Allied Health Association

STUDY MANUAL

for the

Certified Laser Professional

NATIONAL CERTIFICATION EXAMINATION

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Disclaimer
Although every effort was made to secure the most up-to-date information for this manual, Allied Health Association, Inc. shall not be liable for errors or omissions.

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This study manual has been used as the basic document in preparation for the Allied Health Association, Inc. (AHA) credentialing examination. All other texts are ancillary and the test-taker must not rely on other texts, especially in certain areas (e.g., safety precautions, treatment parameters, etc.). In addition, a number of texts are out-dated. This summary manual of study will best serve to prepare for the AHA examination.

* NOTE
Below is a clarification of terms as they pertain to readers of this study manual.

"TRAINING" - Hands-on training from qualified technicians covering many of the same topics in this study manual. For example:

1. Fundamentals of Lasers
2. Laser/Tissue Interaction
3. Laser Safety & Regulation
4. Laser Hair Removal
5. Cooling Systems
6. Anatomy & Physiology of Skin & Hair
7. Microbiology
8. Patient Selection
9. Pre- and Post-treatment Instruction

"CERTIFICATION" - A voluntary credential which one earns by taking a written examination covering standards for proficiency in the discipline.

"CERTIFICATE OF TRAINING" - Typically issued by laser systems manufacturers or by schools, attesting to attendance. Such certificates do not verify the achievement of any national standards.

"LICENSING" - Generally, a function of the state, in which the laser system operator is required to pass state tests. Fees may be involved for testing and licensing. While some states require licensing for the operation of laser systems specifically for hair removal, most do not.

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NOTE:
In this study manual the following words have been chosen in order to ensure consistency and to eliminate confusion.

PATIENT - this word has been chosen to designate the person who is to receive laser hair removal treatment (client, patron, and customer are equally acceptable, but for ease of printing, "patient" has been chosen).

LASER SYSTEM OPERATOR, OPERATOR, LASER HAIR REMOVAL PROFESSIONAL, CERTIFIED LASER PROFESSIONAL, LASER TECHNICIAN, or TECHNICIAN - these terms have been chosen to designate the person actually operating the laser hair removal system. While we recognize that some states require that only Registered Nurses (RN), LPNs, medical physicians, or physician's assistants operate laser hair removal systems, other states have adopted different and/or less stringent requirements. Therefore, for purposes of clarity to residents of all states and for the sake of brevity, these terms will be used in this AHA Study Manual and in the AHA Certified Laser Professional Examination.

Allied Health Association
Study Manual for the Certified Laser Professional
NATIONAL CERTIFICATION EXAMINATION

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SECTION II — HAIR STRUCTURE & SKIN - (20 Questions)
This section will concern itself with your knowledge of the endocrine system, causes of hirsutism, phases of hair growth, types of hair, the Fitzpatrick Skin Types, layers of the skin, and types of lesions.

SECTION III — LASER HAIR REMOVAL SYSTEMS - (10 Questions)
This section will concentrate on, among other issues, the variable parameters of laser units (fluence, pulse width, repetition rate, spot size) and the definition of each, and laser modes.

SECTION IV — LASER SAFETY - (10 Questions)
Topics in this section include the duties of a Laser Safety Officer (LSO), the ANSI Z136.3 standard, the Nominal Hazard Zone (NHZ), general safety precautions taken in the treatment area, ocular protection, and signage requirements.

SECTION V — LASER HAIR REMOVAL TREATMENT - (25 Questions)
This section will test you on your practical knowledge of safely performing an effective laser hair removal treatment. Items to be covered will include patient selection, contraindications to treatment, preparation, equipment settings, shaving, cooling methods, proper handpiece technique of overlapping treatment areas, and post-treatment procedures and issues.

SECTION VI — GENERAL - (10 Questions)
Among other issues, this section will check your understanding of basic microbiology as it applies to laser hair removal and general hygiene requirements of the treatment area.

NEEDS ASSESSMENT

Needs Assessment concerns itself with knowledge or concepts needed by the Laser Hair Removal Professional in order to practice safely, ethically and with understanding. There are four major areas of knowledge needed: (1) laser properties and tissue interaction; (2) laser safety and regulations; (4) hair structure and production; (5) skin and its appendages.

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Chapter 1

HAIR REMOVAL SYNOPSIS

For ages, men and women have attempted to rid themselves of unsightly and unwanted hair. Many methods in the past were destructive to the skin, even when they were not permanent. From pumice stones to flintstone razors; from the use of crude depilatories to clam shells; from sulfide to arsenic to carbolic acid; from barbed needles twisted into the follicles ... such methods were both temporary and harmful. These people might not have known too much about the endocrine system or GnRH analogs (***G***o***n***adotropin ***R***eleasing ***H***ormone derivatives).

Nor would they have known about such things as congenital, topical, and systemic causes of hair growth.

Each generation or culture repeated these crude scenarios for hair removal and eventually tried all the traditional methods - waxing, shaving, tweezing, chemicals, and mechanical epilating devices.

ELECTROLOGY

Electrology is the science of permanent hair removal utilizing only solid needle/probe devices. A fine sterile needle/probe is inserted into the hair follicle and a small amount of electrical energy is discharged which destroys the hair growth tissue. When this is competently and skillfully accomplished, the regenerative ability of the hair follicle is permanently eliminated.

In the 19th century, with knowledge of electricity and physics (not to mention chemistry), a St. Louis ophthalmologist, Dr. Charles Michel, utilized direct current (DC) to permanently remove an infected eyelash. With this method, known as ***electrolysis***, DC is used in conjunction with the body's own chemistry to form lye in order to achieve chemical destruction of the hair follicle. Electrolysis gained slow ascendancy toward the end of the 19th century and into the early 20th century.

In 1923, Dr. Henri Bordier of France found that alternating current (AC) could successfully evaginate a follicle (i.e., permanently disable the follicle from producing a new hair by sufficiently "heating" the tissue). Known as ***electrothermolysis*** (or ***thermolysis***, for short).

Further improvements were made in 1948 by a young electrical engineer named Arthur Hinkel, who successfully demonstrated a method known as ***The Blend*** (also referred to as ***Dual Modality***). With this process, both AC and DC currents are used simultaneously or sequentially to achieve dual-action destruction of the hair follicle.

Electrolysis, however, is tedious, time-consuming, and painful. Its success rate, depending upon the technician, is 40% to 85%.

LASERS

The most recent development in the field had its start quite by accident when, in the early 1960s, it was noticed that hair did not grow back in tissue areas which had been treated with ruby lasers for tattoo removal. However, development of lasers for this application was delayed due to skin damage (scarring and pigment changes). In the ensuing decades, new laser types have been developed, utilizing mediums of solids, liquids, gases, and semi-conductors. Because each of these mediums has a different wavelength, each will cause a different effect upon human tissue. Many of these newer devices are much more "skin-friendly" than early lasers.

In hair removal applications, laser light, at selected wavelengths, reacts with melanin (pigment) to create heat that destroys the hair root (papilla) and stem cells along the follicular wall. This process is known as ***selective photothermolysis***.

And, while electrolysis treats only one follicle at a time, laser hair removal systems can treat many follicles (50 - 60) at once, allowing for very fast coverage of large areas. For example, an upper lip can be treated by laser in 15 seconds; electrolysis would require 40 minutes. The upper back would take 20 minutes with a laser; electrolysis would need 10 - 40 hours.

Ideally, lasers would be used to treat patients with light skin and dark hair. They cannot be used to treat a wide range of skin types and are not considered safe for persons with darker skin types or with tans (with the exception of skin-friendly, long-pulse, 1064 nm

wavelength Nd:YAG lasers with contact cooling). Since lasers can't create heat without melanin, they may not function as well with blonde or red hair. White or gray hair is not "seen" by laser light.

NON-COHERENT, PULSED FLASHLAMPS

In addition to lasers, non-coherent, optically-filtered light sources - pulsed flashlamps - have been utilized to bring about thermal damage to hair follicles; they too have been demonstrated to be effective for hair removal. These powerful light sources, which have variable wavelengths, are less specific in absorption and, in order to deliver an adequate amount of energy to the target, utilize high fluences (energy density). If excessively high fluences are employed, collateral damage can result to unintended tissue targets.

LASER HAIR REMOVAL: A BRIEF HISTORY

An effort to fabricate an improved hair removal laser system with fewer debilitating effects on skin was begun by dermatologist R. Rox Anderson, M.D., Harvard Medical School, in the early 1990s. One of his initial efforts was an effective device utilizing a wavelength of 694nm and, to protect the dermis, a water-cooled sapphire lens. Slow, firing only one 7mm or 10mm pulse per second, it also was unwieldy and heavy (over 800 pounds), causing technician fatigue. Only lighter skin types could be treated safely and there were still incidents of second degree burns and pigment changes in the skin.

Imperfect though they were, these early lasers boasted hair reduction of as much as 80% one year after treatments. Technology has continued to evolve and today we are witness to fourth generation lasers which incorporate a variety of mediums and wavelengths. Patients appreciate the fact that they are faster and more skin-friendly, while operators value them for their efficiency, ease of operation, compactness (some weigh as little as 45 pounds), and profitability.

Chapter 2

FUNDAMENTALS OF LASERS

At first consideration, a laser looms as a rather intimidating piece of technology. Surprisingly, the first laser, invented in 1960, was almost unbelievably simple, fabricated from just a few parts - nothing much more than a quartz flash tube (flashbulb) spiraled around a synthetic ruby rod polished on both ends, a power supply, and a switch, all arranged in a burnished aluminum reflecting cylinder.

That first crude assembly has blossomed into a myriad of sophisticated laser types, with applications in many fields. In fact, life today would be almost unimaginable without them. For our purposes, we will concentrate on the details of laser systems used in the hair removal industry.

Although the basics of laser systems are easy to understand, this man-made beam of light itself can be tremendously powerful - and dangerous if not handled with care and used in the proper environment by a trained technician. In order to work safely with and around laser systems, it is important to develop a basic understanding of laser physics.

