pulses that are emitted. Likewise a panel button might say “single pulse”. This could mean that a continuous wave beam is emitted for a very short period (like 0.1 second) while the foot pedal is depressed, and will not fire again until you release the pedal and fire again. This is really a timer and not a true laser pulse. Its really not as confusing as it sounds. A continuous wave beam is a steady state delivery of energy, while a pulsed laser beam compresses the energy delivery to very high rates of power delivery in very short pulses – usually in milliseconds or faster).

Continuous Wave Emission - CW



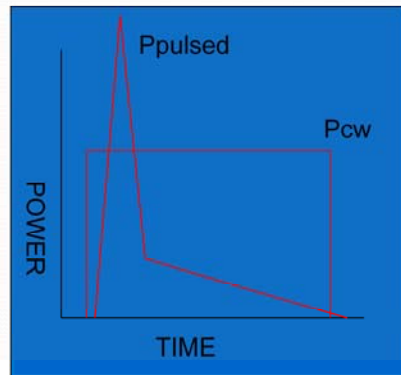
You may emit a CW for short periods of time by “gating” the shutter or electronics. This is then called the “Exposure Duration”.

Continuous Wave (CW) is a steady state delivery of laser energy. It's peak powers are usually lower than pulsed lasers, but can deliver large blocks of energy.

Mostly Surgical Lasers

P_{cw} refers to Power – Continuous Wave. Regardless of the time frame involved (0.1 seconds or ten minutes) the level of the power remains constant throughout. Each laser operating in this mode has a limit to the maximum amount of power it could produce (remember this is how quickly the energy is delivered), because the laser resonator holds only so many atoms or molecules to produce the light. CW lasers can be very effective, but they're not very quick in a laser sense of delivering their energy. Because they act a bit slower to create effects, heat induced in the tissues begins to conduct away from the surgical site heating adjacent structures.

Pulsed Laser Emission



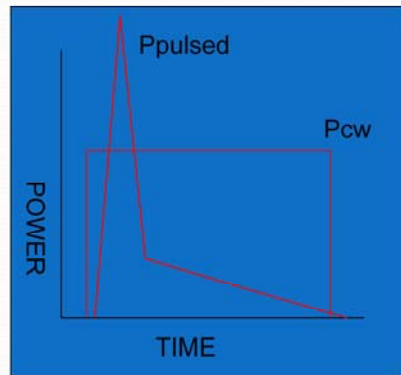
Pulsed Lasers emit light in very short pulse durations which are of much higher peak powers than are possible in the CW mode.

Most Aesthetic Lasers

The Pulse "Compresses" the same amount of energy to deliver it in a much shorter period of time – usually microseconds or nanoseconds. This is then called the "Pulse Width". (A Higher "Flux" energy delivery)

A true laser pulse is a compression of laser energy (high rate, or peak power, of delivery). In a pulsed laser this peak power has the ability to exceed the maximum power output of the laser when emitting in its CW mode. It can't maintain this constantly though like CW can, and there must be intervals (although some can be very short) in between each pulse. These pulses can be emitted individually, slowly, or in a rapid machine-gun like effect. These are high flux laser pulses and keep lateral heat spread from the surgical site to a minimum.

Pulsed Laser Emission



A pulsed laser such as the LightSheer Diode for hair removal for instance may go to 1600 watts of power in 30 milliseconds, and deliver up to 100 joules/cm² of energy in a 9mm spot.



Most aesthetic lasers operate in this high flux pulsed manner. The Lightsheer Diode laser for hair removal is an example that illustrates this. As an operator you'll just select the fluence in Joules'/CM2 you want to deliver with this laser. You may be able to read the pulse width but I don't recall that you can set it directly on this machine. You won't see anything at all about peak power, but this laser emits at over 1600 watts – or 1.6 KW – when you're delivering a high fluence of 100J/cm2 with it's standard 9mm spot. Each laser is different, and although it's not important for you to understand or even know the technical parameters behind each piece of equipment, an understanding of the general concept is very important.

Pulsing Terminology

- Q-Switch (very high peak power pulse delivered in nanoseconds)
- Pulse Repetition Rate (PRR) – times per second
- Hertz (Hz) – times per second
- Pulse Width – used when discussing pulsed lasers
- Exposure Duration – used when discussing CW lasers

Lets just summarize some of the buzzwords used when talking about laser pulses so you're more familiar with the terminology. You'll see terminology used in various ways on manufacturers literature and in the scientific papers.

Q-Switch is a very fast laser pulse measured in the billionths of a second, or nanosecond, and usually generate very high peak powers in the megawatt range. In aesthetics you'll see these as tattoo removal lasers.

Pulse Repetition Rate and Hertz mean the same thing – the number of pulses per second that you deliver.

When discussing the time of a pulse there are different terms for a truly pulsed laser versus a CW laser, although most people will just use the term pulse width for both. Just so you've heard it once though, the term exposure duration is more properly used for a CW laser.

REMINDER

You're about a third the way through this review!
(Only 127 more slides to go)

Just a reminder to concentrate on those review slides with the bullet points, and don't overly fixate on the expanded slides.

THIS IS THE END OF THIS MODULE.

CONTINUE ON WITH MODULE II to start with Review Slide 22 .



Laser Certification Review

Expanded Study Guide – Module II

Certified Laser Hair Removal Specialist

National Council on Laser Certification

www.LaserCertification.org

Not All of these Slides are Narrated, but many are.

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22. Laser & Energy Concepts

FLUX


- Concept of delivering more energy in shorter time periods, in a pulse, to reduce thermal spread.
- 1W at .2s (.2J) is lower flux than 2W at .1s (.2J still).
- Look at the concept, and balance the power and time settings to see which is a higher fluence.

FLUX

Joules of Energy = Watts x Seconds

Concentration of Energy in Time

F
L
U
X



- o 50 millijoules (mj) = 100 watts for 0.0005 sec
- o 50 millijoules (mj) = 50 watts for .001 sec
- o 50 millijoules (mj) = 5 watts for .01 sec
- o 50 millijoules (mj) = 1 watt for .05 sec

- Hot & Fast – or Low & Slow -

Just get the concept – don't worry about the term.
It's better to deliver energy quickly so heat does not spread.

Don't worry about the terminology in this slide – I just want you to get the idea of delivering energy quickly in a pulse.

If Power Density describes the concentration of laser energy in a physical space, then FLUX describes its concentration in time. You won't hear this term much but its an important concept.

If one has a fixed amount of energy that is desired to be delivered (here it's 50 millijoules, typical of one pulse from a CO2 superpulsed laser), then the faster the time period you can deliver that amount of energy is said to be of a higher flux. Since Joules = Power x Time, and you're holding the Joules fixed, it means that to deliver the same amount of energy in joules in a shorter time period requires a higher peak power pulse. This will be a "compression" of energy delivery in time. It is the basis for all modern pulsed lasers used in aesthetics, and for the Ho:Yag laser used on urology and orthopedics.

FLUX

Joules Energy = Watts x Seconds

Concentration of Energy in Time (Bolos of Light)

- The concept of MORE Energy in a SHORTER time
- $1W @ 0.2s = 0.2J$
- $2W @ 0.1s = 0.2J$ (This is the higher flux)

- $25J/cm^2 @ 40ms$
- $25J/cm^2 @ 5ms$ (This is the higher flux)

*Higher Flux pulses result in less thermal spread
and are required for very small structures such as Velus hair
or small capillary's*

Lets look at a couple examples of higher flux pulses. In the first we're looking at 0.2Joules of energy. One delivers it in 0.2 seconds, and the other in half that time – 0.1 second – so that's the higher flux and more precise in terms of confining thermal spread.

The second example would be from a typical hair removal laser generating a Fluence of 25 Joules/cm². One is delivered in 40 ms, and the other in 5ms. The 5ms delivery is a higher flux pulse and would be more effective at the laser hair removal – being careful still about darker skin that we'll deal with in later modules. Some aesthetic lasers allow you to vary these pulse widths and others do not. You just have to play with the control panels and see what each piece of equipment allows you to change.

23. Laser & Energy Concepts

Typical Power/Energy Display & Measurement:

In addition to the Energy “Joules” orientation, most aesthetic lasers are set to J/cm^2 which is the Radiant exposure and include aesthetic and hair removal lasers such as”

- Alexandrite
- Diode
- Nd:Yag, and others

Power/Energy Displays

As a General Rule:

- CW Lasers are set and measured in WATTS (rate of energy delivery)
- Pulsed Lasers (most aesthetic lasers) are set and measured in JOULES (total energy delivered)
- Many manufacturers set the display so that JOULES is automatically converted to J/cm²

When looking at the power and energy displays on various lasers, we can make some generalizations about how the settings are made and read. Remembering that power in watts and energy in joules applies to all lasers all the time, it's not important to see all this info on each laser.

CW lasers, which are primarily surgical, are set and measured in WATTS of power, and you rarely see an energy reading in Joules.

Pulsed lasers, which are primarily - but not entirely - aesthetic, have their energy set in JOULES of energy delivered.

On most aesthetic pieces of equipment the manufacturers usually take it even one step further by factoring in the spot size of the delivery system, and actually allow you to set the energy in Joules/cm² which will be your treatment parameter.

Power/Energy Displays

Watts or Milliwatts:

- CO₂, CW Nd:Yag, CW Dye, Argon, Many Surgical Diodes – Watts
- Ophthalmic Diode Laser - Milliwatts

Joules or Millijoules:

- Ho:Yag, Alexandrite, Ruby, Pulsed Dye for vascular, Q-Switched Tattoo Nd:Yag – Joules
- Q-Switched Ophthalmic Nd:Yag, Pulsed Dye for lithotripsy - Millijoules

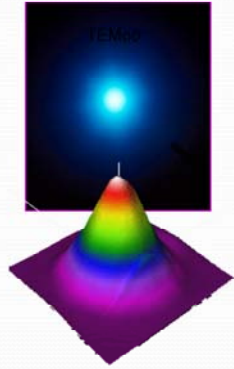
OK – so without having to remember all of these, these are some of the examples of lasers that typically have their control panels set in either WATTS, or in JOULES.

24. Laser & Energy Concepts

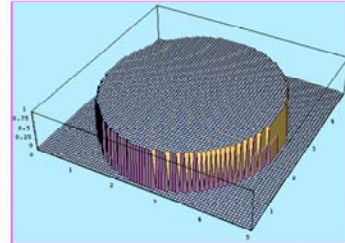
Optics Principles - Beam shapes

- Sinusoidal “TEM₀₀” best for sharp incisions and ablations
- “Flat Top” or “Top Hat” type modes preferred for aesthetic procedures including laser hair removal

Energy Distribution in Large Spots



Sinusoidal “TEM00” best for sharp incisions and ablations



“Flat Top” or “Top Hat” mode preferred for Aesthetic Laser Procedures for even distribution within the spot.

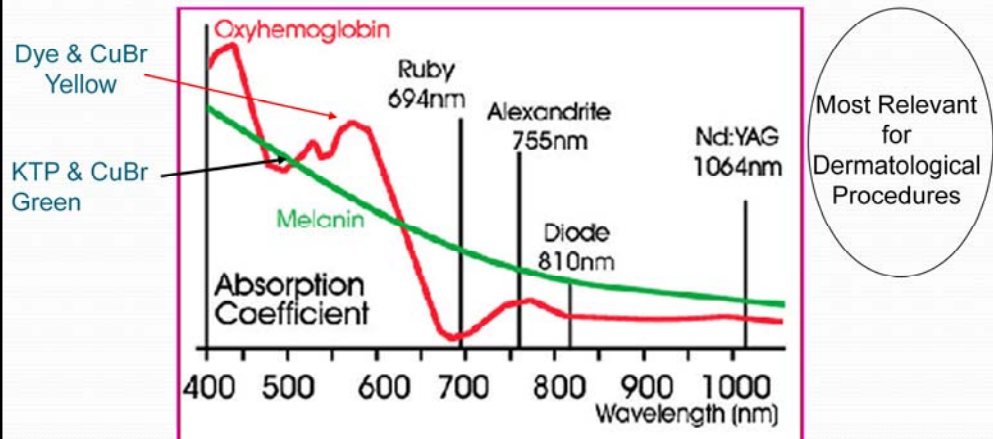
Before we discuss laser delivery devices we need to introduce just the concept of Laser Beam shapes – the distribution of energy within the actual laser spot. This is referred to as the Transverse Electromagnetic Mode (TEM) of the laser beam. For the surgical operator or user, one need not get too technical with this, but be aware of the differences and possible effects. The basic laser mode is a TEM₀₀ mode, meaning that it is “brightest” in the center and continues to fade with distance from the center. These make excellent excisional or marking lasers because they may be focused to very small spots. Trying to broaden the spot to treat larger areas of skin in aesthetic procedures though could cause a problem because the center of a 7mm spot size will have more of an intense effect than the outside of the same spot – resulting in irregularities in treatment. Beams that have “flatter” beam profiles are more desirable in these applications because the results are more uniform. This beam mode is fixed in the design of the laser, is not adjustable by the user and does not ordinarily change. Some manufacturers discuss their beam shape in their literature, but it’s also possible to test each device at very low power by using special thermal paper to see this shape.