LIGHT

A form of electromagnetic energy, ordinary light is generated as electrons give off energy in the form of ***photons*** (small parcels of energy). The amount of energy carried by photons is relative to their wavelength - the shorter the wavelength, the greater the energy. Specific wavelengths correspond to specific colors in visible light. Possessing relatively low energy, for instance, red light has a wavelength of about 700 nanometers (a nanometer - the usual measure of light wavelength - is one-billionth of a meter, abbreviated as ***nm***). Violet light is at the other end of the visible light spectrum, with a wavelength of 400 nm and with high energy. The whole electromagnetic energy spectrum includes visible light (from 400 to 700 nm), ultraviolet light (less than 400 nm), and infrared light from 700 nm up (see Figure 1.). Medical lasers usually have wavelengths of the visible, near infrared, or infrared part of the electromagnetic spectrum.

Examples of lasers used in hair removal and their corresponding wavelengths are:

- ***Nd:YAG*** (***N***eo***d***ymium ***Y***ttrium ***A***luminum ***G***arnet) at 1064 nm
- the ***diode*** at 800 nm
- the ***alexandrite*** at 755 nm
- the ***ruby*** at 694 nm

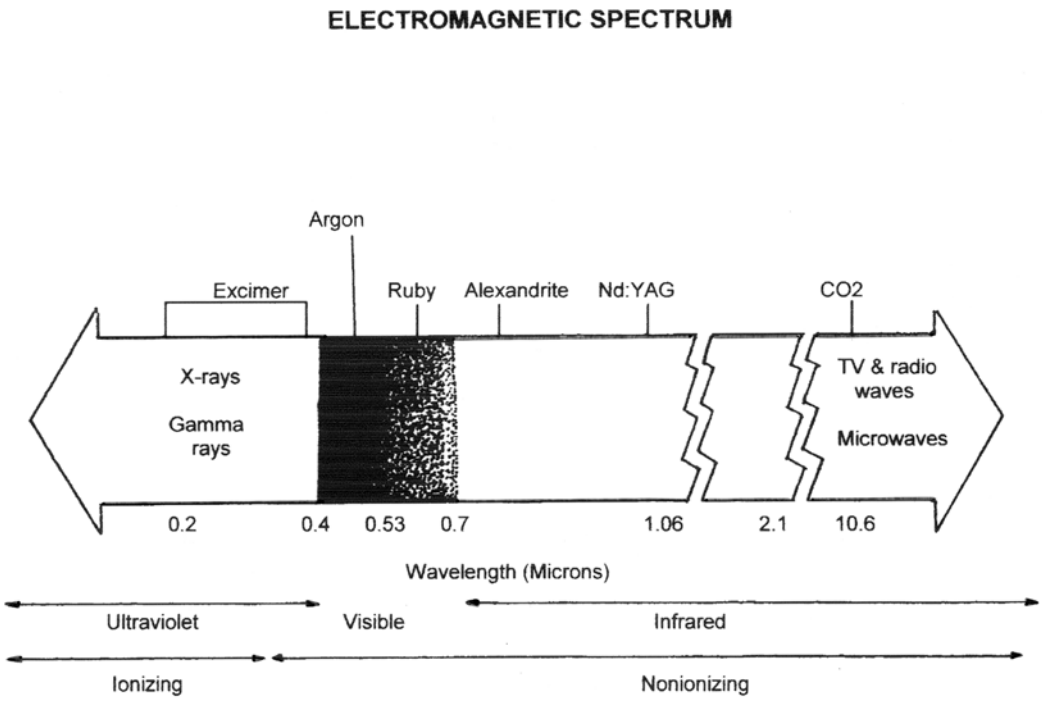
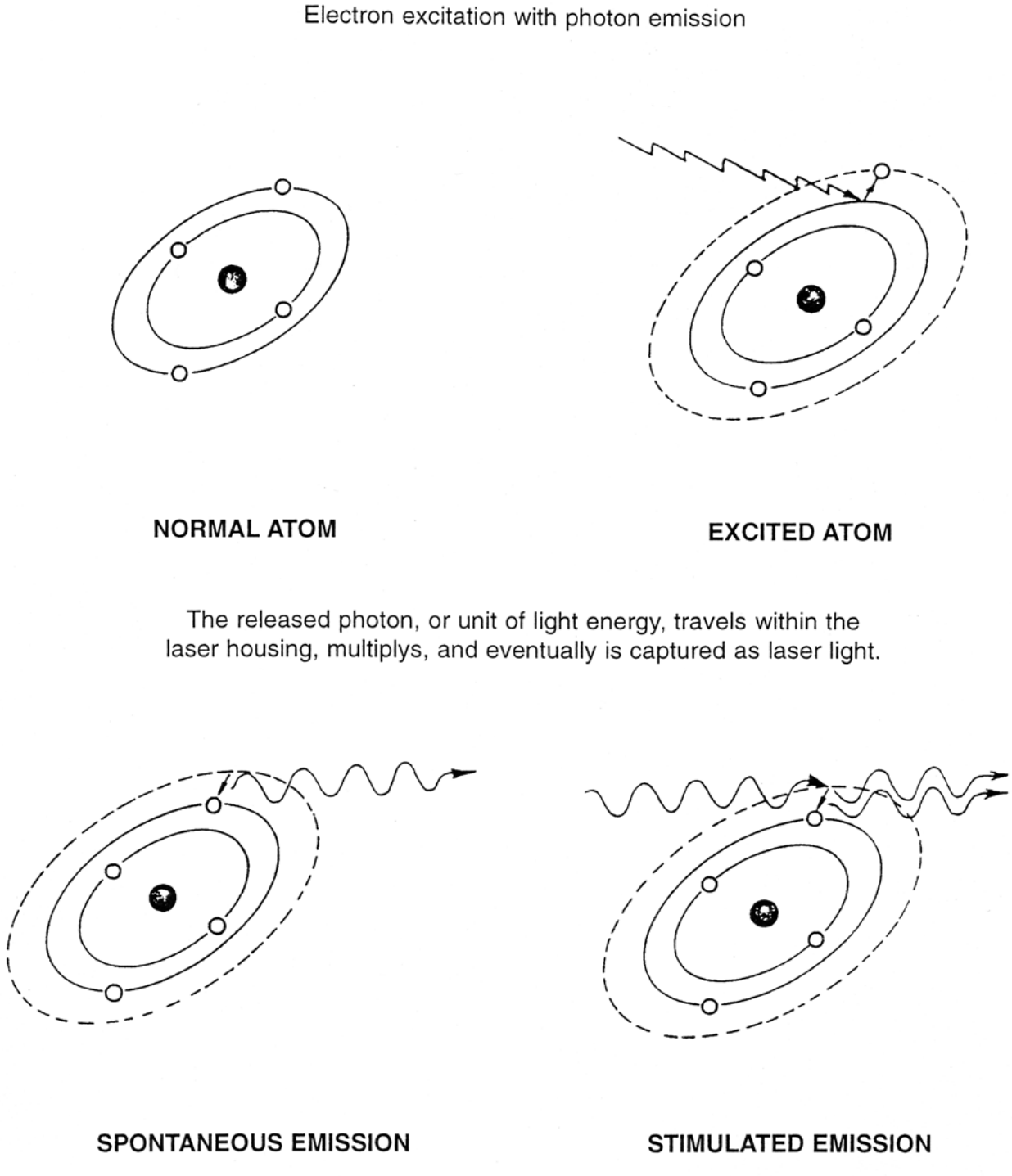


Figure 1

Inside an atom, one or more electrons orbit a positively charged nucleus. Those furthest from the nucleus have higher energies than those closer to the nucleus. When energy from an outside source is absorbed by an electron, it moves to a higher energy level. An electron in this excited state seeks to release its additional energy, which can be released either as heat or as a photon (in a random direction).

STIMULATED EMISSION

The production of laser light depends upon a large number of electrons absorbing energy from an external source (such as an electric current, a flash lamp, or another laser beam), which elevates them to an excited state. Some of the electrons will release their extra energy as photons of light in the laser ***medium*** (the medium can be a solid [such as a



crystal], a liquid, a gas, or a semi-conductor (see Figure 2). Note that lasers usually are named according to the particular medium they utilize, i.e., Nd:YAG, ruby, etc.).

Figure 2

The medium is bounded by two mirrors, one on either end. These mirrors cause the photons to circulate back and forth through the medium. Each released photon stimulates another electron, also in an excited state, to release an identical photon. Because they possess identical energy, these two photons are of the same wavelength. Laser action is possible because of the production of photons of the same wavelength. Hence the acronym ***LASER:*** ***L***ight ***A***mplification by the ***S***timulated ***E***mission of ***R***adiation.

The light pulse continues to build up to high power and drains the energy stored in the medium. One of the mirrors is not 100% reflective; in one particular type of laser, for example, it is only 90% reflective. Eventually, 10% of the photons escape through the partially reflecting mirror and make up the laser beam. A series of optical assemblies then focus the beam into a fiber optic cable or other device, depending upon the application. As we shall see later, when this beam encounters tissue, its light energy transforms into heat to produce the desired effect. See Figure 3.

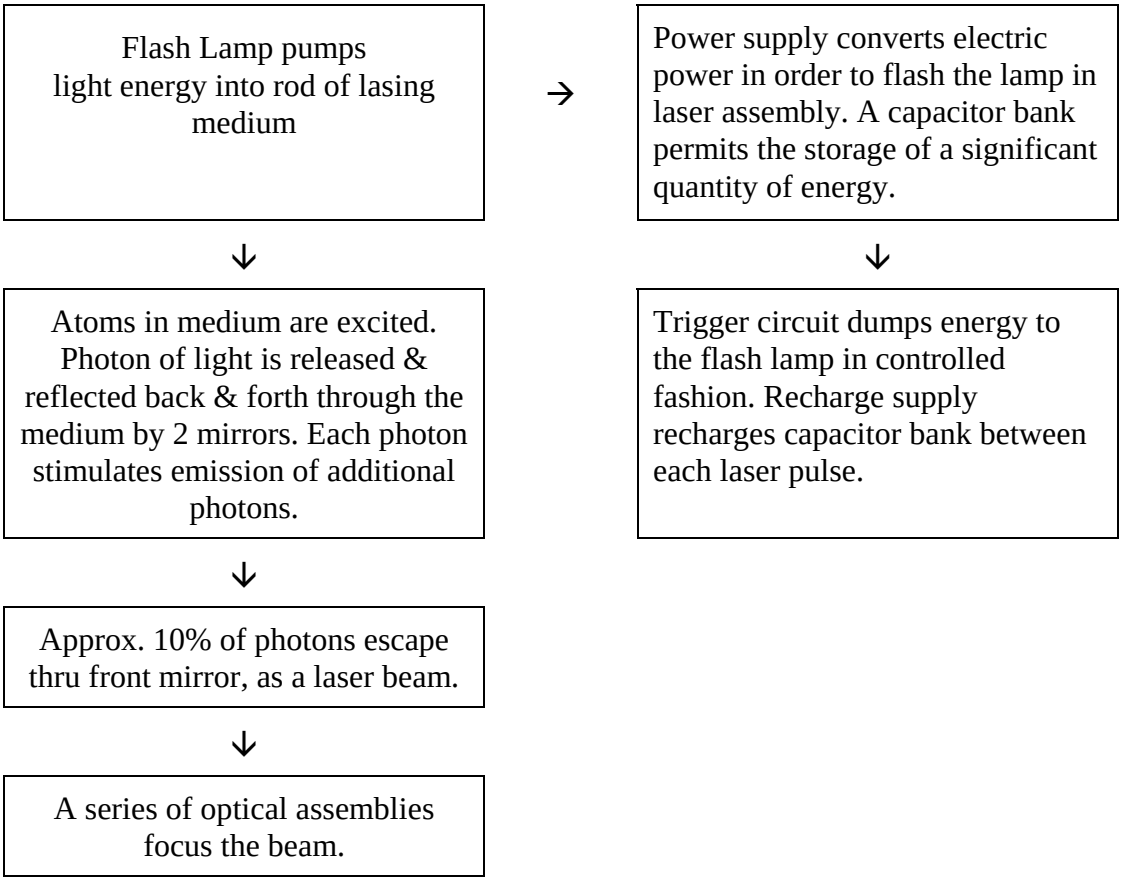


Figure 3 - Simple diagram of a typical laser system

THREE CHARACTERISTICS OF LASER LIGHT

Each of the different laser mediums produces light of a different wavelength (as well as a different color, since color also is wavelength-dependent). Different wavelengths are utilized in various laser systems for different effects on tissue.

Laser energy has three important characteristics:

1. **MONOCHROMATIC**

   It consists of photons of a single wavelength or a very narrow band of wavelengths. This aspect of laser energy is of special interest to the laser professional because a specific wavelength will need to be chosen based upon the desired effect on tissue.

2. **COLLIMATED**

   All of its rays travel parallel to one another in a single direction, with very little divergence (spreading) over long distances. This allows laser light to be focused to a very high intensity.

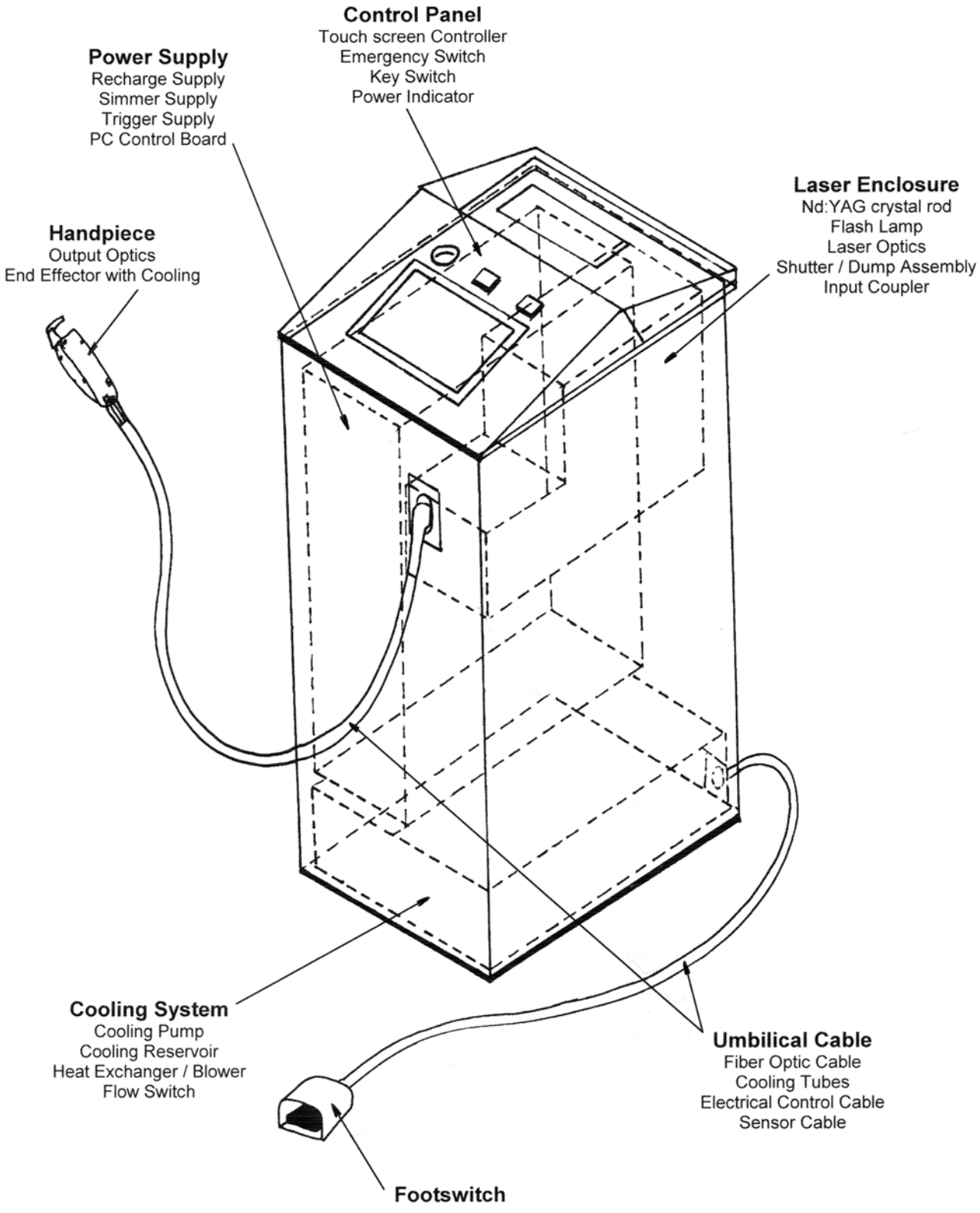
3. **COHERENCE**

   Its light waves are all in phase in both time and space, i.e., the waves travel in step with each other crest-to-crest and valley-to-valley. By contrast, ordinary light, such as that from a flashlight, has a mixture of wavelengths moving at different times in different directions.

ILLUSTRATION OF LASER HAIR REMOVAL SYSTEM

On the following page is a schematic drawing of a typical laser hair removal system. The handpiece contains fiber output optics (allowing the selection of different spot sizes), a foot switch (allowing the operator to call for laser pulses as needed), a sensor (ensuring the end effector is in contact with the skin before it can be fired), and a cooling plate (water is supplied to the handpiece for skin cooling during hair removal procedures).

The control panel includes a key switch, emergency off button, and a touch screen controller. The touch screen controller allows the operator to input laser control parameters - ***fluence*** (or ***laser energy***, measured in joules per square centimeter), ***pulse width*** (or ***pulse duration***, in milliseconds), and ***repetition rate*** (number of pulses per second).


Control Panel
Touch screen Controller
Emergency Switch
Key Switch
Power Indicator
Power Supply
Recharge Supply
Simmer Supply
Trigger Supply
PC Control Board
Laser Enclosure
Nd:YAG crystal rod
Flash Lamp
Laser Optics
Shutter / Dump Assembly
Input Coupler
Handpiece
Output Optics
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Cooling System
Cooling Pump
Cooling Reservoir
Heat Exchanger / Blower
Flow Switch
Umbilical Cable
Fiber Optic Cable
Cooling Tubes
Electrical Control Cable
Sensor Cable
Footswitch

Chapter 3

LASER PROPERTIES & TISSUE INTERACTION

The four principal interactions between laser light and tissue are:

- Absorption
- Scattering
- Reflection
- Transmission

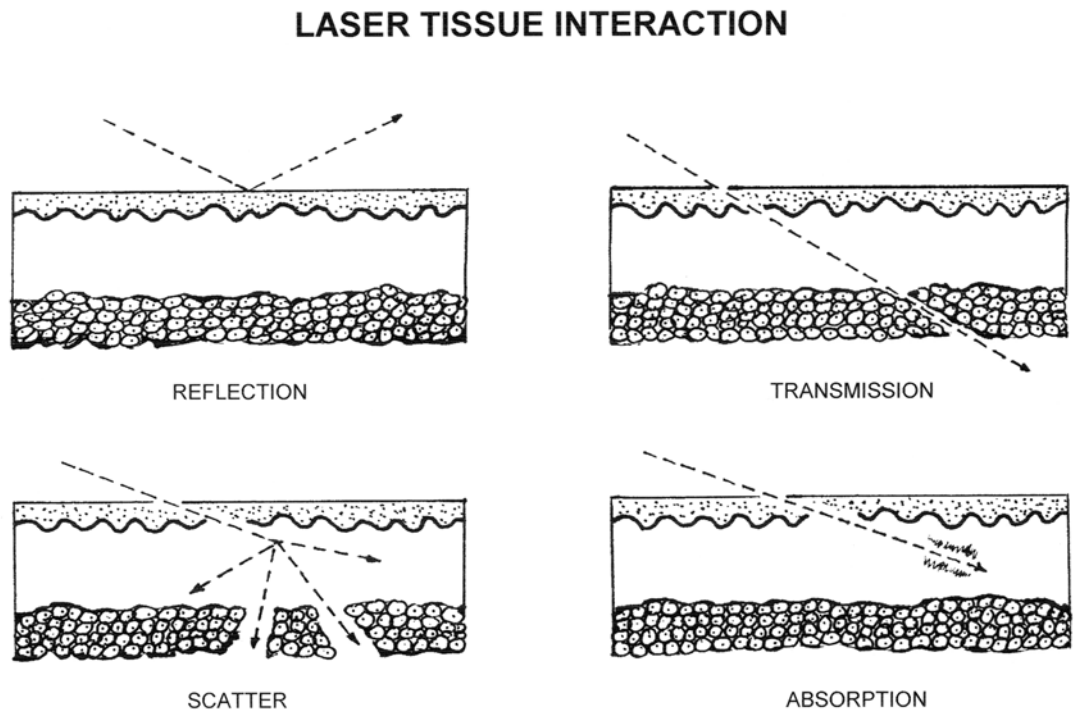


Figure 1

Absorption (see Figure 1 above) of radiant energy is the essential interaction between laser light and tissue. This is what makes laser hair removal systems effective. Laser light penetrating the tissue to the appropriate depth reacts with melanin in the hair shaft to create heat, which destroys the target - the hair follicle. With longer wavelengths, melanin absorption decreases; therefore, darker skin can be treated if sufficient fluence can be used. The laser's wavelength determines the depth of penetration of the skin.