25. Tissue Interactions

Chromophore

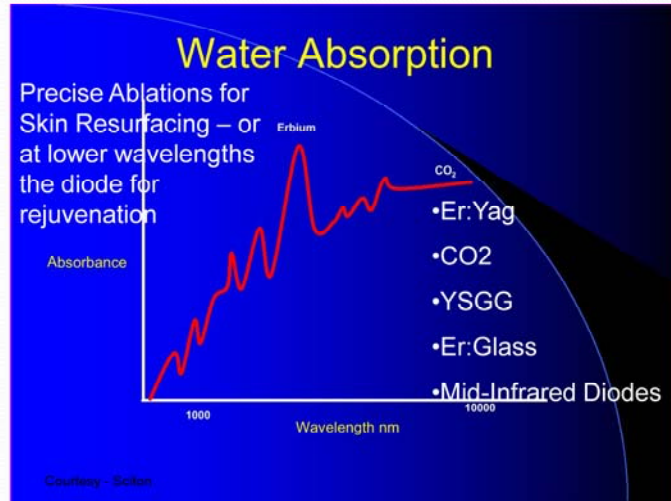
- Refers to the object that absorbs that particular wavelength of light. In dermatological laser procedures the two primary competing chromophores are melanin in skin and oxyhemoglobin in blood vessels

Simplified Tissue Absorption



1. Longer wavelengths are less absorbed by melanin (safer for dark skin)
2. Longer wavelengths penetrate more deeply into skin (deep vessels)
3. Red blood vessels absorb best in the yellow to orange range (safest)

Water Absorption



Water is another major chromophore for absorption of laser light. Once you're past about 1400 nm in the near infrared, fluid in your cells becomes the most predominate factor for absorption of light, rather than melanin or hemoglobin per se. You'll see some skin rejuvenation lasers at about this 1400nm cutoff because they're good for deep dermal heating due to a high degree of fluid absorption. The most highly absorbed by water is the Er:Yag laser, closely followed by the YSGG, CO₂ and Er:Glass lasers – all used for laser skin resurfacing. Remember too that the wavelengths above 1400 nm will not transmit back to the retina, so are corneal hazards rather than retinal ones.

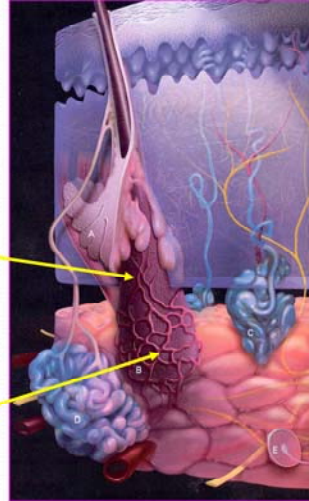
26. Tissue Interactions

Laser Hair Removal

- Target is the hair follicle – the bulb and “bulge” of the hair follicle, and the matrix of nerves and vessels surrounding the hair bulb. Melanin around the follicle is the target chromophore.
- Laser Hair Removal works by selectively heating these targets to lethal temperatures
- Steps must be taken to prevent overheating of the skin at the same time

Target for Laser Hair Removal

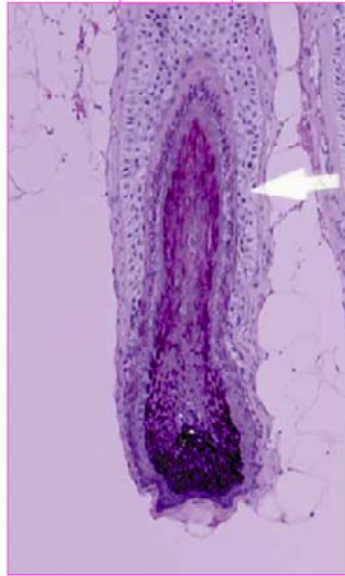
- ↘ Hair bulge
 - ↘ Thickened area of root sheath above bulb. Contains cells that can regenerate entire hair follicle.
- ↘ Hair bulb
 - ↘ Deepest structure in hair
 - ↘ Melanin responsible for hair pigmentation



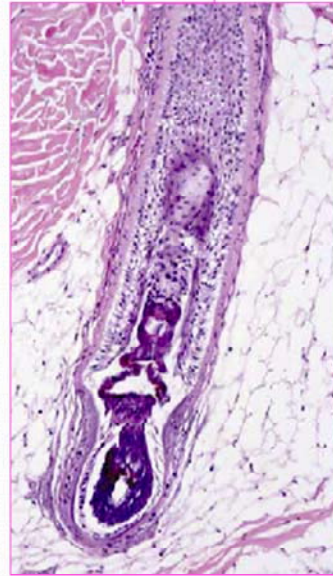
Recall that we're trying to destroy the hair follicle by killing the hair bulb and bulge with high temperatures, without hurting overlying skin.

Hair Histology

Before



After



What we're finally after is thermal destruction of the hair follicle as shown here.

Strategic Skin Cooling

Active skin cooling must be used to prevent bad outcomes, and to increase client comfort:

- Cooling Gels
- Cryogen Sprays (Dynamic Cooling Devices)
- Cold Air Chiller
- Contact Cooling (cold sapphire & metal plates)
- Post treatment cooling packs

Active skin cooling is a very important consideration in aesthetic laser skin procedures, and there are various options. The use of cooled gels on the skin is probably the most common but least effective method, although it does work. More aggressive methods include cryogen sprays automatically generated from the handpieces of some lasers, external cold air chillers that get very cold – which are frequently used with the gels, or cold contact cooling plates like chilled sapphire plates which you can fire many lasers through, or just plain cold metal plates or rollers that are applied just before and after the laser pulse. Most practitioners additionally provide the client with refrigerated cooling packs to place on the affected area for a few minutes after the treatment.

27. Tissue Interactions

Laser Hair Removal

- Treatment regime of 5-7 treatments may be required. (sometimes more)
- FDA defines “permanent” hair removal as a long term stable reduction in the number of hairs regrowing after a treatment regime.

What is Permanent Hair Removal?

The FDA defines this as a long term stable reduction in the number of hairs regrowing after a treatment regime.

Laser / IPL can do a good job, but the patient can't be promised that all of the hair in the treated area will go away forever. Most are very pleased with the results however, and some is truly permanent.

Permanent is a relative term. You should not promise patients that Laser Hair removal will rid them of hair forever in the treated areas. The FDA defines it only as a long term stable reduction in the number of hairs regrowing after treatment. In spite of that most people are happy with the results, and sometimes you can get truly permanent and complete hair removal.

28. Tissue Interactions

Hair Color

- “Pheomelanin” in Red and Blond hair does not respond well to wavelengths above 740nm.
- Red and blond hair may respond better to IPL wavelengths below 740nm, or Ruby lasers at 694nm.
- Regardless of device, Red and Blond hairs are among the most difficult to treat (aside from Gray or White which are worse).

Pigmentation of Hair

→ **Eumelanin**

- Brown, black – any laser works

→ **Pheomelanin**

- Red, Blond
- Does not respond much above 740nm, so the Ruby or short wavelength (640-740nm) IPL's are the only ones effective

→ **Gray Hair**

- Mixture of normal hair follicle and those with no color

Hair can be divided into those with two types of pigment.

Brown and Black hair contains Eumelanin, and virtually any of the lasers work for this.

Red and Blonde hair contains Pheomelanin which doesn't respond well at all to any of the wavelengths above 740nm, which are most of the hair removal lasers. Here the shorter wavelength 694nm Ruby laser, or even the short wavelengths on an IPL are more effective. The problem with these short wavelengths is that it must be with a light skinned patient or you'll create at least pigmentary changes if not burns and blisters on darker skin.

Gray and White hair is also very difficult to treat.

29. Laser & Energy Concepts

Equipment Considerations - Skin Cooling

Multiple methods may be used for skin cooling to prevent burns & include:

- Cooling Gels (maybe least effective, but common and adequate)
- Cryogen sprays
- Contact Cooling - Chilled Crystal windows such as sapphire plates used for contact cooling of the skin (chilled circulating fluids keep the plate cool), or cold metal rollers.
- Cold Air Chillers to blow refrigerated air on skin

31. Laser Safety

Safety Practices - Skin Cooling

Overcooling of the skin could make treatments like laser hair removal less effective, but appropriate skin cooling is always provided in order to:

- Reduce the risk of blistering and burns (or scars)
- Reduce swelling & inflammation
- Reduce patient discomfort

32. Laser Safety

Safety Practices - Skin Cooling

“Forgetting” to use or to activate the skin cooling system, or failure of the system during a case, can result in burns or blistering of the patient.

Always monitor the skin cooling system.

33. Laser Safety

Safety Practices

- Excessive Heating of Skin
 - Developing strategies to prevent or control excessive skin heating is critical to all dermatological laser procedures.
 - Blistering can potentially lead to infections.
 - Scarring, including Keloids, or hypo or hyperpigmentation can also result.

Protective Skin Cooling

(Applies to All Aesthetic Laser Procedures)

- Cooling Gels
- Cryogen sprays
- Chilled Crystal windows such as sapphire plates used for contact cooling of the skin (also metal rollers)
- Cold Air Chillers to blow refrigerated air on skin

Cooling is the first line of defense against both discomfort and adverse reactions. These include cooling gels, cryogen sprays, cold sapphire and metal plates, and cold air chillers.

Protective Skin Cooling

(Applies to All Aesthetic Laser Procedures)

Overcooling of the skin could make treatments like laser hair removal less effective, but appropriate skin cooling is always provided in order to:

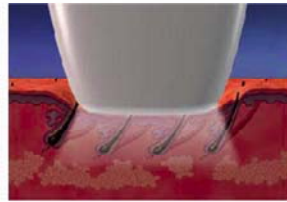
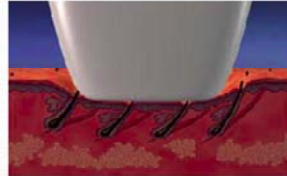
- Reduce the risk of blistering and burns
- Reduce swelling & inflammation
- Reduce patient discomfort

It is theoretically possible to overcool the skin so that you'd actually protect your intended target from any heat damage. This is why simple techniques like holding ice bags against the skin for prolonged periods prior to the treatment are not used. You'd probably prevent discomfort and damage, but you'd also reduce the effectiveness of your treatment.

The various skin cooling methods are used though to first increase comfort, and then reduce the chance of swelling and inflammation or blistering and burns.

CONTACT COOLING

- Water circulates around the tip of the hand piece to cool the skin.
- Condensation builds up on the tip and technician needs to keep cleaning it.
- Cools only when the tip is in contact with the skin. Ensure that it IS in contact before firing, and hold it there momentarily afterward.



Very Effective

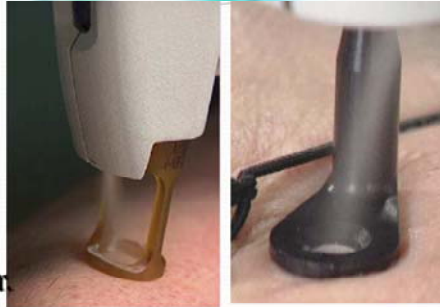
Contact cooling adds the advantage of compression of the skin to bring the hair follicle closer to the surface. Failure of the cooling system, or failure to activate it, can result in significant burns, so that it is important to continually check the “coldness” of the tip during treatment.