Longer wavelengths reduce scattering in the dermis and, thus, achieve greater penetration.

And so, of the four interactions, we are most concerned with ***absorption***, which can result in coagulation or ablation (volume removal of tissue by vaporization). As light penetrates tissue, some is ***scattered*** and a small amount is ***reflected***. Even though the clinical effect of reflected light is generally negligible, it may represent a safety concern to the laser operator and others in the treatment area. This issue is of particular prominence with the visible and near-infrared lasers (including Nd:YAG) since at these wavelengths, the eye is transparent and even small amounts of laser energy may be focused onto the retina by the lens in the eye. It is for this reason that appropriate eyewear is mandated for all persons in the laser treatment area. If laser light is not completely absorbed in tissue, some of it may be ***transmitted*** through the tissue to structures on the other side.

Tissue absorbs laser light depending upon the characteristics of the tissue and upon the wavelength of the laser. ***Chromophores*** are colored bodies in tissue which absorb light of particular wavelengths. For our purposes, the two most significant chromophores are oxyhemoglobin and ***melanin*** (the pigment which gives color to hair or skin). Laser hair removal centers on melanin. As laser light is absorbed by the melanin in the hair shaft, heat is generated and diffuses to the surrounding follicular ***epithelium*** (membranous tissue). Because heat absorption by melanin can damage hair follicles, long-term hair loss can be the result. But as the target tissue becomes heated, the heat is conducted to adjacent tissues, possibly causing unwanted damage.

Heat diffuses by a process known as ***thermal relaxation***. Thermal relaxation time (TRT) is the amount of time required for an object to cool to 50% of the temperature achieved immediately following exposure to laser light. If the target is sufficiently heated with a pulse duration shorter than the thermal relaxation time of the tissue, little damage will result in adjacent tissue. However, if a ***pulse duration*** (also known as ***pulse width***) is longer than the TRT, significant amounts of heat will be conducted to adjacent tissue, possibly resulting in unwanted injury.

For our purposes in laser hair removal, the objective is to deliver sufficient laser energy to the hair follicle to destroy it, while utilizing a pulse duration short enough to avoid damage to surrounding tissue. The four variables to be considered are:

1. Fluence
2. Pulse width (also known as "Pulse duration")
3. Repetition rate (number of pulses per second)
4. Wavelength

How tissue is affected by a laser is dependent upon several factors. Absorption and scattering characteristics primarily will be determined by wavelength. Other considerations are:

- Power density
- Laser energy
- Beam diameter
- Pulse width
- Chromophores in the target and adjacent tissues

Energy, measured in joules (J), is proportional to the number of photons.

Power, measured in watts (W), is simply a measure of the rate of energy delivery in joules/second. 1 W is equal to 1 J/sec.

POWER DENSITY

Besides exposure time and wavelength, the laser system's power and the beam's diameter also influence the laser beam's effect upon tissue. A laser's power density is its power output (in watts) divided by the area of the cross section of the beam where the beam hits its target (in cm^2). The beam's power density can be increased by raising the laser's power output or by reducing the beam's area (utilizing focusing lenses). The more efficient method is to focus the beam. As an example, halving the beam's diameter through focusing reduces the beam area by a factor of four and, consequently, increases the power density by a factor of four as well. By contrast, doubling the power output of the laser only doubles the power density.

FLUENCE (ENERGY DENSITY)

A vital laser parameter, ***fluence*** (energy density) is the energy (measured in joules [J]) of a single laser pulse divided by the area of the beam (in square centimeters), i.e., J/cm^2. Fluence can be increased by increasing the energy output of the laser or by decreasing the diameter of the laser beam (although decreasing the diameter of the beam will also

reduce penetration depth). Alternatively, fluence can be increased by increasing the duration of the exposure time.

PULSE WIDTH

Pulse width (also known as "pulse duration") is the amount of time the laser energy is applied (not including the time between pulses). The speed with which pulses are generated is measured in hertz (Hz), or in ***pulses per second***.

Penetration depth of laser light into tissue is determined by the interaction of wavelength, concentration of chromophore, fluence, and the amount of laser light scattering in the tissue.

PEAK POWER/AVERAGE POWER

Other significant aspects of laser systems are ***peak power*** and ***average power***. Often these are not directly specified but are reflected in:

- Fluence
- Pulse width
- Repetition rate
- Spot size

The rate at which energy is supplied during the laser pulse is peak powe**r** (expressed in watts, or joules/second). Affecting peak power are fluence, spot size, and pulse width (duration). Peak power is at its greatest at short pulse widths. A laser system's maximum peak power is usually what determines the available energy at the shortest pulse widths.

Also measured in watts (or joules/second) is average power - an indication of the total amount of energy produced per second by the laser system. Average power reflects the overall rate of energy flow (including the time between laser pulses), while peak power is a measure of the rate of energy delivery only during the laser pulse. A laser system's maximum average power capability is usually what determines the maximum repetition rate.

LASER MODES

Lasers can operate in different ***time modes***, based upon the rate at which energy is delivered. ***Continuous wave*** lasers produce a stable beam of energy. Those that produce pulse durations as high as several hundred milliseconds are ***long pulse*** (***normal mode***)

lasers. ***Q-switched*** lasers store energy and release it in a massive burst over only a few nanoseconds. Because of this short duration of the pulse, Q-switched lasers have a very high peak power output, but do little damage to the epidermis. The application is what determines the appropriate mode. Some lasers can be operated in more than one mode.

SPOT SIZE

One of the two factors controlling fluence (energy density) is spot size. The other factor is the total power, measured in watts, of the laser (set by the operator).

Spot size itself is influenced by ***lens focal length*** (shorter focal lengths produce smaller spots and, thus, higher fluence) and by the ***wavelength*** of the light (the shorter the wavelength, the smaller the spot).

What determines the spot size of a focused beam are the size, shape, and color of the beam as it enters the lens. Beams emitted from the output end of fibers are somewhat different. A laser beam's spot size is an altogether distinct factor from the ***impact size*** that the laser leaves behind. Impact size is a measure of the actual dimensions of the incision width created by the laser. If spot size is unchanged, the impact size will increase when the beam is applied to the site for a longer period of time (the edges of the beam have more time to create an effect and, thus, increase its width).

The smaller the wavelength, the smaller the spot size. The kind of laser you will work with will be chosen for its specific effects upon tissue and for its delivery mechanism rather than for its spot size.

As stated previously, longer wavelengths reduce scattering in the dermis and, thus, achieve greater penetration. Use of a larger spot size will heat deeper without the need to increase fluence. For example, a 5mm spot at 60 J/cm^2 must be increased to 100 J/cm^2 to reach the same depth in tissue as a 10mm spot size at 60 J/cm^2. This means that a longer wavelength is safer and a longer pulse width and larger spot size are best.

Mode refers to the distribution of power over the spot area and determines the precision of the spot (or how finely the beam can be focused).

Chapter 4
LASER SAFETY & REGULATIONS

Proper operation of laser systems by trained professionals and the appropriate treatment environment are necessary to ensure the safety of the patient and staff members. All who come in proximity to the laser system must be informed of the appropriate procedures and precautions.

The laser hair removal clinic must have a designated Laser Safety Officer (LSO), properly trained and experienced in order to administer a laser safety program. The LSO may be required to identify and evaluate hazards, verify that proper safety practices are followed, ensure appropriate ongoing education and training of staff members, maintain safety procedures and their documentation, provide for the maintenance of laser systems, and remain cognizant of laser operators' visual health.

ANSI Z136.3 STANDARD

The facility's employees must be aware of safe laser practices and the most current issue of ANSI (American National Standards Institute) Z136.3 standard, entitled Safe Use of Lasers in Health Care Facilities, in order to be in compliance with OSHA (Occupational Safety and Health Administration) standards for safety in the workplace. It is essential that laser system operators attend a suitable laser training course and procure a certificate of attendance. Training may usually be obtained from laser manufacturers. A copy of the ANSI Z136.3 standard should be kept on site, not only for reference purposes, but in order to be in compliance in the event of a facility inspection. Such proper compliance also will avoid the issuance of fines.

Laser safety training programs also are provided by the American Society of Laser Medicine and Surgery (ASLMS) and by the Laser Institute of America (LIA). In addition to the ANSI standards, federal, state, and local regulations should be taken into account when safety policies, procedures, and practices are being decided upon for each facility.

INHALATION

Studies imply that contained in laser smoke/plume are chemicals which may be irritating to bronchial mucosa and also may cause biological mutation. It is recommended that laser hair removal be performed in a well ventilated area. The use of a smoke evacuator is recommended, not only to exhaust the laser plume, but also to deal with unpleasant odors resulting from hair removal. Use of protective respiratory masks is addressed later in this chapter, under the heading Safety Precautions During Laser Treatment.

BURNS

The laser beam will burn tissue and can cause dry objects (including cotton gauze, sponges, and draperies) to combust. To avoid accidental burns, always place the laser in "standby" when not in use and always aim it in a downward direction. Combustible liquids (such as alcohol, acetone, flammable prep solutions, flammable anesthetics, hair spray, or hair gels), and gases (such as oxygen) must not be in the proximity of the laser system. It is critical to have a supply of water and an appropriate fire extinguisher in the treatment area.