Cryogen Spray

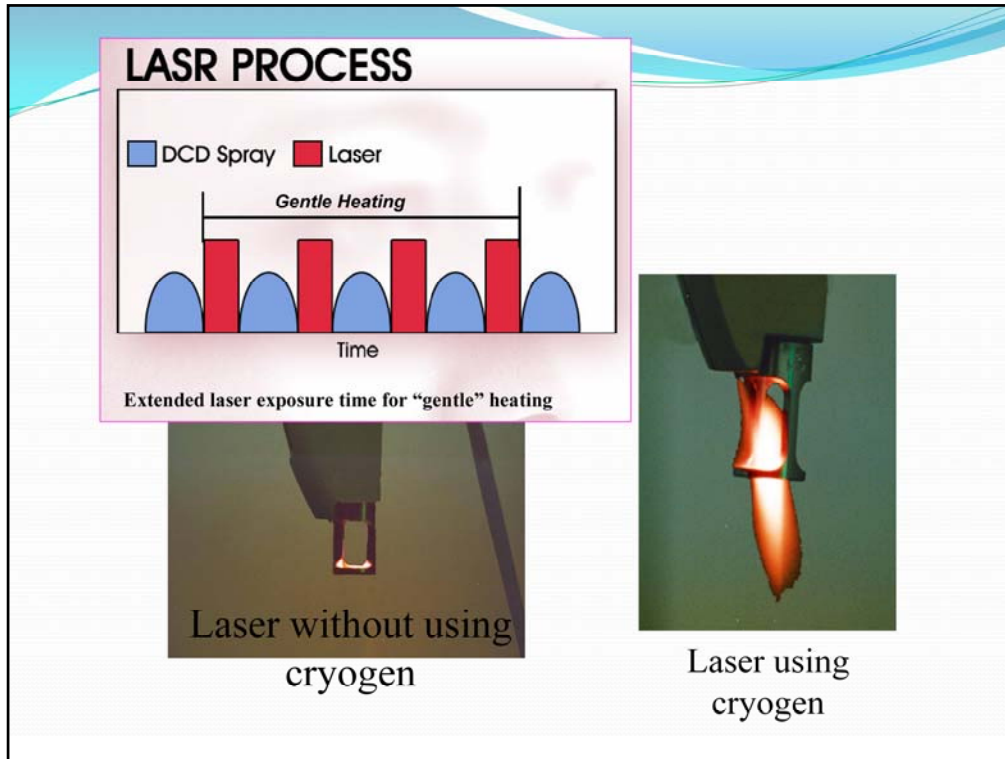
DCD (Dynamic Cooling Device)

It was originally designed to cool the skin because the laser pulse duration (3msec) is harsh on the skin. Developed by Candela Laser

It is very effective, but care must be taken not to lose the “triangulation” of the laser and cryogen spray, and not apply excessive spray times.



The cryogen sprays are very effective, and allow more aggressive shorter pulse widths than might ordinarily be tolerated, and make it safer to more aggressively treat dark skin. You must be careful though to maintain coordination so that the cryogen spray keeps hitting the point of laser impact. Otherwise burns and blisters may result. Excessive cryogen pulse times can also cause “freezer burn” like effects to the skin.



The cryogen spray does scatter the laser light and absorb some of the energy. Empirically however it works well and these pulsed lasers have adequate energy delivery to overcome any scattering/absorption of the cryogen spray. In hair removal these would be alexandrite and nd:Yag lasers.

34. Tissue Interactions

Laser Hair Removal

- Ideal patient has light skin, dark hair, and is not overly sun sensitive.
- Difficult or impossible to treat would be gray or white hair – especially on dark skin. This is a relative contra-indication.
- Other methods for treating light hair include Photodynamic Therapy or Radio Frequency Electrical methods (aside from electrolysis)

Laser Hair Removal

- Ideal patient is light skin with dark hair, and no sun sensitivity
- Difficult or impossible is gray or white hair, especially on dark skin. This is a relative contraindication.
- Other methods for light hair include electrolysis, radio frequency or photodynamic therapy (future use).

Remembering that we're trying to generate heat to kill the hair follicle through absorption of light by melanin around the follicle, the best candidates remain very light skinned people with dark hair. Almost any hair removal laser works well on these patients and you can use fairly aggressive settings with little risk of injury. The really hard ones to treat are with darker skin, and if they are older with gray or white skin it becomes virtually impossible.

Gray & White Hair Problems



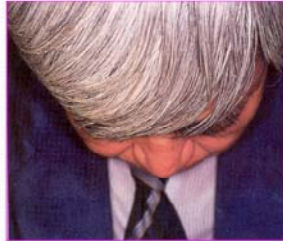
Gray hair is treatable but it takes very aggressive settings, which then limits it to light skinned clients. You also should determine whether the hair is really gray – which contains some pigment to target – or just appears to be gray because the hair is a combination of black and transparent white hairs as in this photo. Here the laser would be extremely effective on the dark hairs, but wouldn't touch the white ones. On a patient like this you might get a complaint that your treatments are turning their hair gray or white – because over time all that remains is the white hair and they don't realize that it's just because you're removing the dark ones.

Gray & White Hair Problems



Options:

- Electrolysis – Most effective
- RF Plus Light (i.e. ELOS – Syneron)
- Meladine Dye
- VERY aggressive settings IF they are very light complected (Type I or II)
- Discretion is the better part of Valor – leave well enough alone and don't bother



* PDT was shown in the 1980's to kill hair follicles of any color – including white.

Although one could try RF or meladine dyes with these truly white hairs, the more certain solution would be to followup on all the remaining white hairs with electrolysis. Gray hairs are difficult but easier than the truly white ones.

35. Aesthetic Procedures

Laser Hair Removal, Tissue Effects

Ensuring first that no blistering or burning is created on skin, good indications of the clinical end point for laser hair removal can include ejection of the hair shaft from inside the follicle, or redness & swelling around the hair follicle (perifollicular edema).

Remember not to be blind sided by staying fixed on written parameters – pay attention to what the tissue is doing.

If the skin starts turning gray or you get some separate of the epidermis – STOP. Immediate erythema or stronger reactions is also a reason to stop and reassess the situation

Clinical Endpoints

(first ensure no burns or blisters)

- Slight erythema response seen 5-20 minutes post test spot / treatment
- Follicular edema is seen 10-20 minutes post treatment. (perifollicular edema)
- Immediate ejection of the hair shaft stub
- **Caution:** immediate erythema / purpura could be an indication of recent sun exposure, tan or too high energy

The expected clinical endpoint is a slight erythemic response. Effective treatment is to the hair follicle, not to the epidermis, and perifollicular edema may be seen in 10-20 minutes after treatment, but is not seen every time.

The clinical endpoint can be determined by placing test spots at a variety of energies on the patients skin and waiting 15 – 30 minutes. A light erythemic response indicates the energy best tolerated by that individual.

An immediate erythemic response or purpuric appearance usually indicates recent sun exposure or tanning. Laser energy must be decreased or the treatment stopped. Future treatments may continue when the tan has faded.

Aside from perifollicular edema, another good endpoint is the immediate ejection of the hair shaft.



Here's a good example of perifollicular edema seen several minutes after the treatment. This is a good sign.

Indications of singed hair can also be a good sign. You may notice the odor, or the gel takes on a brownish color from the vaporized follicle. Sometimes you can see singed hair as it is ejected.

36. Laser Safety

Safety Practices: Skin prep for Laser Hair Removal

- If area is tweezed or waxed, or had electrolysis, then you've removed the primary target for the laser to generate heat at the follicle, and the laser treatments will be ineffective. If performing electrolysis first, the same applies, but there is no reason for laser treatments after electrolysis.

Pretreatment for Laser Hair Removal

- ➔ Shave the day of, or the night before the treatment
- ➔ Discontinue waxing / electrolysis, depilatories etc. once treatments start
- ➔ SPF 15 sunscreen for 4 - 6 weeks prior to treatment if sun exposure can't be avoided.
- ➔ Avoid sun exposure, tanning booths or creams
- ➔ Caffeine can make skin more sensitive

Patients should be instructed to shave prior to the laser therapy.

Waxing and electrolysis should be avoided for 1 month to allow for the growth of the hair follicle. For effective laser treatment the hair follicle must be in the anagen or growing phase, but you don't have direct control over that.

Sunscreen should be applied to the treated area 4-6 weeks prior to the laser treatment whenever that area is exposed to the sun.

Sun exposure must be avoided afterward to avoid post treatment complications.

Pretreatment for Laser Hair Removal

- **SHAVING** - If area is not shaved the energy will be wasted on the exposed hair shaft. The vaporizing hair shaft can also contribute to skin burns, or burn the delivery device such as contact windows or IPL filters. In addition the extra odor is unnecessary.

If shaving is not done then the energy is wasted on external hair shafts, and singeing of the skin or damage to your delivery device might occur from the charred hair on the skin – not to mention the extra smell involved.

37. Laser Safety

Safety Practices - Laser Hair Removal

Stronger relative contra-indications may include:

- Photosensitizing medications – (i.e. accutane)
VERY Strong contraindication
- Active Infections such as herpes, cold sores, etc.
(one of the stronger contraindications)
- Dark Tan in a Caucasian (send them away until the tan fades, or sometimes can use bleaching creams to speed the process)
- History of Keloid scarring in family

Photosensitizers

A very wide range of foods and drugs can cause exaggerated reactions to laser & IPL treatments.

Some of the major of these include NSAIDS (i.e. Ibuprofens), Antibiotics, Anti-Arrhythmics, Birth Control Pills, Retin-A®, Premarin, Anti-depressants, Chemotherapy agents, Corticosteroids, Endometriosis Management, Erectile Dysfunction (i.e. Viagra), Appetite suppressants, some sunscreens, fragrances & perfumes, and many others.

Recent sun exposure is the first on the list for creating photosensitivity and exaggerated reactions to treatments, but there are a wide range of medications, foods and skin ointments that can also cause adverse reactions. Some of those are listed here.

Photosensitizers

More In-Depth Resources:

www.LaserTraining.org,

then choose “Resources”,

then choose “Photosensitizers”

Articles, Lists and Links.

We can't list all the drugs and foods that might cause these photosensitive reactions in a slide show, so we've posted most (but not all) of them on our nonprofit website at www.LaserTraining.org, under “Resources” and then under the photosensitizers selection.

That page also contains links to other good sites such as the FDA, Merck Manual, Medical Societies and others that contain good information on photosensitivity and photosensitizers, as well as photodynamic therapy. Everyone reacts differently so what might cause a reaction in one person may not in another. If you're doing a treatment and get unexpected heightened reactions, first ask again about recent sun exposure, then ask about recently taken medicines or different foods.

Contraindications

The following slides indicate some typical contraindications.

The determination of what actually constitutes contraindications though should be left up to the medical director of the practice. This can be affected by many variables unique to each patient.

There are a variety of conditions that could be considered a contra-indication to laser hair removal or other aesthetic laser or IPL procedures. Because this really boils down to unique specifics with each patient, the medical director of the program should be the one to ultimately determine the relativity of various contraindications and whether or not to offer treatments.

Contraindications

- ↘ Sunlight Sensitivity
(can be balanced with settings and test shots)
- ↘ Recent Sun Exposed Skin
- ↘ Sun Tan
- ↘ Photosensitizing Medicine, Foods & Ointments.
- ↘ Seizure Disorders Triggered by Light
- ↘ Suspicious lesions (refer for assessment)

Recent sun exposure or tanning are two contraindications that usually increase the likelihood of post treatment complications such as blistering, hyper or hypopigmentation and or scarring.

Individuals that exhibit sensitivity to the laser wavelength are not candidates for laser therapy.

Individuals that exhibit seizure disorders triggered by light may develop seizures from the pulsation of the repetition rate of the system and are not candidates for laser therapy.

Any suspicious lesion or presentation of the patient should be referred to a physician for assessment, and this can be assisted through your medical screening form and/or triage training of the laser hair removal technicians.

Contraindications

- Accutane, (Claravis, Sotret & Amnesteem generics) – or other Photosensitizers.
- Active Infections – Herpetic, cold sores, shingles, etc. (place on anti-viral medication pre-treatment)
- Electrolysis, waxing or tweezing in last 6 weeks (target has been removed)
- History of Family Keloid Scarring

Some of the more active photosensitizers such as accutane are a contra-indication, and patients should stop taking them for a period of from a few weeks to a few months, as determined by the medical direct.

Active herpetic infections don't impede the treatment, but they can exacerbate the outbreak and laser operators would not want to be exposed during these active outbreak periods anyway. The patient may be placed on an antiviral prior to treatments.

If the hair follicle has been recently destroyed or removed by electrolysis, waxing or tweezing, then there is no target for the laser and no point in doing the treatment. A family history of keloid scarring is a fairly strong contraindication to performing laser skin procedures.

Contraindications

- Absolute -

DO NOT LASER OR IPL OVER TATTOOS!

(but can treat around them)

The longer a person has had a tattoo the farther you need to stay away with the laser (granules migrate).

The ink can spread out as far as 3mm and become a target for the laser.



The technician needs to be mindful of tattoo's in the area to be treated. If the tattoo is hit with the laser light the ink will be the primary chromophore and absorb all of the energy. The result will be a painful burn and in some cases a deep wound.

If a client still requests that treatment be made over the tattoo because they want it removed anyway, we recommend against it. The laser energy will need to be lowered as the melanin in the hair will not be the primary target. Any attempt at trying to destroy the hair follicle will not be successful because not much of the laser energy will be absorbed by the hair if it gets absorbed by the ink which sits right in the epidermis.

Hair removal lasers are not the correct laser to use to remove tattoos anyway. The ms pulse width is much longer than the required ns pulse width of the required Q-Switched lasers, and would generate excessive heat at the site possibly causing burns.

38. Tissue Interactions

Thermal Relaxation Time (TRT)

- Amount of time required for a target to dissipate heat (time to return to $\frac{1}{2}$ of peak temperature)
- Smaller objects have shorter TRT's – will get hotter, faster than larger objects, and then lose their heat more quickly

Thermal Relaxation Time (TRT)

This is the time that it takes for a “wave” of heat to start flowing out of a structure. All organic structures have their own thermal relaxation times.

Smaller structures will both get hot and lose their heat in a shorter time than larger structures.

The thermal relaxation time is the time it takes a target to heat up, and then cool off to half of its peak temperature. Small structures get hotter faster and cool off quicker than larger structures which are slower for both.

We'll expand a bit on this concept when we get to the Laser Hair removal module, but want to introduce the idea here with general tissue effects.

If a clinically useful dose of light is delivered to the target in a time shorter than the Thermal Relaxation Time (trt) then the target will NOT be able to dissipate the heat and it will not survive the impact. If that same dose is drawn out in a period longer than the trt then the target may be able to dissipate enough of the heat that it will survive.

When directly impacting the target (i.e.; skin resurfacing), deliver ablative doses of light in a *SHORTER* period than the Thermal Relaxation Time of the skin. This keeps the heat confined to the target so that it does not conduct to surrounding tissues.

When impacting the target underneath the skin (i.e.; hair removal, vascular skin lesions), deliver ablative doses of light in a *SHORTER* period than the Thermal Relaxation Time of the target (such as a hair follicle) to kill it, but *LONGER* than the overlying tissue (epidermis) to spare it. This destroys the target but allows the skin to dissipate the heat.

Clinical users don't need a technical understanding of this concept but should have a conceptual one of the heat flow.

Thermal Relaxation Time (trt)

- The time necessary for the target to cool down 50%, through the transfer of its heat to surrounding tissue via thermal diffusion.
- The thermal relaxation time (tr) is directly related to the size of the target and its composition.
- Smaller objects of the same material will get hotter faster, and lose heat at a much faster rate than Larger objects. Smaller objects require shorter pulse widths to destroy the target.

Thermal relaxation time, or trt, relates to heating and cooling, and how quickly a pulse must be delivered.

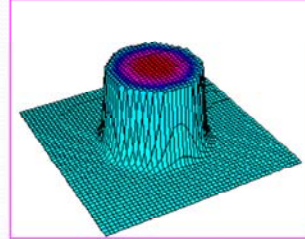
The **thermal relaxation time** is defined as the time it takes for the temperature to fall to 50% of the peak temperature created. This time is roughly equal to the square of the diameter of the target structure, which means that smaller structures get hotter and cool off more quickly than larger structures.

The **thermal containment time** is the concept of the initial delay period in which no heat is dissipated to surrounding tissue, and is roughly one-quarter of the thermal relaxation time. This time defines the ideal pulse width for treating a given Chromophore because all of the heat will be retained within that structure causing very high temperatures.

Thermal Relaxation (TRT)

Example: Temperature rise in Hair Bulb

A short Pulse Width “beats” the TRT of the hair bulb allowing a lethal temperature rise to 70°C or more.



The same energy applied over a longer pulse width loses the race with heat leaking out, and the temperature does not rise sufficiently to kill the hair bulb.

Graphics courtesy of Sciton

A computer generated graphic of temperature rise in a hair bulb aptly illustrates the concept of thermal relaxation times.

If a clinically effective “dose” (J/cm^2) is applied in a pulse time equal to or less than the TRT of the hair bulb, heating to necrotic temperatures of around 70°C occurs.

The energy was delivered so quickly that it didn’t have any time to “leak” away from the structure, allowing it to get hotter.

If that same clinically effective “dose” is applied in a pulse time that is LONGER than the TRT for the bulb, then heat begins to flow out of the structure and one does not obtain a significant enough temperature rise to kill the bulb – therefore ineffective laser hair removal in this case.

Thermal Relaxation Time

Small diameter hairs respond best to very short pulse widths at the same fluence, while larger hairs do best with longer pulse widths.

All other things being equal, shorter pulse widths at the same energy density are more painful to the patient and “riskier” for darker skin. Can be balanced with aggressive cooling.

The same principle applies to vessel sizes in things like telangiectasia or portwine stains.

The initial take-home lesson with this is that smaller structures, such as small hairs or fine blood vessels, will require shorter pulse widths at the same fluence in order to be effective.

This has to be balanced though with the patient’s skin type, because these shorter pulse widths are harsher on skin – creating more discomfort, and even adverse effects on darker skin.

One way to retain the effectiveness of these short pulses while minimizing discomfort and adverse reactions is very aggressive cooling – like cryogen sprays timed in concert with the laser pulses, or aggressive use of the air chillers.



REMINDER

You're about two thirds the way through this review!
(Only 75 more slides to go)

Just a reminder to concentrate on those slides with the bullet points, and don't overly fixate on the expanded slides.

THIS IS THE END OF THIS MODULE.

CONTINUE ON WITH MODULE III to start with Review Slide 39 .



Laser Certification Review

Expanded Study Guide – Module III

Certified Laser Hair Removal Provider

National Council on Laser Certification

www.LaserCertification.org

Not All of these Slides are Narrated, but many are.

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39. Tissue Interactions

Adverse Reactions

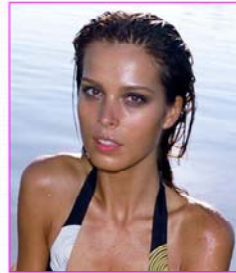
- Recent Sun Exposure is the most common reason for unexplained adverse reactions (rashes, redness, blisters) in the middle of a treatment series.
- Photosensitivity due to drugs/food/etc. would be the second most common reason.

Suntans

Suntans create a much higher risk of patient injury.

Generally patients are encouraged to stay out of the sun for a few weeks prior to treatment, and/or use skin lighteners.

All other things being equal, it is usually safer to treat Asian, Latino or light black (brown) skin, than it is to treat Caucasian skin that is tanned. (Also depends on the wavelength of the Laser)



tan



natural

Recent sun exposure represents one of the more insidious problems for aesthetic laser operators. You'll instruct clients to avoid the sun prior to treatments, but that doesn't always happen and sometimes adverse reactions occur. If they show up with a definite tan they should be turned away for 4-6 weeks until they're rid of it, but this isn't always practical – especially if you practice in South Florida or Texas. There are practical ways to mediate this with longer wavelengths and more conservative settings, but the first choice is to not treat clients with either suntans or even recent sun exposure. All other things being equal, it's generally safer to treat type IV or V natural skin, that it is to treat type III skin with a tan that matches the darker color.

Sun (U.V.) Exposure



It is critically important that clients understand the importance of avoiding sun exposure prior to, or just after Laser & IPL treatments. This includes the use of tanning beds or tanning agents.

Such exposure can result in the skin overreacting to the treatment with resulting bad outcomes.

We try to explain to clients that there are many other ways to get significant sun exposure without necessarily trying to get a tan. Sun exposure does not just mean laying out by the pool or on the beach to get a tan.

Sometimes clients may hear you tell them to avoid sun exposure prior to treatments, but in their mind that might mean laying out on the beach for a tan. Working in the garden all weekend without a shirt doesn't count to them because they weren't intentionally trying to get a tan. This is a big issue in aesthetic laser and IPL treatments and should be continuously addressed in your practice. The U.V. exposure causes the skin to be much more sensitive to laser treatments and you can get adverse reactions including urticaria (hives), redness and even blisters, that may not have occurred otherwise.

40. Tissue Interactions

Thermal Relaxation Time (TRT)

- To “kill” an object with heat (i.e. hair follicle), the clinically effective dose of light must be delivered in a time shorter than its TRT – otherwise it will shed the heat and survive.

41. Tissue Interactions

Thermal Relaxation Time (TRT)

- To spare adjacent structures that also might absorb the light (epidermis), the time period should be longer than its TRT – so that it can dissipate the heat and survive.

Scientific Basis for Hair Removal using Thermokinetic Selectivity

- ➔ “Ideally the laser pulse duration would lie between the thermal relaxation times for the epidermis (about 3 to 10 msec) and the target follicles (40 to 100 msec).” *
- ➔ Thus, a pulse duration of approximately 10 to 40 msec will damage hair follicles with minimal epidermal injury.

*Grossman et. al. J. Amer.. Acad. of Derm. December, 1996

Dr's Melanie Grossman and Rox Anderson had discovered in the 90s that in order to safely destroy a hair follicle the laser pulse should be in between the thermal relaxation time of the skin and the hair. That is the basis for Thermokinetic Selectivity – a term coined to describe how pulse times can select the targets they will either destroy or spare via heat generation.

Thermokinetic Selectivity, or TKS, is really an extension of Selective Photothermolysis and it's what a lot of the laser companies are using as a guideline when developing new lasers.

42. Tissue Interactions

Typical Thermal Relaxation Times

- Hair Follicle – 40-100 milliseconds
larger follicles have longer times
- Epidermis – 3-10 milliseconds

Therefore a theoretically ideal laser pulse (at clinically effective doses) for hair removal would be from 10-40 milliseconds

43. Tissue Interaction

Laser Pulsing

- Repetition Rates (frequency) of the laser pulse (usually in pulses per second) relate mostly to convenience for the user, and comfort for the patient. Slower repetition rates take longer, but allow for better heat dissipation so that it usually is less painful for the patient and better tolerated.

Pulsed Laser Emission

Think HEAT!

Pulses spaced closely together in either timing or distance will allow heat to accumulate faster than if you space them apart.

Pulses applied rapidly may treat an area faster, but the heat level and pain level will increase (and sometimes the potential for blistering).

Slower pulse repetition rates take longer, but are generally better tolerated by the patients.

Overlapping pulses is sometimes recommended by manufacturers for a variety of reasons, but be aware that such practices, particularly at higher fluences (ie leg vein removal) may create significant heat damage. This is sometimes called "Pulse Stacking".

Adjusting your pulse repetition rate, or pulses per second, doesn't really directly affect the effectiveness of the treatment one way or another, but does affect how long it takes you to finish one patient, or sometimes how a patient tolerates the treatment.

When pulses are applied very rapidly, even if there is not excessive overlap, then the heat sensation can build and it may become uncomfortable for the patient. Slow your number of pulses per second will provide a bit of relief in this sense, but also take you longer to complete that case.

Most manufacturers recommend some degree of overlap of pulses, such as 10% for lower fluence applications like laser hair removal or skin rejuvenation. Pulse overlap in high fluence applications such as leg vein removal is to be avoided because the overlap will cause a significant temperature rise in that spot possibly causing burns or scarring. Follow the manufacturers recommendation.

Achieving coordination in placing spots together with the right degree of overlap takes some practice, and is a universal skill required for any type of aesthetic laser procedure. This is one of the things we do in our hands-on workshops to develop practice in uniformity.