ELECTRICAL ISSUES

Maintenance or service of the laser system, other than that which is detailed in the operator manual, should be performed only by qualified, laser service personnel. Maintenance is to be performed with the system turned off and disconnected from power. Proper grounding must be in place. Regular inspections of the system should be conducted (according to a schedule indicated by the manufacturer in the laser operation manual); written records of maintenance and service should be on file.

Electric cords/cables should be inspected for damage before each use. The clinic's LSO should be familiar with local codes covering electrical equipment.

OCULAR PROTECTION

Most lasers utilized in medicinal fields are designated by the FDA and ANSI as Class 4. The emission of these lasers is a potential hazard to eyes and skin by direct or scattered radiation. Protective eyewear with sideshields must be worn by both the laser technician and patient (and by any other person in the vicinity of the laser system). The eyewear must be specific to the wavelength of the laser being used and must be marked or labeled

with the wavelength and with the optical density (OD) at that specific wavelength. Most manufacturers supply the correct eyewear with delivery of the laser.

Contact lenses and conventional prescription glasses do not offer suitable protection. Contact lens wearers should also wear the proper protective eyewear with sideshields.

The Nominal Hazard Zone (NHZ) is the area where protective eyewear should be used, according to the maximum permissible exposure (MPE) designation (detailed in the ANSI standard). Many laser system operators designate the whole laser treatment room as the NHZ.

It is important to realize that a person working with or around lasers over time without sufficient ocular protection may receive a ***cumulative*** effect from scattered radiation.

Laser light of some systems is invisible infrared and is capable of causing ***permanent eye damage***. Even when wearing the protective eyewear, one must not ever look directly into the handpiece. Additionally, never look directly into or at the laser beam or at scattered light from metallic or reflective objects (including instruments and jewelry). Be aware that laser light of certain wavelengths can pass through windows or glass. The laser should never be activated into free space, as reflection hazards can exist well beyond the laser system itself.

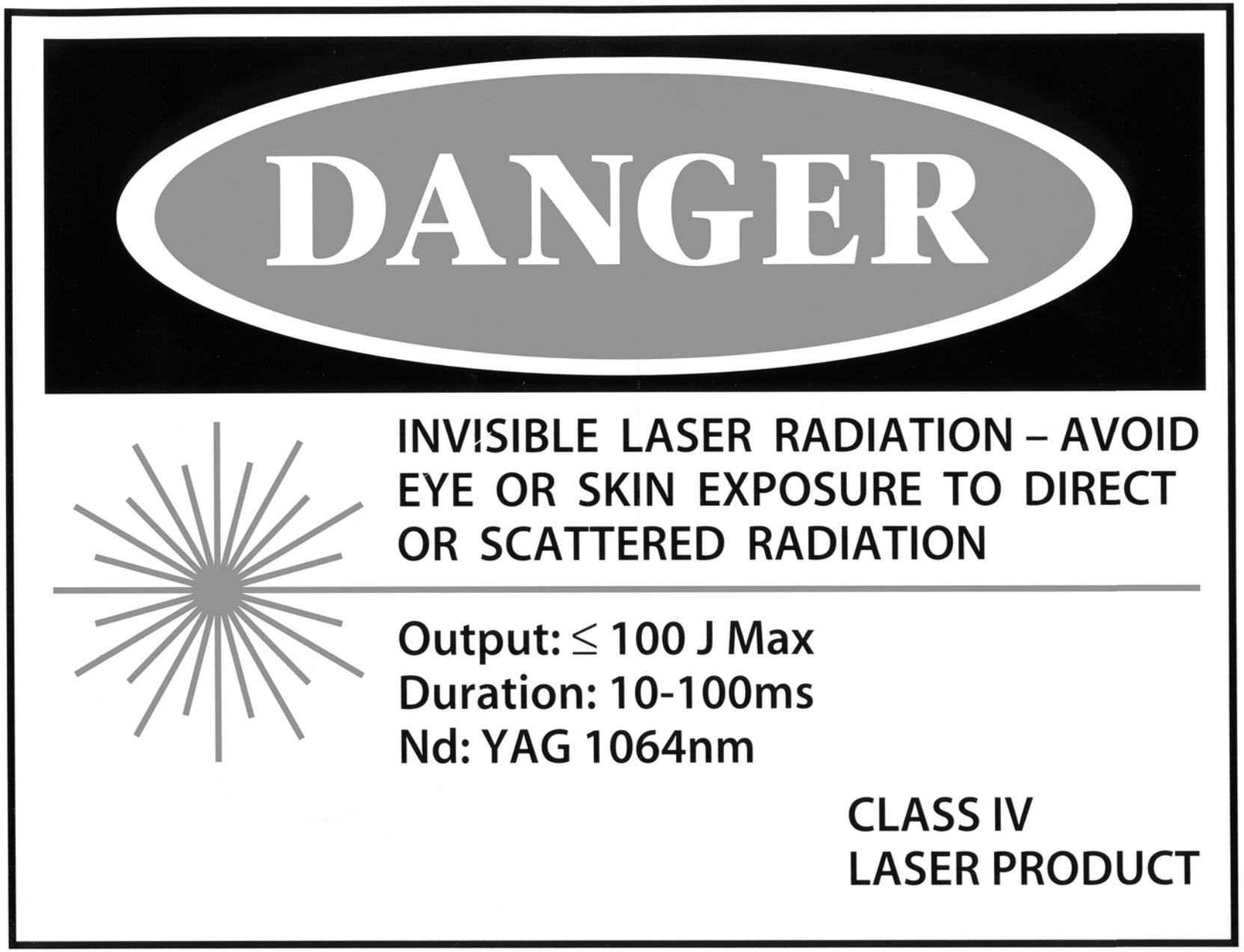
CLEANING

In addition to ordinary maintenance and general cleaning of the laser system, prior to each treatment, the laser system operator should ensure that the laser lens is clean. If the lens is dirty, laser light could refract and burn tissue. Laser light can refract off debris and pit the lens cover. The lens should be cleaned, with alcohol; the lens cover also should be cleaned.

AREA SIGNAGE

ANSI standards state that an appropriate ***area sign*** be attached to the outside of the door of the treatment area, indicating the wavelength of the laser system being used. Refer to Figure 1 below. It is also recommended that proper eyewear be secured to the sign in case of any entry during laser operation. To prevent escape of laser light (and to prevent entry of any person), any and all doors to the treatment area always should be closed and

locked during the entire laser procedure. Any windows in the treatment area should be covered with material sufficient to prevent escape of laser light.


DANGER
INVISIBLE LASER RADIATION – AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION
Output: ≤ 100 J Max
Duration: 10-100ms
Nd: YAG 1064nm
CLASS IV
LASER PRODUCT

SAFETY PRECAUTIONS DURING LASER TREATMENT

The laser system operator will obtain an informed, signed consent and release form from the patient prior to treatment. A photograph(s) of the area to be treated will be taken prior to treatment; a photograph(s) also will be taken after treatment, as part of good documentation protocol. The operator will check the laser system for proper function (including condition and connections of electric cords/cables). Staff and patients shall have proper eye protection in place when in areas of potential exposure to direct or reflected laser light. To ensure accurate settings, the laser system will be calibrated prior to each use (however, most lasers self-calibrate as they are turned on). To avoid injury while the scanner is in beam mode, calibration should be performed at only one pulse per second (repetition rate). The laser system operator must be credentialed for the particular laser to be used. The operator should refer to a treatment settings chart, similar to the one shown in Figure 2 below.

HAIR REMOVAL TREATMENT GUIDELINES - 1064nm Nd:YAG Laser
For all treatments listed below, the recommended spot size diameter is 10mm.

LOCATION	FITZPATRICK SKIN TYPE	FLUENCE	PULSE WIDTH
Face	I - III	40 - 60 J/cm^2	10 -20 ms
	IV	35 - 50 J/cm^2	15 - 30 ms
	V	30 - 45 J/cm^2	20 - 30 ms
	VI	20 - 40 J/cm^2	30 ms
Body	I - III	45 - 60 J/cm^2	10 -20 ms
	IV	40 - 55 J/cm^2	15 - 30 ms
	V	40 - 50 J/cm^2	20 - 30 ms
	VI	35 - 50 J/cm^2	30 ms

These parameters are provided as a guide only. Observe laser-tissue interaction and clinical response to determine appropriate settings for each patient.

Starting fluence should be at the low end of the range, with adjustments made based on epidermal response. Areas with high hair density and/or coarse dark hairs, such as the chin, should be treated at lower fluences than areas with sparse hair. Lower fluences may also be used for treatment over bony areas. Increasing the fluence may provide increased efficacy; however, factors such as skin type, tanning, hair density, and body location may limit the maximum useable fluence that does not result in unwanted epidermal damage.

Pulse width should be adjusted based on skin type and hair thickness. Pulse width settings near the middle to upper end of the given ranges are appropriate for most treatments. The longer pulse widths provide epidermal safety and are well-suited to coarse hairs. Thin hairs respond best to the shorter pulse widths.

Figure 2 - Treatment Settings Chart

NOTE: Because safety is of primary concern when determining laser control parameters, special attention should be paid to the chart below (Figure 3). These maximum fluence levels should be committed to memory, as they will be encountered in the day-to-day operations of a laser hair removal clinic and also because they likely will appear on the AHA National Certification Examination.

MAXIMUM FLUENCE *All of the settings in this chart apply to treatments of skin areas on the face (not the body). For fluence levels listed below (on the three laser systems in this chart), pulse width should be from 10 to 30 milliseconds.*		
LASER TYPE	**FITZPATRICK SKIN TYPE**	**MAX. FLUENCE**
Nd:YAG	I - III	60 J/cm^2
	IV	50 J/cm^2
	V	45 J/cm^2
	VI	40 J/cm^2
Diode	I - III	50 J/cm^2
	IV	40 J/cm^2
	V	35 J/cm^2
	VI	Not Recommended
Alexandrite	I - III	45 J/cm^2
	IV	35 J/cm^2
	V	Not Recommended
	VI	Not Recommended

Figure 3 - Maximum Fluence Chart

A secure location will be designated and used for the laser key; the key will not be left in the laser unattended. The laser system shall be turned off and the key removed when the laser is left unattended for any significant period of time. Only authorized, trained laser system operators should have access to the key.