44. Laser Safety

Applicability of ANSI Z136.3 Standards
Applies to ALL Health Care Settings Including

- Hospitals & Surgery Centers
- Small medical clinics & offices
- Mobile laser vans & services
- Medical Spas & Cosmetic Centers
- Anywhere a laser is used on a person

Non – Regulatory

(but De-Facto standard)

American National Standards Institute



ANSI Z136.1



ANSI Z136.3

136.3 – Safe Use of Lasers in Health Care Facilities

Medical Laser Safety is based on the American National Standards Institute – ANSI – recommendations for the safe use of Lasers. There are two applicable documents. The Z136.1 is the parent standard that incorporates all of the technical data. The Z136.3 standard is specifically the Recommendations for Safe Use of Lasers in Health Care Facilities, and this is what our safety program is based upon. The ANSI standards are only recommendations – they are not law. However, other organizations such as OSHA, JCAHO and various states do enforce based upon ANSI standards. These are not a black and white set of rules but establish your options for assessing laser hazards and instituting control measures to keep people safe. They relate to the laser work environment though and have nothing at all to do with patient treatment safety, in terms of clinical use.

Laser Safety Program

to Assess & Control Potential Laser Hazards

- Each Facility (including offices & spas) **MUST** appoint a Laser Safety Officer (LSO) to manage a safety program.
- A formal Safety program, including policies and procedures, **MUST** be in place in each institution.
- You **MUST** review the specific policies and procedures for each facility. Based on ANSI.

Each facility utilizing medical or health care lasers must establish a formal laser safety program, which will be managed by an appointed Laser Safety Officer. Specific policies may vary from program to program, but they are all based on the ANSI 136.3 recommended standards.

45. Laser Safety

Medical Laser Safety Officer

- Appointed by the facility administration
- Administers the facility's Laser Safety Program
- May or may not run actual equipment
- No particular background nor education required
- Utilizes many different resources in order to manage the Laser Safety Program
- Required by ANSI in all health care facilities that utilize lasers. (Including medical spas & offices)

Laser Safety Officer

- No specific “Certification” or background requirements.
- “Experience, training and resources” from many sources to complete this job.
- May or may not be the person in the Laser Room (Laser Assistant or Operator).

Medical Laser Safety Officer Certification (CMLSO) is a professional credential that is voluntary, but may serve as evidence of proper training & qualification.

There is no “one” place for a person to go to become a Laser Safety Officer. They are a manager. ANSI says they are a person with the “experience, training and resources” from many sources to complete the job. Training programs for Laser Safety Officers are a good place to start, but the process of education is a continual one. The LSO may or may not be the person actually running the equipment (the Laser Operator). Each facility has ONE LSO and the laser operators work under their authority. For multi-center practices it is common to appoint one Laser Safety Officer in a geographical region, rather than in each office. There is no legally mandated certification, although voluntary certification of Laser Safety Officers is available, and may be accepted by the facility as a credential to meet their own internal standards for a Laser Safety Officer.

Laser Safety Officer

The Evaluation of the Total Hazard by the LSO is dependent upon:

- Ability of the Energy to injure personnel or patient
- Personnel who may be exposed in the NHZ
- Type of delivery system used.



"Pucker Factor"

The role of the LSO is to evaluate the potential hazards and take various measures to control them. The hazard is obviously related to the ability of the energy (to which people are actually exposed – not just internal in the box) to hurt people, but it may include many different variables in this assessment, such as the people that may be coming into or out of the treatment room, the type of laser delivery system used, the wavelengths and energy outputs that are utilized, and any other relevant practical consideration. The LSO assesses all of these variables and then uses their “informed judgment” to determine the level of hazard and how to control it.

46. Laser Safety

Medical vs. Industrial/Scientific LSO's

- Both are required by ANSI to be appointed by their respective facilities
- Industrial/Scientific based upon ANSI 136.1
- Medical based upon ANSI 136.3
- Need for measurements and calculations to determine NHZ and Laser Classification for Medical LSO's is minimized because of manufacturer preclassification and information.

47. Laser Safety

Administrative Controls

LSO responsibilities:

It is for overall management of the safety program to include education of staff, protective measures implemented (safety glasses), program monitoring, etc.

It is NOT to establish or enforce clinical treatment parameters or protocols – they implement those established by their medical director.

LSO Establishes Controls

- Administrative Controls
 - Documentation, training programs, etc.
- Procedural Controls
 - Policies, Safety Glasses, Signs, etc.
- Engineering Controls (by Mfg)
 - Interlocks, standby, emission indicators

The LSO then controls these hazards by three general areas of Administrative, Procedural and Engineering Controls.

The administrative controls are mostly what one would find in the written folder for the documented Laser Safety Program. These would include your written policies and procedures, documentation of your service work and bi-yearly calibrations, attendance sheets or certificates for laser safety training of all staff, and written reports for the annual laser safety audits.

The procedural controls include the implementation of those things that you actually do to control the hazards which would entail monitoring and enforcement of the safety policies, use of the protective eyewear, displaying appropriate laser danger signs at room entrances, operational use of the standby button, use of smoke evacuation when required, and similar procedures.

It is the manufacturer that puts into place the engineering controls for medical lasers, so the LSO's role is to monitor the ongoing proper function of these controls, such as standby buttons, emission indicators and cover interlocks (service personnel can report this to the LSO during their PM's on the equipment).

48. Laser Safety

Laser Treatment Controlled Area (LTCA)

- The entire laser room, or a designated area in a very large room
- Signs required on all entryways
- Safety glasses provided, but are not required to be worn until within the NHZ
- Occupied only by authorized personnel trained in Laser Safety

Laser Treatment Controlled Area (LTCA)

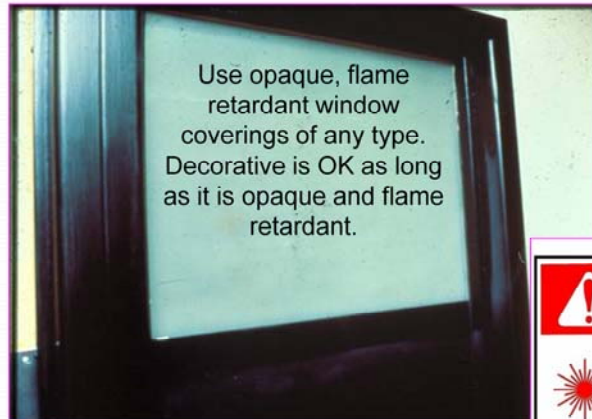


In small treatment rooms such as for Aesthetic Laser Procedures, the NHZ and LTCA will be one and the same.

- This is the entire room where the procedure is performed
- Signs are required on doors.
- Glasses required to be made available but not worn until in NHZ.
- Controlled access by trained personnel only

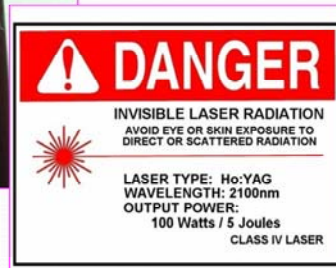
The room where the procedure is performed is known as the Laser Treatment Controlled Area (LTCA). This is conceptually different than the NHZ, though it always contains the NHZ, and LSO's sometimes make them one and the same. Warning signs must be posted on each entry to the room that states the laser wavelength and power outputs. Glasses must be made available upon entry. It is a controlled access room and only those who have had documented laser safety training may enter.

Window Coverings & Signs



ANSI says the windows must be covered only when they are in the NHZ.

Signs must be on the door for the LTCA.



When windows are contained within the NHZ (when the LSO makes the NHZ the entire room) then the windows must be covered with a flame retardant opaque material. This does not apply to the CO₂ and Er:Yag lasers used for resurfacing, which do not transmit through glass and are acknowledged by ANSI.

ANSI NEW LASER SIGNS



"New" as of 2005

Old Signs – should be replaced



New Signs:

Download free copy at
www.LaserTraining.org
on the "Free Material" page

Courtesy of Dan Little

Signs must be the "official" laser safety signs and homemade warnings or even the older signs are unsatisfactory. Signs must be placed at every entryway into the room. They should not be left in place when the laser is not in use – only during laser cases. You can download free copies of signs on the lasertraining.org website under the "Free materials" page. Since there are so many power/energy combinations you'll still have to enter that figure on these jpg signs, but you can get that information from the FDA label that's on the back of your laser.

49. Laser Safety

Pregnancy in workers or patients

- Laser “Radiation” is electromagnetic but not ionizing like X-Rays, and is of no actual risk to women in any stage of pregnancy – whether the patient or a technician running the equipment.
- In spite of this “no risk”, most services will NOT treat women with lasers for elective laser procedures because a certain percentage will abort anyway, and the practice does not want to be exposed to the potential liability.

Pregnancy

Lasers DO NOT present any risk to either the mother or fetus in pregnancy.

Most Laser “Experts” however discourage treatment of pregnant women for the simple reason that many will spontaneously abort anyway, and the laser treatment facility may then face litigation.



I think we've already addressed this in a previous module, but Lasers present no type of “radiation” risk to women in any stage of pregnancy. Most elective procedures are not performed with lasers on pregnant women however, in case they have a natural spontaneous abortion and somehow the laser (and you) get blamed for it.

50. Laser Safety

Eye – Skin Hazards

- Hazard levels for eyes are determined by a value known as the MPE – Maximum Permissible Exposure (MPE) level for the cornea or retina.
- Safety Glasses Optical Density value is designed to keep the MPE below the hazard level.
- Laser Safety Glasses do NOT guarantee protection from direct impacts of the laser into the eyes through the glasses (reflections only).

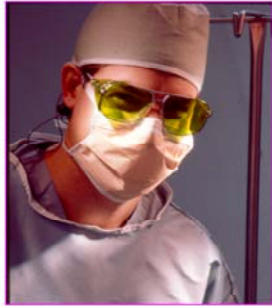
Laser Safety Eyewear



- Must be labeled according to the wavelength λ for which they offer protection.
- Must be labeled according to the Optical Density (O.D.) of the material. 4-7 O.D. is OK for most medical lasers

Laser Safety Eyewear must be labeled with two items of information – the wavelengths for which they offer protection and the Optical Densities at those wavelengths. The wavelength is the most important aspect of this because this must match that of the laser being used. The Optical density reflects the degree of protection with higher numbers offering more protection.

Laser Safety Eyewear



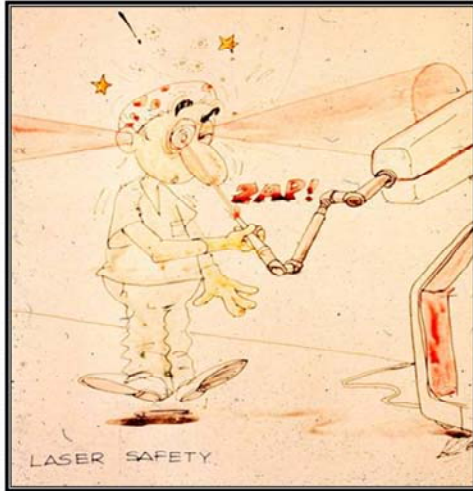
- Must be labeled according to the wavelength λ for which they offer protection.
- Must be labeled according to the Optical Density O.D. of the material. (4-7 O.D. OK for most medical lasers)

- Optical Density is the attenuation measured on a logarithmic scale. I.E. 10^4 power of attenuation is an O.D. of 4.0. That means that an O.D. difference between 4.0 and 6.0 is a factor of 100.

Protection vs. Ability to See & Work

Laser Safety Eyewear must be provided to all personnel as they enter the laser treatment room (LTCA), but must be worn only when they are within the Nominal Hazard Zone (NHZ) as it is defined by the LSO. These laser glasses are different for all the lasers. A higher O.D. affords more protection by a factor of 10 fold, for each increase of 1 in O.D.. An optical density of 6 affords 100 times more protection than an O.D. of 4, however the more protection afforded the harder it is to see through. A range of between 4.0 – 7.0 for most medical lasers is satisfactory. Remember that they are NOT designed to provide protection from direct impacts. The dilemma here in aesthetics is that the higher Od's provide the greatest protection, but also make it more difficult to see the patients skin as you treat. We recommend that you use the lowest OD recommended by the manufacturer to make treatments easier, and of course always taking care not to point the output into your face. A Medical Laser Safety Officer is not required to calculate the requirements for Optical Density on the glasses – ANSI allows you to utilize those within a range recommended by the manufacturer. Staff should be instructed to ensure that the wavelength label of their glasses matches the wavelength of the warning sign posted on the door.