After being turned on, the laser system should be ***standby mode*** at all times except during treatment. Whenever there is a pause in treatment, the laser shall be placed in standby**.**

A label showing maximum output shall be affixed to laser equipment. Suitable eyewear will be available outside the treatment room door. The specified laser sign shall be affixed to all doors leading to the procedure room (see Figure 1 for example). All doors leading to the procedure room will be closed and locked during the entire laser treatment session.

Laser procedures will be conducted with a suitable fire extinguisher and a supply of water available.

Proper precautions for skin protection should be taken, including adequate cooling techniques.

Personnel should wear protective respiratory masks specifically designed for laser use to inhibit the inhalation of airborne contaminants. For those facilities in which an exhaust system is employed, suction should be positioned as close as possible to the source of the laser plume. Exhaust suction should not be directly connected to wall suction, because particles will settle within the wall system and clog it. Operators should don gloves when charging the moisture filter and tubings in the evacuator. The filter shall be bagged and labeled as hazardous waste.

Instruments used in the laser procedure area should have dulled finishes. The laser foot pedal should be positioned only in front of the operator.

Following the treatment, the laser system is to be turned off and the key removed to a secure location. The treatment procedure and outcome should be well documented (including photographic documentation). All laser equipment should be cleaned, inspected, and placed in its proper location. Eyewear should be cleaned between patients. The operating manual for each particular laser system should be referred to for additional safety procedures.

OPERATOR COMPLIANCE

Operators and users of laser systems must adhere to the requirements of a designated Laser Safety Officer (LSO), safety training, familiarization and compliance with regulation issues, development of and compliance with standards of care, safety of patients and staff, and provisions for equipment maintenance.

Some states allow laser systems to be operated by non-physician personnel for laser hair removal; some states restrict this work to physicians only. In states where the supervision of a licensed physician is mandated, the owners of the laser system should contact their state's medical board to determine if the physician must be on-site at all times.

The requirements of state medical boards for personnel who operate laser systems for hair removal include, but are not limited to, the following:

- Physicians only
- Physicians, nurses, physicians' assistants
- Non-medical personnel under the direction of an on-site physician
- Non-medical personnel under the direction of a medical director
- No regulation

State medical boards' requirements for operators of laser hair removal systems change from time to time. Therefore, it is necessary for laser owners/operators to contact their state medical board to determine the most current stipulations.

Other organizations which should be contacted for applicable regulations and/or oversight include state and/or local licensing groups and the state board of cosmetology.

Laser system operators need to familiarize themselves with the most current ANSI laser safety recommendations, ANSI Z136.3, Safe Use of Lasers in Health Care Facilities.

As an ethical consideration, liability insurance covering the operator is a necessity. Ensure that the liability insurance covers the particular ***type*** of laser system, the type of procedure, and the type of technician being employed.

Chapter 5
HAIR STRUCTURE

We now move to the issue of hair structure. Again, we do not expect the technician to be a dermatologist. The chapter will address the issue of the hair itself.

THREE LAYERS

The obvious question then is - what is hair? Hair is an appendage, an outgrowth of the skin. Hair is made up of protein, keratin, and other chemicals/fibers. There are three layers to the hair:

1. **Medulla** - the innermost layer
2. **Cortex** - the middle layer
3. **Cuticle** - the outer layer

The medulla is a soft fiber network surrounded by empty spaces. The medulla is soft to the point that if chemicals are used or mechanical means over-used, it can be crushed. Pigment granules are present in the medulla. The medulla, according to many authorities, can collapse as the hair is subjected to mechanical or chemical abuse.

The cortex of the hair (see Fig. 1) accounts for almost 75 - 90% of the total hair fiber. The cortex actually is a layer consisting of other layers. Amino acids link up end-to-end to form a poly-peptide chain. Lastly, there are large fibers which we commonly call the cortex but which are, in fact, just the outer "shell" of the entire structure. The cortex, therefore, looks like a rope or piece of yarn which is made by twisting single strands around each other. Through experiments and research, it has been found that a single hair is actually stronger than a piece of copper wire of the same diameter. (Note: no wonder then that we will say later in this manual that our task is not to destroy hair but to disable the follicle!) The cortex contains the pigment for hair color and supplies the natural curl, elasticity, moisture, and oils.

The cuticle holds together the other two layers. Although it accounts for only 10 - 25% of the hair composition, it is the major protector for the hair structure. It contains overlapping cells (like shingles -- also called imbrication) that dehydrate and flatten as

the hair is formed in the follicle, wrapping themselves around the hair. The cuticle's job is to protect the interior of the hair. The tighter the cuticle cells are to each other, the more difficult it will be for foreign particles to enter the hair. The cuticle is responsible for the natural sheen of the hair.

Now that we have "dissected" the hair itself, we can look at it as it relates to or rests in a follicle.

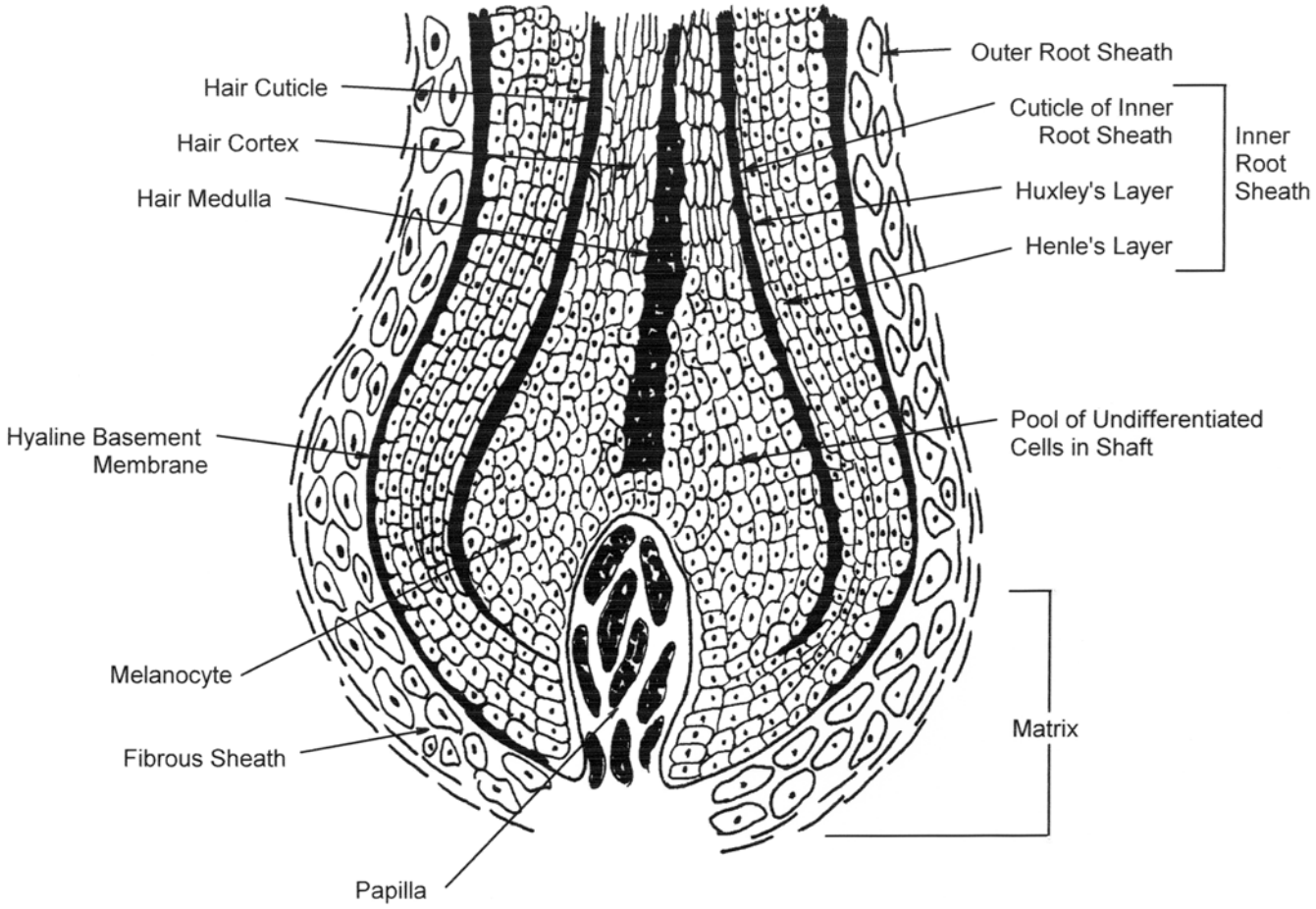


Figure 1

A hair cycle begins as a primary hair germ and this, in turn, develops into an ***anagen hair***. The hair will then pass - in time - through a ***catagen*** and a ***telogen*** phase. In telogen (the ***resting phase***), the secondary hair germ cell will form a new anagen hair. And so the cycle continues. The hair follicle begins as an ***epithelial bud*** projecting

downward from the fetal epidermis. This primary germ is guided in its development by the underlying ***dermal papilla.***

A "cap" of basal cells just above the dermal papilla moves upward to form the ***hair shaft***. The hair shaft is the keratinized portion of a hair that extends from a hair follicle and projects above the surface of the epidermis.

A thin ring of basal cells forms the three cell layers of the ***inner root sheath*** (see Figure 1). The coating of basal cells from the upper follicle extend downward to the lower bulb area and becomes the ***outer root sheath*** **(ORS)**. As one approaches closer to the follicle opening, there is a switch from ORS keratinization to epidermal keratinization (and the formation of the stratum corneum).

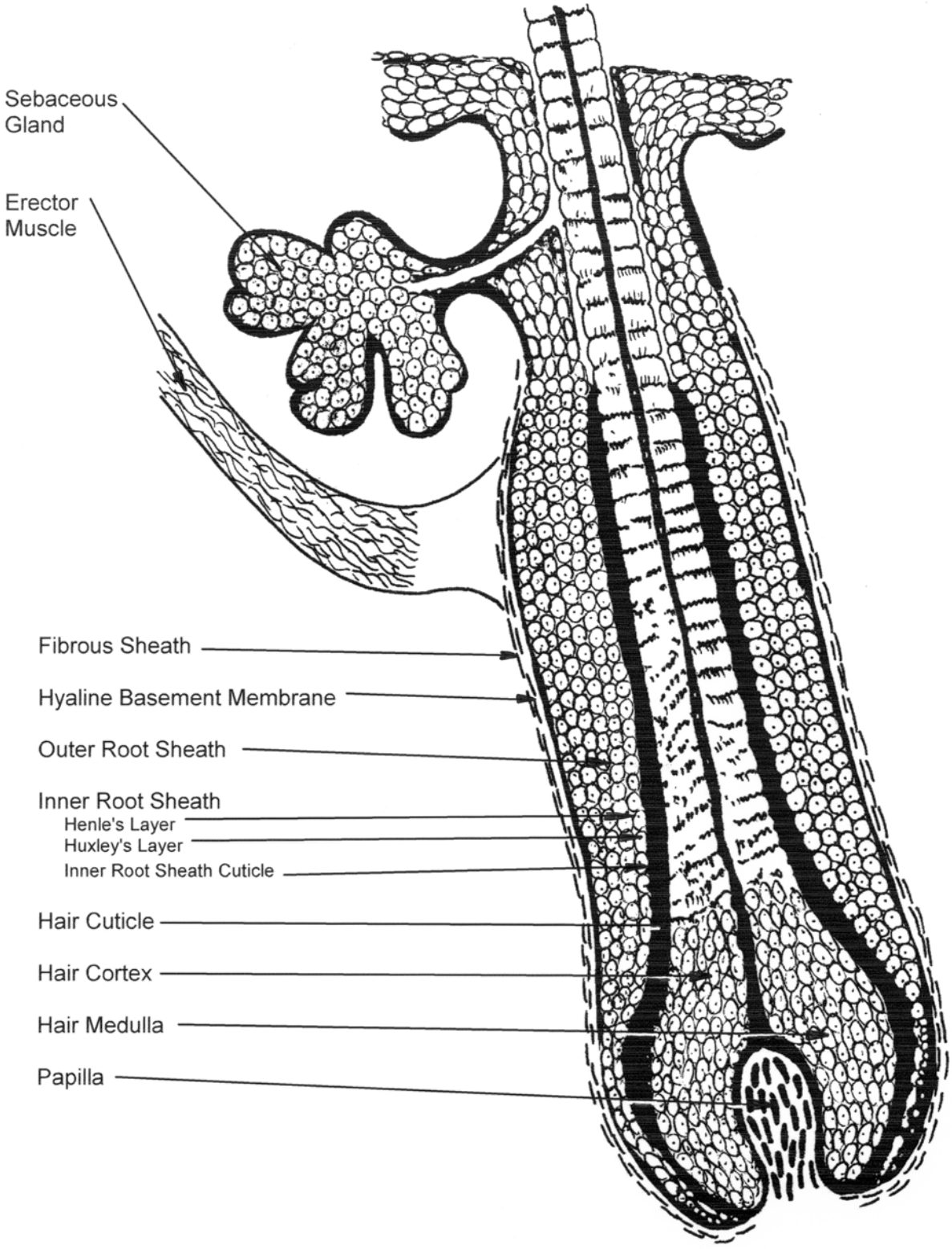
THREE PHASES OF HAIR GROWTH

We enter a brief description of the ***three phases*** of hair growth:

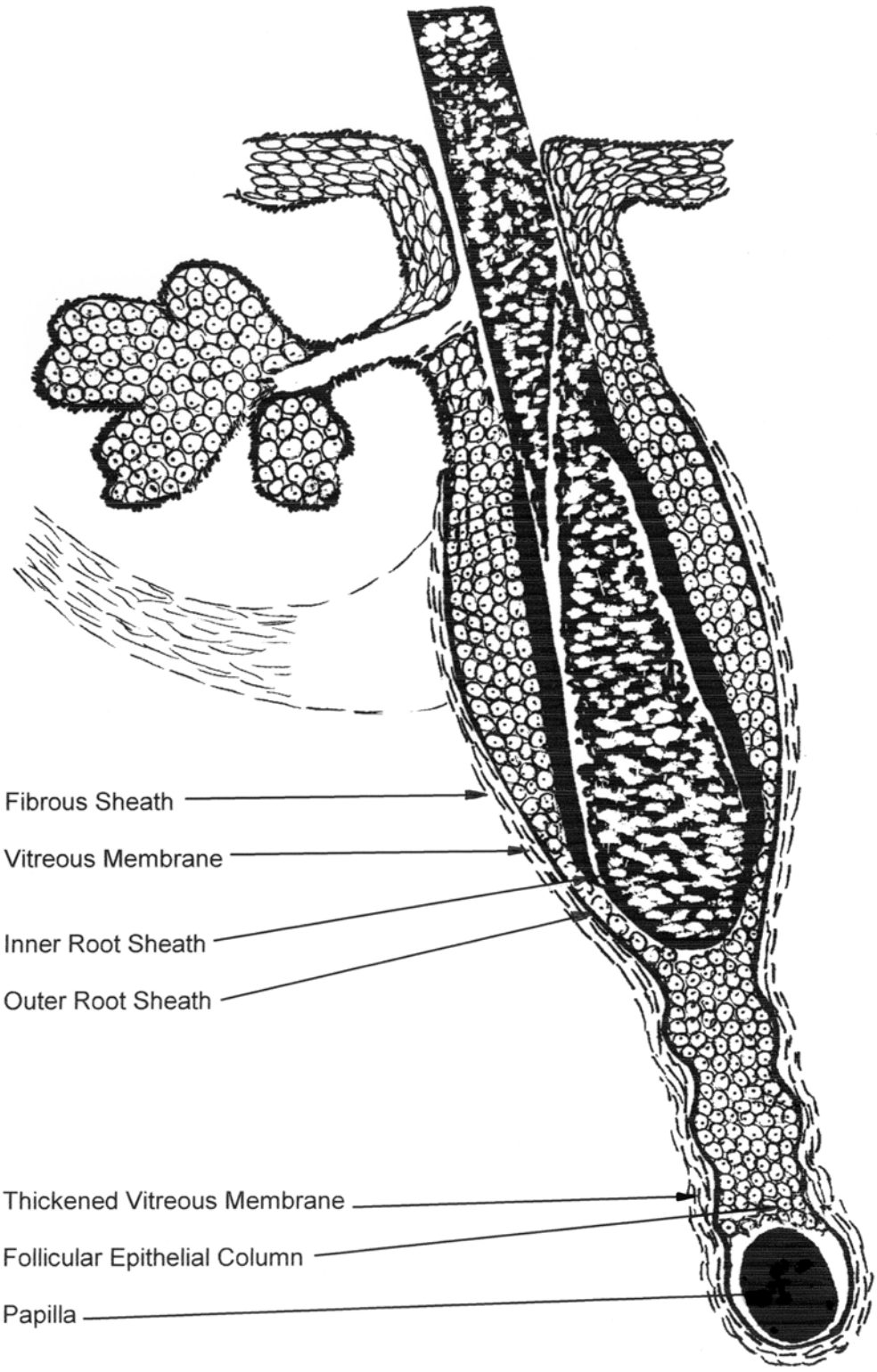
1. **Anagen**
2. **Catagen**
3. **Telogen**

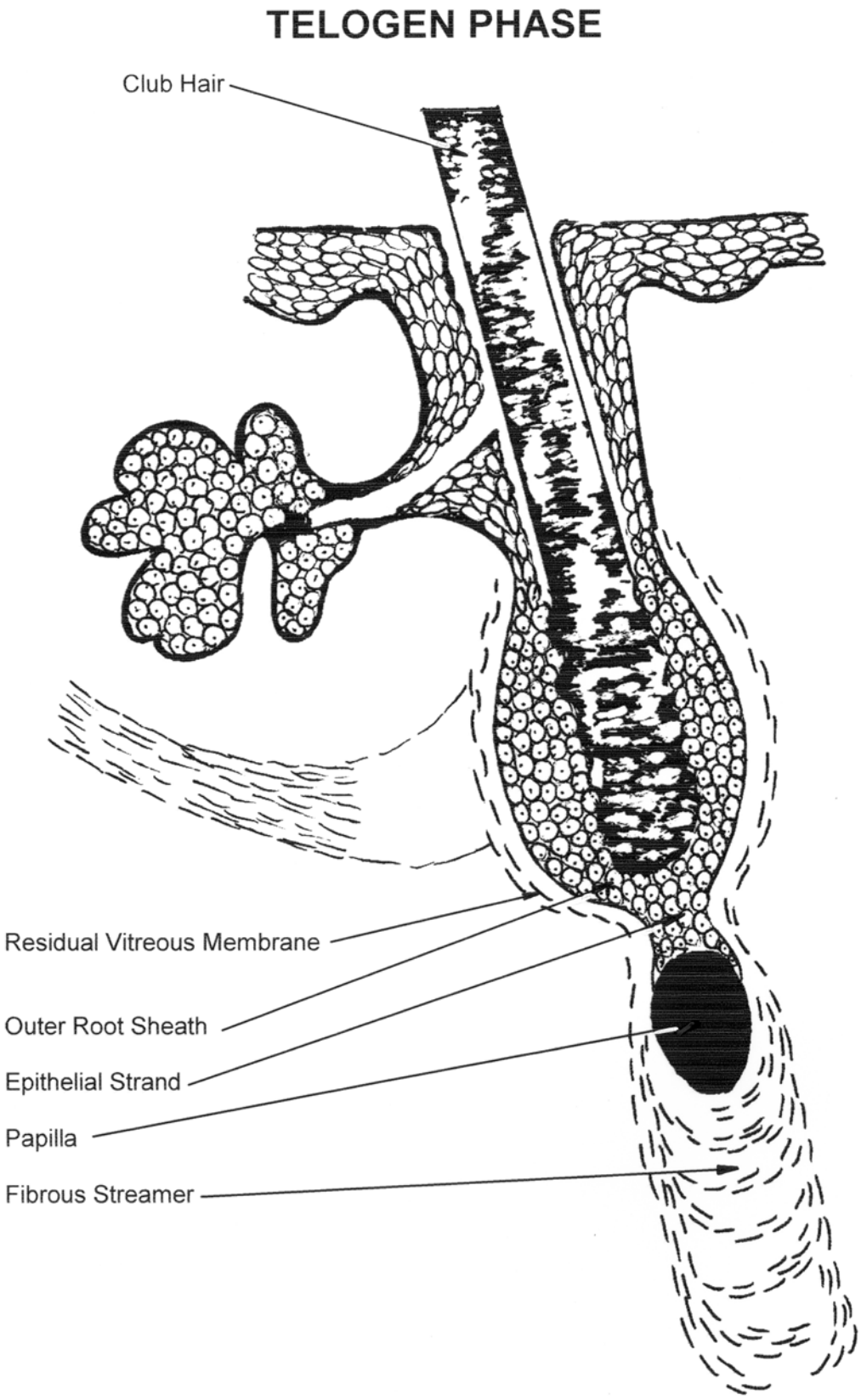
The active or ***growing*** phase is called ***anagen***, which continues to produce a hair for up to 2 - 3 years. At the end of anagen (and the beginning of catagen), the club-shaped, keratinized shaft is pushed upward by the epithelial cells. The dermal papilla moves upward and the epithelial column shortens from below. ***Catagen*** (the "transition" or "intermediate" stage) lasts but a few weeks and becomes a "***resting***" or ***telogen*** hair. Catagen hairs are easily identified by their thickened and pleated glassy membrane. (Anagen hairs, on the other hand, will be easily identified by their dark, black bulb at the bottom; telogen hairs have no bulb, no membrane, and will usually have a small, broom-like fibrous bottom). Telogen hairs last about three months. At that point, a secondary germ cell (or bud) and the underlying dermal papilla begin to form unit from which a new anagen hair will grow and develop.