Laser Eye Hazards



- Safety glasses **DO NOT** guarantee protection against direct laser impacts

They would be of some help, but cannot be relied upon to prevent eye damage from direct impacts through the glasses.

We will continue to reiterate however that laser safety eyewear is NOT guaranteed to provide protection against direct impacts into the face. They are designed to protect the wearer from the reflected light coming back from the patients skin. If one were to get a direct shot into the face the glasses would certainly help some, but could not be relied upon to provide full protection.

51. Laser Safety

Eye – (MPE) Maximum Permissible Exposure Limits

- Exposure limit used in skin & eye safety calculations.
- Where the MPE is exceeded, that defines the Nominal Hazard Zone (NHZ).
- For wavelengths that transmit into the eye, the exposure to the surface is multiplied by 100,000 times to compare to the MPE.

Nominal Hazard Zone (NHZ)

This is the actual area where one could get hurt (burned) with the laser. It is determined solely by the LSO.

In small offices and clinics where laser hair removal and other aesthetic laser procedures are performed, the NHZ should generally be the entire treatment room.

Please take note that this requirement to establish the NHZ and wear safety eyewear within it does NOT apply to IPL's – but it remains good practice with IPL anyway.

Establishment of the Nominal Hazard Zone (NHZ) is one of the primary responsibilities of the LSO. For ease of administration many facilities simply make this the entire room where the procedure is performed, but there is no requirement to do so and in most cases is not actually the entire room. It is important to differentiate here between an LSO in an industrial/scientific facility operating on the basis of ANSI 136.1 standards, and Medical Laser Safety Officers operating in Health Care Facilities and Aesthetic Practices on the basis of ANSI 136.3 standards. Medical Laser Safety Officers are not required to make measurements and do calculations to determine the NHZ and Optical Density of eyewear as are their industrial counterparts. They are allowed to use their informed judgment, recommendations by laser manufacturers or consultants or other knowledgeable source to determine the NHZ. In truth medical laser use is quite safe when knowledgeable users run them.

Nominal Hazard Zone (NHZ)

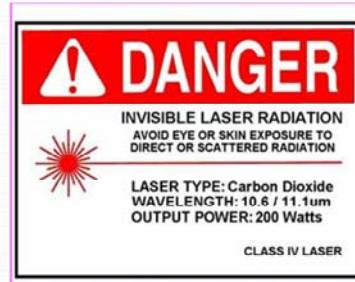
The NHZ is determined *solely* by the LSO utilizing recommendations from the manufacturer or other suitable analysis, but measurements *are not* required to be made by a Medical Laser Safety Officer.



The significance of the NHZ is that all protective measures apply all the time for the class IV lasers we use within the NHZ. In other words you have to wear your laser safety glasses in the NHZ. If the LSO has determined this to be the entire room then you must wear them upon entry.

Nominal Hazard Zone (NHZ)

Because of the relatively small size of treatment rooms in most aesthetic practices, the entire room is usually designated as the NHZ – but this is neither a “law” nor ANSI requirement.



In Hair Removal and Aesthetic Practices it's usually prudent to make the entire room the Nominal Hazard Room, both because the treatment rooms are reasonably small, and that most aesthetic lasers are visible to near infrared and pose potential retinal hazards, even across a small room.

52. Laser Safety

Retinal Hazards – Depends on Wavelength

- All wavelengths which pass through fluid
- Incorporates all visible light lasers
- Between approximately 400-1400nm
- Practical difference between hazards of visible vs. infrared. (Because of aversion response)
- Ho:Yag on up are Retina Safe, & Ar:Fl on down
- Lens of eye increases power density on Retina by 100,000 times.

Laser Eye Hazards



- Lasers present either retinal, or surface burn hazards.
- Hazards are present ONLY within the Nominal Hazard Zone (NHZ)
- Safety glasses DO NOT protect against direct laser impacts

OK – lets get into some of the nitty gritty with eye hazards.

Lasers present hazards to the eye at either the level of the cornea or the retina and this is specific to each laser. These hazards are present ONLY within the area called the Nominal hazard Zone and this is determined by the LSO. It is very important to remember, that regardless of where the NHZ is declared, that laser safety eyewear do NOT afford protection from laser impacts directly into the face through the glasses. The laser should NEVER be pointed into someone's face. This is one of the most important rules for laser safety. It is exactly like gun safety. Never point the loaded weapon directly at someone's face.

Retinal vs. Surface Eye Hazards

Photo-Thermal

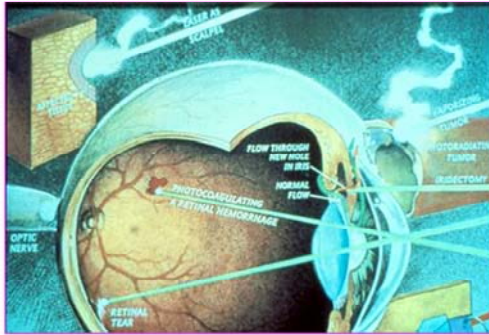


Photo-Chemical Injury (cataracts) may occur with Chronic Exposure to Ultraviolet Lasers starting about 351nm. These are NOT hair removal lasers.

- **Surface of the Eye Hazards – distance & power density are determinants.**
- **Retinal Eye Hazards – are NOT directly power density nor distance related. 400-1400nm**

Differences between retinal vs corneal burns create a major difference in where the hazard zone is located. Any burn to the surface of the eye (cornea) is entirely dependent upon the incident power density. Power density in turn is primarily determined by spot size, which is determined by distance from the focal point or fiber tip. In practice anything more than a few feet away from most surgical lasers using common delivery devices are perfectly safe and will not cause either eye or skin burns at this distance (see your own LSO for specific info).

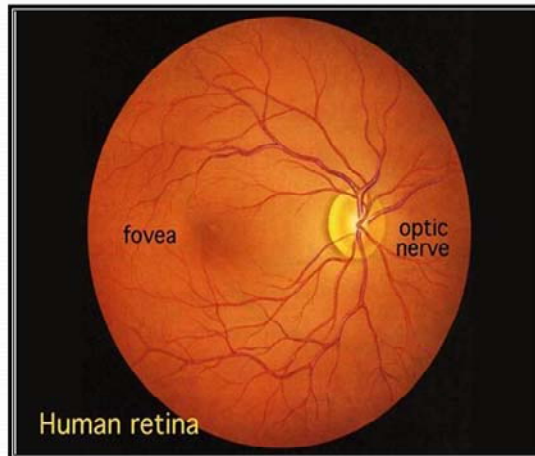
Most aesthetic lasers present retinal hazards, which are different because they are not dependent on the incident power density. These laser wavelengths are the ones that transmit through fluid and into your eye and will be refocused by the lens in your own eye. This can increase the power density from the cornea to the retina by as much as 100,000 times! This can result in high enough power density to cause a retinal injury.

The pucker factor for retinal hazard lasers are therefore generally higher than with corneal hazard lasers.

There is also a different type of risk from short wavelength Ultraviolet lasers that is not an immediate burn as would occur with the corneal and retinal risk lasers.

These are longer term chronic exposure risks from excimer lasers – generally over months or years –that cause photochemical degradation of tissue with the possibility of causing cataracts over time. This is not a practical problem for the way excimer lasers are used in a medical or aesthetic practice, but it should be mentioned.

Laser Eye Hazards



The degree of damage created by a potential laser hit cannot be predicted in advance – it depends on many factors to include laser settings, distance from the laser output, motions of the eye, and where the hit actually occurs. A hit on the peripheral retina might produce negligible damage, while hits within the central vision will be more devastating. The fovea is the central part of vision within the retina and a laser hit here (caused by looking directly into the barrel of the laser when it fired) could create major damage. The optic disc is where the optic nerve and vasculature enters the eye and is a natural blind spot on the retina. Theoretically a major laser hit here could destroy the optic nerve and cause total blindness, but this is entirely theoretical and has never been documented in the past.

53. Laser Safety

Patient Eye Protection

- Corneal Shields (anodized metal shields) used when working within the bony orbit of the eye. (ANSI recommendation) – most secure protection.
- Alternative Patient Eye protection depending on type of laser use:
 - Laser Safety Glasses
 - External Eye shields of some type
 - Plastic “Laser Resistant” goggles
 - Metal Eyeshields (best)
 - Disposable adhesive laser eye protection

Patient Eye Protection



- Determined by LSO
- Should be provided & documented for all patients.
- “Real” vs. “Administrative” precautions

Patients eyes must be protected, and the manner is determined by the LSO. It should be provided and documented for all patients. Patients eyes (and your pucker factor) are more at risk in some situations than others and the LSO should provide protection commensurate with the level of hazard. Working around the face & eyes presents significantly greater risk than working lower down on the body, particularly if working lower down on the legs or on the back.

Working Around the Eyes & Face

All metal eye-shields are the best and the safest.



Plastic sun-tanning goggles are not recommended because they can melt and burn when impacted with a laser. (But disposable Laser Shields are fine)

When working directly around the eyes special eyeshields should be used rather than glasses or moist packings. There are other disposable or plastic goggles that may be used, but these are specific for laser use. Do not use any plastic goggles, like sun tanning goggles, because when working close to their edge the laser or IPL may actually melt a part of the goggle causing a burn and blister on your patient.

Working Around the Eyes



Special corneal shields are recommended when working directly on or near the eyelids. (Bony Orbit of the Eye)

Although it is not difficult to safely place these corneal shields on the eye after a few drops of a dilute lidocaine solution are made, these are probably best left to a medical setting or performed by a Nurse or Physician because of the sensitivity of the area.

Working directly around the eyelids and bony orbit of the eye presents the greatest risk to the patient. There, special eyeshields should be used rather than glasses or moist packings. These go directly on the cornea, to protect against accidents such as was presented a few slides ago. Although they're not difficult to place, because of the sensitivity of working in and around the eye, most aesthetic practices will refer out such procedures that have eye involvement to a medical practice, or at least do this under direct medical supervision.

Eyebrows

Most “experts” discourage laser hair removal on the brow for a variety of potential liability areas, but not because of a direct laser eye injury (if shields are used).



If performing treatments around the brow or the cheek bones, advise the patient that they may see “flashes” of light, even with infrared lasers. These are harmless.

When working around the eyebrows or cheekbones you should advise your patients that they will see bright flashes of light – this is true even for the infrared lasers. This happens because the bone conducts the light around to the back of the eye to harmlessly stimulate the retina. It is not going through the lens and becoming concentrated so it's really not a safety issue but may make your patients concerned if they have not been warned that it will occur.

54. Laser Safety

Aversion Response

- The body's reaction to "jerk" away from bright light sources (aversion to bright light)
- Considered to be 0.25s
- Those visible lasers that cannot exceed the MPE (Maximum Permissible Exposure level) within this time are considered eye-safe
- The aversion response time is not fast enough to guarantee protection from Class IV lasers, but it would reduce one's exposure

Aversion Response

- Reflexive action of the body to “jerk” away from bright light in 0.25 seconds or less.
- Lasers that cannot exceed the MPE within 0.25s are considered “Eye-Safe” (Class 2 Lasers)
- Class 4 Lasers are NOT Eye-Safe
- HOWEVER – The aversion response to Class 4 visible light laser reflections (not direct impact) does provide a significant added safety factor over invisible lasers.

Just a quick mention of our aversion response and how this helps protect us from bright light sources. This is an involuntary jerk away from bright light that occurs in less than a quarter of a second. If a laser such as a low power pointer cannot create eye damage in less than a quarter of a second it is considered eye safe because your own reflex is enough to protect your eye.

The Class IV lasers that we use are NOT to be considered eye safe, and damage occurs much more quickly than the quarter of a second.

However, in truth this does provide an additional level of protection compared to infrared lasers which you can't see and would have no aversion response. If someone gets a laser hit from a diffusely reflective surface (like tissue) then it's not as intense as a direct impact, and although there is no guarantee that your aversion response would protect you from even these reflections, it definitely gives you a fighting chance and may considerably help.

55. Laser Safety

Corneal Hazards – Depends on Wavelength

- All wavelengths which do NOT pass through fluid
- From 1400nm on up, and 400nm on down
- Includes CO₂, Er:Yag, Ho:Yag and Ar:Fl excimer as corneal hazards.

Laser Eye Hazards - Corneal

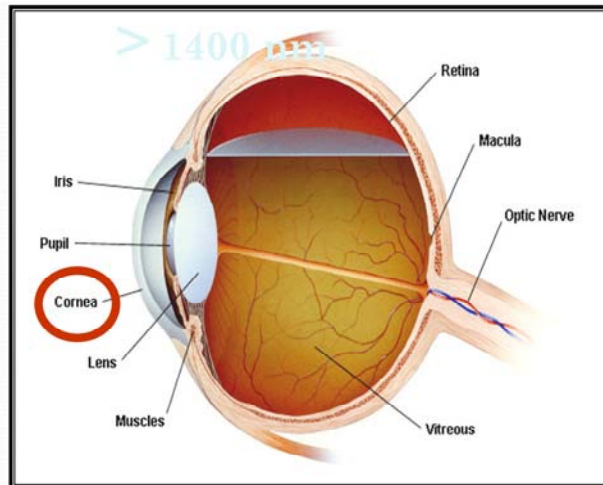
Surface Burns:
> 1400 nm

CO₂

Erbium:Yag

YSGG

Erbium:Glass



The commonly used aesthetic lasers, greater than 1400nm in wavelength, that present Corneal risks only, include the CO₂, Er:Yag, YSGG and Er:Glass lasers – all of which are used for different types of laser skin resurfacing. I consider these lasers lower eye-risk lasers because you must be fairly close to the laser output and shoot the laser directly into your face. Reflections off skin during normal procedures would present no risk at all – unlike the lasers which present retinal hazards. With lasers like these I might even be inclined to declare the hazard zone only at the immediate treatment table. If you're at the table then you'd wear eyewear, but those elsewhere in the room would not. In practice you'd have no problem anyway unless you shoot it directly into the face. This is a choice each laser safety officer must decide themselves, using their informed judgment as allowed by ANSI.

Laser Eye Hazards

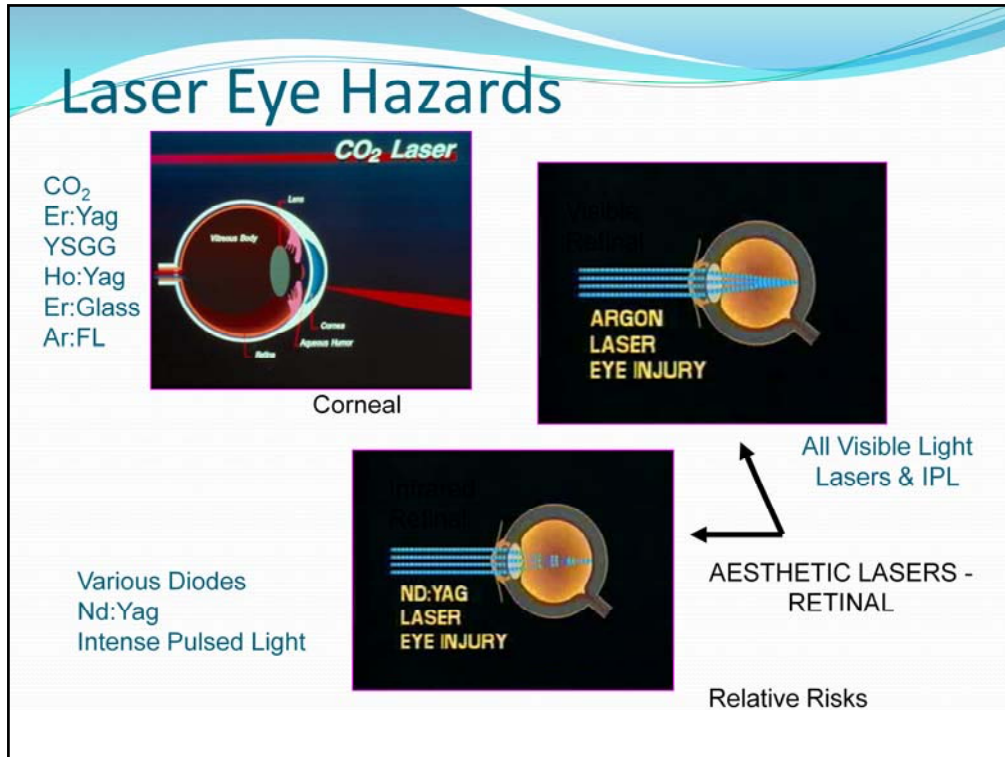
CO₂ Laser
Corneal Burn

Occurred during a
Blepharoplasty.
(skin tightening around the
eye).

Courtesy
Occuloplastik



Here is one of the only two examples that I am aware of in over 30 years in a medical setting, of a CO₂ laser eye burn on the cornea, courtesy of Occuloplastik. To me this incident has absolutely nothing to do with laser safety, and is really due to total negligence. Even the most basic of precautions would have prevented this burn but no patient eye protection was provided here whatsoever. A blepharoplasty was being performed with a CO₂ laser on an anesthetized patient. One should not have to be laser trained in order to have the sense to know that when you're working with a focused CO₂ laser beam within one inch of the surface of the eye – that it might be a good idea to do something to PROTECT that eye. The surgeon was using a metal skin hook to apply traction to the skin during the laser excision. The laser nicked the metal skin hook and the reflection skidded across the patient's cornea causing this burn. There was absolutely no reason for this. When working this close to the eye one should be using metal corneal shields, but even wetted gauze would have prevented this accident.



Aesthetic lasers used in skin resurfacing such as the CO₂, Er:Yag, YSGG and Er:Glass lasers are corneal hazards, not retinal ones. Therefore distance from the output of the delivery device has a dramatic effect on the spot size and “safe” power densities.

Visible light lasers and the rest of the infrared ones will transmit into your eye and are retinal hazards. Even though you may be at a safe enough distance to prevent a high power density burn (a few inches will do), your own lens can refocus it and cause an injury. Though specular reflections would be a high risk and diffuse ones lower (like reflected off tissue), the primary problem is having the laser fired directly into your face. Remember that the glasses aren't sufficient to protect you from this. Although both the visible light and infrared lasers that create retinal injuries are hazardous, your “pucker factor” should go up some with the infrared ones because you have no warning of being able to see the light. Though no guarantee that you can protect your eyes with the high powered visible lasers, you have more of a fighting chance because the light is so bright you MUST jerk away from it – the aversion response.

56. Laser Safety

Laser Protective Eyewear

- Should always be worn within the NHZ
- Does NOT guarantee protection from direct impacts from the laser beam for retinal hazards (It is MOST IMPORTANT to not allow the beam to be directed toward one's face)
- Must be labeled according to the Wavelengths & Optical Density (O.D. or degree of protection).
- O.D. is a logarithm. I.E $10^4 = OD\ 4$, so a change from 4-7 is a 1000 fold increase in attenuation. (tenfold for each unit of O.D.) Higher numbers offer more protection.

57. Laser Safety

IPL Eye Hazards

- IPL's do NOT present the same level of risk as lasers because they are NOT point sources of light. (non-laser light source)
- However, they DO still present eye hazards and eye protection is required.
- Used for a variety of procedures including hair removal, skin rejuvenation, treatment of pigmentary and vascular issues, etc.

Intense Pulsed Light (IPL)



IPL's are Broad Band Light Sources that span a range from about 400nm in the visible to about 1400nm in the Infrared.

Various cut-off filters may be used on the IPL to limit the lower wavelength ranges – protecting darker skin and targeting specific structures such as red blood vessels or brown spots.



While we're talking about energy delivery let's at least introduce you to the concept of other high energy light sources besides lasers. You're not going to see an IPL in surgery but you might have one in the outpatient clinic. They come in all sizes and varieties and go by different names such as Intense Pulsed Light, or Broad Band Light. Essentially they use a very bright and powerful flashlamp that puts out broad spectrum light all the way from the deep blue at about 400nm to infrared around 1400nm. These are used in different cosmetic skin procedures such as skin rejuvenation or hair removal. There are different handpieces or cutoff filters that simply block the light below a certain wavelength for specific applications. For instance a 755nm cutoff filter does not just give you 755nm like an alexandrite laser – It cuts off all the light BELOW 755nm but still gives you all the broadband light from 755-1400nm. They're all different. This is done primarily to protect darker skin types from shorter wavelengths which could cause blisters or pigmentary changes. Just be aware that they are not lasers and don't fall under the same standards as lasers.

Intense Pulsed Light (IPL)

Advantages of IPL

- Cover Larger Areas (i.e. back)
- More affordable than Lasers
- More effective on Blonde & Red Hair in light skin



CAVEAT: Used primarily for LIGHT SKIN clients.
Use in dark skin is not recommended

While not as intense nor sometimes as effective as laser for specific skin targets and applications, they have the advantage of covering much larger skin areas at a time and are better when going after “mixed” targets such as brown pigment and red vascular areas seen with general skin rejuvenation – sometimes call photofacials. They’re also generally less expensive than lasers so it’s easier to be profitable with the same number of cases. My own opinion is that they work very well for general skin rejuvenation. I think lasers are still better for hair removal if you can afford them, but short wavelength IPL heads do offer some advantage in hair removal for blonde and red hair in light skin clients – an area where lasers have difficulty. Just use caution with darker type IV skin, and my recommendation is not to use them at all on Type V and VI skin types.

Eyewear for IPL's

(Different Names, but all the same thing)

IPL

Intense Pulsed Light

AFT - Advanced
Fluorescent Technology

Broad Band Light Source

**All of these are non-laser,
but very intense light
sources.**



IPL's by definition cover many different wavelengths across a broad band, so it's not possible to use specific wavelength glasses. The ones that are usually provided with IPL's are crappy green glasses that by necessity cover a very broad range of wavelengths. The problem then is that it also EXTREMELY difficult to see the color and texture of the skin as you're treating to see what you're doing. The solution is a pair of the LightSpeed glasses for the laser operator. These have some tint to them but are fairly easy to see through. When they see any intense flash of light the crystalline lenses actually shut down and become opaque so they protect your eyes. This happens so quickly that it's hard to tell what happened – other than a blink like effect as you work. We highly recommend that anyone doing IPL work get at least one pair of these glasses.

58. Laser Safety

Laser Safety Eyewear Labeling

- Must be labeled with both wavelength ranges of protection, AND Optical Density (O.D.) of degree of protection.
- O.D. is a logarithm, so the difference in each unit of O.D. is a factor of 10. In other words the difference of an O.D. of 4 to 6 is a factor of 100 in attenuation. Higher numbers are more protection.

59. Laser Safety

Safety Practices Glass Transmission

- Lasers that don't transmit through glass include CO₂, Er:Yag, Ar:Fl, and present superficial corneal burn hazards.
- Glass in optics of scopes & instruments afford protection to the viewer
- Window glass affords protection to outside viewers so that no coverings are required (for those lasers listed above)

CO2	Far Infrared	10,600 nm (10.6u)	
Er:Yag	Mid Infrared	2,940 nm (2.9u)	
Ho:Yag	Mid Infrared	2,100 nm (2.1u)	
Nd:Yag	Near Infrared	1,064 nm (1.06u)	
Diode Lasers	Visible & NIR	~ 530 – 2100 nm	
Alexandrite	Deep Red	755 nm	
Ruby	Deep Red	690 nm	
Krypton	Red, Yellow, Grn	647, 568, 531 nm	
Helium Neon	Red	632 nm	
CuBr	Yellow, Grn	578, 511 nm	
Dye Lasers	Red, Yellow, Grn	632, 585, 504 nm	
KTP	Green	532 nm	
Argon	Blue, Green	488 & 515 nm	
XeCl Excimer	UV	308 nm	
ArFL Excimer	UV	193 nm	

It is not important to remember all the laser wavelengths, but it is important to remember those that you work with. This table of medical lasers lists the active medium that produces the laser light, its associated color range and specific wavelength(s). The next slide will focus on the common aesthetic ones.

It is VERY relevant to note where the breaks come in wavelengths for fluid and glass transmission by lasers. The lasers above 1400nm won't go through fluid so are not a retinal eye hazard. Lasers above the 2.9u won't go through standard fibers so they use articulated arms for laser delivery. The short 193nm ArFL excimer laser also will not go through either fluid (eye) or glass, but for different technical reasons than the longer wavelengths. For those wavelengths that do transmit through fluid (into the eye) it will be important to differentiate the visible light from invisible infrared for safety considerations.

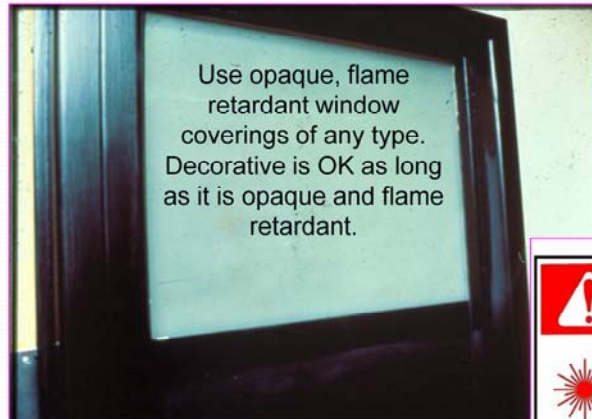
For staff working a laser room, it is important for them to know that the wavelength stated on the warning sign at the doorway must match the labeling on the laser safety eyewear. Different lasers require different types of safety glasses, and IPL's are different still.

60. Laser Safety

Window Coverings

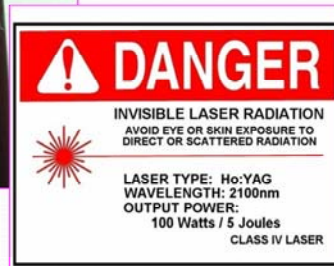
- Must be flame retardant when used
- Applies only to wavelengths that transmit through glass
- Required only when the window is located within the NHZ of the room.
- Any material opaque to the wavelength is sufficient
- Consideration given to use of barriers at doorways in special circumstances

Window Coverings & Signs



ANSI says the windows must be covered only when they are in the NHZ.

Signs must be on the door for the LTCA.



When windows are contained within the NHZ (when the LSO makes the NHZ the entire room) then the windows must be covered with a flame retardant opaque material. This does not apply to the CO₂ and Er:Yag lasers used for resurfacing, which do not transmit through glass and are acknowledged by ANSI.

61. Laser Safety

Safety Practices – Instrument Reflections

- Not a major practical problem, but a consideration around sensitive areas (esp. the eye).
- Ebonizing instruments just creates a black color and doesn't affect the reflection much – especially from IR lasers.
- Anodizing an instrument creates a “roughened” micro-surface on the instrument that helps to disperse the reflection.
- The major problem is reflection from a flat metal surface in close proximity to a sensitive area (i.e. eye, teeth, etc.)

Reflections

Anodized Instruments



Minimizes reflections

www.LaserTraining.org
-Resources & Links, then
-Laser Links

For a Complete Listing of Laser Safety Equipment Vendors.

Jewelry:



Not really an issue for Laser & IPL, unless you're going to be treating in that immediate area – then have them remove the jewelry.

Reflections are not a major problem with lasers provided that you are observing where you're firing, but there are times when special anodized instruments are useful – especially when using them as a temporary guard around the eyes, mouth or other structures. Anodized Instruments don't totally eliminate reflections but they reduce them significantly making them very useful if you need instruments around the laser target area. Don't confuse these with blackened "ebondized" instruments which have nothing to do with the reduction in laser reflections. The anodized surface is just a bit rougher than the otherwise smooth surface of the instrument and this is what makes them work.

Jewelry isn't a problem either unless it's right in the target area. If that's the case just have them remove it.

Mirrors (Reflections)



Mirrors are generally not a problem within the treatment room.

Just ensure that they're not placed close to the treatment site where you might accidentally fire into the mirror at close range.

Mirrors are the classic question regarding laser treatment rooms. It is true that if you fired directly into a mirror, the specular reflection that would return to you would be hazardous. Having them in the room somewhere is not a problem though. Just ensure that they're not so close to the treatment table that you could accidentally fire the laser into it as you're doing treatments.

62. Laser Safety

Fire Hazards

- Water available for quenching flames (water from the sink in the room or hallway should be adequate for aesthetic laser uses)
- Fire Extinguisher immediately available (does not have to be in the room – just know where they are)

Fire Hazards

- CO₂ Laser the primary Hazard, but this is used only for skin resurfacing in aesthetic medicine.
- Flammable materials.
(Hair lines – Hair Spray, Peri-Anal)
- Aesthetic Lasers (or IPL) can present a fire hazard when fired directly into dry towels or materials. (including furniture upholstery)



Though any laser could create a fire, this is primarily a hazard with the CO₂ laser. Flammable materials must not be used within a treatment field. In aesthetics, aside from firing the laser output when it's resting directly in towels or cloth, the potential risk is at hairlines. Hairspray is flammable, and hairlines should be covered with damp cloth if hairspray has been used. There is always the question of bikini areas and patient's passing gas during a procedure. Don't worry about it. While it is true that flatus is flammable – you would be more at risk here than the patient – and your face probably would not be that close. Just cover the peri-anal area appropriately with a damp towel and it won't be an issue even if they do pass gas.

Control of Fire Hazards

- **Electrical Equipment Fire Extinguisher - position Outside Controlled Room**
- **Fire extinguisher must be Immediately Available**
- **Open water (for dousing flames)**
sink in room or in area would suffice for aesthetics.

ANSI says that a fire extinguisher should be available, but doesn't require it to be on the laser cart or even in the room – just know where to quickly access one. ANSI also says that water should be immediately available for dousing flames. Aesthetic lasers have lower risks of fire to begin with, and the sink in the room or just outside would serve this purpose.

63. Laser Safety

Treatment beam & Guide-Light Alignments

Some lasers are infrared and therefore invisible to the eye. These laser use visible (usually red) guide lights so that one can see where the treatment laser is aimed. ANSI standards require that the alignment of the treatment and aiming beams be checked prior to EACH case.

Test Shots

Check the alignment of the aiming beam and treatment beam EVERY CASE



ANSI requires that the alignment of the surgical laser beam be checked against its lower powered aiming beam prior to each case (this applies to The CO₂ or Er:Yag lasers and their HeNe aiming beams).

Other infrared lasers that use fibers (i.e. Nd:Yag and Diode lasers) don't share this problem with articulated arm lasers, because once the beams are launched into the fiber, wherever the aiming beam goes the other beam must go too.

64. Laser Safety

Laser Plume (smoke)

- Although Laser hair removal may produce odors, it generally does NOT produce laser plume that needs to be evacuated.
- ANSI standards require that whenever a laser plume is generated (such as ablative skin resurfacing) that “local exhaust ventilation” (smoke evacuators) be used.
- For odors generated by Laser or IPL hair removal, room electrostatic precipitators (room air cleaners) may be effective to eliminate odor.
- Masks that filter to viral sizes are generally considered by ANSI to be ineffective as the sole protection from Laser Plume.

Laser Smoke Plume

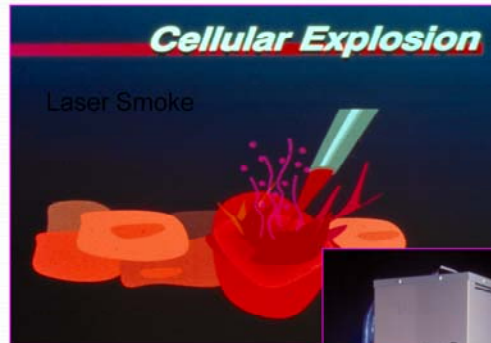
ANSI 7.4

LGAC – Laser Generated Airborne Contaminants:
The primary measure to control LGAC ... shall be
local exhaust ventilation (LEV or Smoke
Evacuators). (7.4.2)

The laser plume, or smoke is at the least very offensive. There have been questions about whether it contains infectious materials but this has never been proven. Smoke evacuators need to be used for all laser cases that generate smoke no matter what one thinks of the potential for infections. The terms ANSI use to describe Laser Plume and Smoke Evacuation are Laser Generated Airborn contaminants (LGAC) and Local Exhaust Ventilation (LEV).

Laser Plume (LGAC)

- Plume is “Nasty”, whether or not infectious.
- ANSI requires Smoke Evacuator to be used in all “smoke” cases.



ONLY where a smoke plume is generated. Not applicable to most aesthetic procedures except ablative resurfacing.



In aesthetic procedures only ablative skin resurfacing procedures really make smoke. All the others are smokeless and don't require a smoke evacuator. The question comes up sometimes regarding hair removal because you can smell the odor, but our take on this is that a smoke evacuator is not required for laser hair removal. At most a room air de-ionizer will handle the odor from hair removal. If you do resurfacing or other ablative procedures you need to deal with the smoke. Laser Plume is obnoxious, whether or not it is proven to be infectious. Either way it must be removed and smoke evacuation is the way to accomplish this and required by ANSI. Large tubing smoke evacuators may be used, or in some cases regular wall suction with a special smoke filter between the suction bottle and wall.

“Laser Masks”

**.1 μ Filtration Masks are Not First Line of Protection For
*Occupational Exposure to Surgical Smoke***

- Fit Tested
- Must Be Worn and Disposed of Properly
- Effective Only When Media is Dry
- 100% Compliance for All Smoke Producing Procedures



HCF Shall Rely On Appropriate LEV As First Line Of
Protection For Occupational Exposure To LGAC (ANSI)

ANSI discusses the viral sized face masks and says that they are NOT to be used for protection against plume, in lieu of smoke evacuation. ANSI says that masks are designed to protect the patient from health care personnel – not the other way around.

ANSI does not prevent one from using these masks though, provided that smoke evacuation is also used. We generally recommend that hospitals keep a box of these masks on their laser cart for staff that feel more comfortable wearing them, but we are also of the opinion that they are ineffective because it is difficult to use them properly.

65. Laser Safety

ANSI Laser Safety Practice Guidelines

- ANSI Guidelines deal SOLELY with a laser safe environment for personnel.
- ANSI Guidelines DO NOT deal with ANY clinical treatment safety practices nor treatment guidelines.



Let's first differentiate between "Laser Safety Hazards" and Patient Treatment Hazards with lasers. They are two entirely separate issues and frequently unrelated. Laser Safety practices such as are outlined in the American National Standards Institute, or ANSI, 136.3 standards all relate to maintaining a "Laser Safe" environment so that accidental injury from the laser does not occur.

ANSI does not address any treatment issues whatsoever, and it is entirely possible to follow all the Laser Safety practices and still treat a patient so poorly that you create burns or disfiguring injuries. Patient treatment outcomes and safe use of the laser on people are clinical issues that require proper training and experience on clinical indications, contra-indications, technique, possible complications and management of those complications. These are not Laser Safety issues. This is a very important differentiation. Simply because one has had adequate Laser Safety training, does not mean that they are then able to treat patients safely. Training in both aspects is important.

We'll look at a few aspects of these Patient Treatment Safety issues at the end of this presentation.

66. Laser Safety

ANSI Guidelines – Laser Safety Training

- Provided to ALL health care personnel responsible for ALL perioperative activities related to laser.
- Essentially this means that anyone that might be in the laser room, or even might HAVE OCCASION to be in a laser room shall be provided with Laser Safety training.

Laser Safety Program

to Assess & Control Potential Laser Hazards

- TRAINING – all personnel that will be working in a laser room, or anyone that might have occasion to enter the room, is **REQUIRED** to have Laser Safety Training. This is essentially ALL peri-operative personnel. It must be documented and on file with the LSO.
- MAINTENANCE – written service reports are **REQUIRED** to be kept by the LSO (or reference their location). Calibrations must be performed every six months.

ANSI requires that ALL personnel – anyone who even might have occasion to work around the laser or be in the treatment room – have documented laser safety training. In an aesthetic practice this essentially means all employees. For staff that aren't really performing or assisting with laser procedures this can be a very short laser safety inservice which your safety officer can provide. If it is more convenient for your practice, our Laser Training Institute does have such a short and inexpensive safety inservice available online, with a certificate of completion printed at the end. Other staff that will actually be working more with the equipment will of course need more training, such as the Laser Hair Removal or Aesthetic Laser Procedures program you are taking now.

Records must be kept of all maintenance and service provided on the laser, including service reports for the Calibration checks which are to be done once every six months.



**This is the end of the Expanded Laser
Certification Review for Hair Removal.**

**If you purchased this review as part of a
package for your NCLC Laser Certification
Exam, then your exam and testing fee will
already be covered.**

**If you want or need (to qualify for the credits)
actual training courses, go to
www.LaserTraining.org**

GOOD LUCK ON THE EXAM!