ANAGEN PHASE



CATAGEN PHASE




TELOGEN PHASE
Club Hair
Residual Vitreous Membrane
Outer Root Sheath
Epithelial Strand
Papilla
Fibrous Streamer

DURATION OF HAIR GROWTH CYCLES

After laser hair removal, hair re-growth will occur at different rates depending upon the area of the body (see Figure 5 below). Other variables affecting re-growth are hair diameter and color, laser fluence, and laser pulse width.

AREA	***TELOGEN*** (Approx. duration of Telogen phase, in months)	***ANAGEN*** (Approx. duration of Anagen phase, in months)	***TOTAL*** (Approx. total duration, in months)
Back	3 - 6	3 - 6	6 - 12
Thigh	3 - 6	3 - 6	6 - 12
Arm	3 - 5	1 - 2	4 - 7
Calf	3 - 4	4 - 5	7 - 9
Axilla	2 - 3	3 - 4	5 - 7
Upper Lip	1 - 2	3 - 4	4 - 6
Bikini	3 - 4	2 - 3	5 - 7

Figure 5

While many laser system operators will re-treat at the first indication of hair re-growth, others will follow up and re-treat without any obvious sign of re-growth, based upon **estimated** time of re-growth.

THREE LAYERS OF INNER ROOT SHEATH

Just as the hair itself has three layers, so too the inner root sheath has three layers:

1. **Cuticle**, which interlocks with the hair cuticle
2. **Huxley's layer**
3. **Henle's layer**

Each of these layers is part of the process of coating and supporting the hair itself up to the level of isthmus. In the isthmus, the inner root sheath disintegrates and its keratinized cells break up.

External to the inner root sheath is the clear-colored ***outer root sheath***. The outer root sheath is thickest at the isthmus and narrowest at the lower portion of the bulb. The cells of the outer root sheath remain relatively stationary. In the lower portion of the follicle

(below the isthmus), the outer root sheath does not keratinize. As the cells move upward, the ORS eventually merges with the surrounding epidermis. Surrounding the ORS is the ***fibrous root sheath*** which is the outermost layer of the follicle. It is composed of thick collagen bundles and provides the final coating or protection for the follicle.

Hairs per Square Inch - the issue is not so much hairs per square inch, but follicles per square inch. Many follicles are dormant and can be activated depending upon issues confronting the person (e.g., diet, medications, stress, etc.). In general, textbooks note that there are some 350 follicles per square centimeter on the scalp, up to 800 per square centimeter on the cheeks, down to some 60 per square centimeter on the legs and axilla (armpit) region. No hair-producing follicles are found on the lips, palms of the hand, or soles of the feet.

Chapter 6

HAIR PRODUCTION (ENDOCRINE SYSTEM)

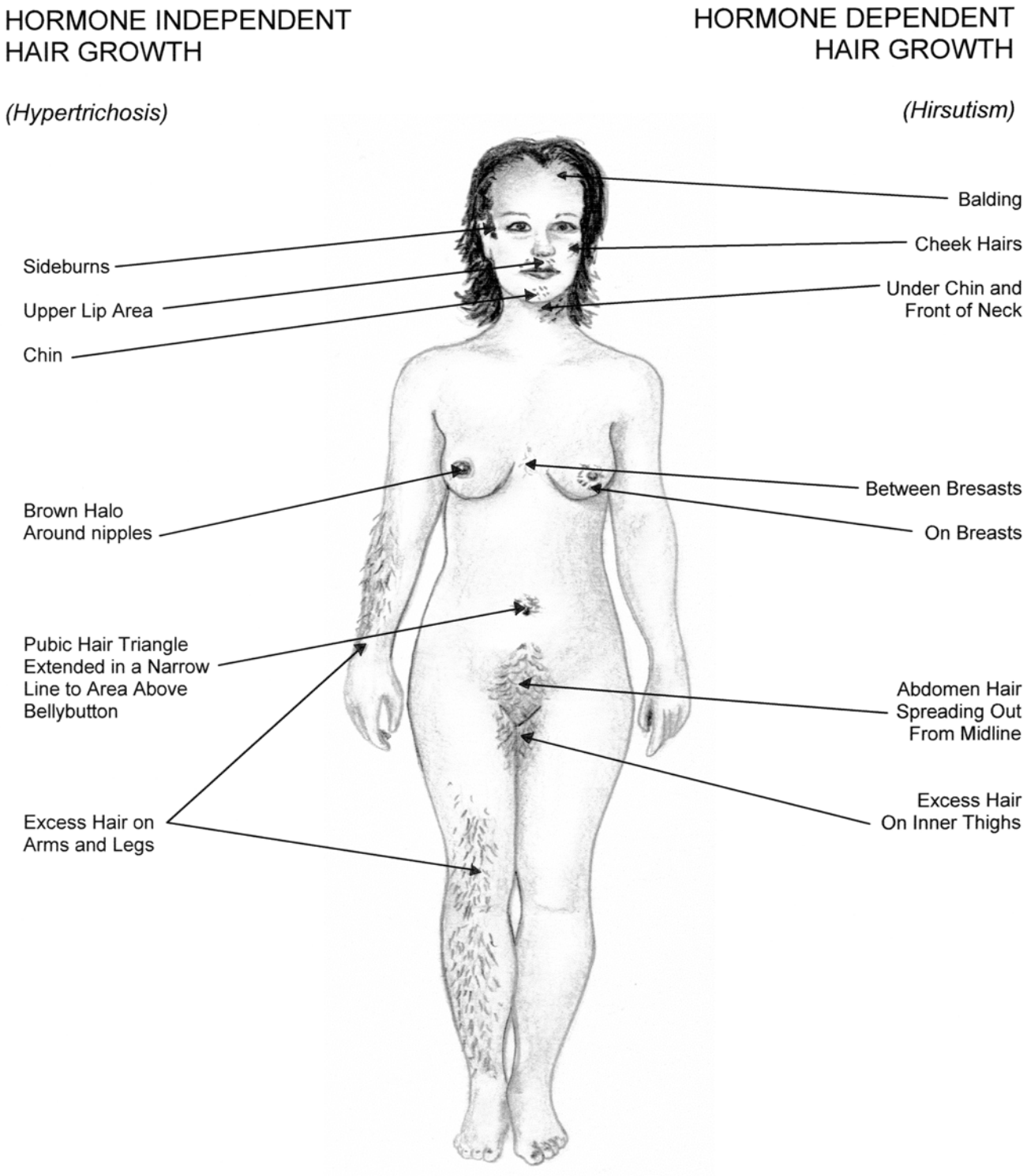
Before discussing hair production, we must say a word about the concept of "unwanted" hair.

HYPERTRICHOSIS & HIRSUTISM

"Unwanted" is a subjective term. This may vary from person to person, society to society, ethnic group to ethnic group. The terms ***hypertrichosis*** and ***hirsutism*** have been bandied about for years. Hinkel, one of the leading electrology text authors, defines hirsutism as "unwanted hair on women going through physiological changes ... superfluous hair which is undesirable socially."

When we assemble some of the current authorities in endocrinology (e.g., Hanley, Rittmaster, Rose, Griffing, Hataska), we find a rather astounding and simple common denominator to distinguish hirsutism from hypertrichosis. This distinction, we must note, will be the basis of your professional assessment as to length of treatments, total length of working time, etc. ***Hirsutism*****, as understood in this manual, is the excess male-pattern terminal hair on a woman due to androgen dependency.** Note that the key words are "***androgen dependency***." ***Hypertrichosis*****,** on the other hand, is an **excess of androgen-independent vellus hair, not following a male sexual pattern**.

With that as background, it is now time to discuss the "culprit" itself: HAIR. How does it grow? What activates a hair to grow? What is its structure? What role does the endocrine system play in hair growth? All of these issues will now briefly be explored.



(Figure 1 clearly shows the difference between hirsutism and hypertrichosis).

THREE TYPES OF HAIR

Traditionally, hair has been divided into three types:

1. **Vellus**
2. **Accelerated Vellus**
3. **Terminal Hairs** - pigmented hairs which occur at puberty can be divided into two groups:
    - **ambisexual hairs**
    - **male sexual terminal hairs**

In the past, the term lanugo was used, but it has been found that lanugo hairs are womb hairs which shed immediately before or shortly after birth. The resulting downy, fine hairs are called vellus hairs. In addition, both men and women have the same number of hair follicles at birth and these remain throughout life. While males may develop coarser, more dense hair growth, the number of follicles is the same in both females and males.

Vellus hairs are characterized as mostly unpigmented, growing from the sebaceous gland, having a shorter ***anagen*** (growing) cycle, and appearing as fine, soft, downy hair, which covers the trunk, forearms, lower legs, eye lashes, eye brows, and face.

Accelerated vellus hairs are those which, through some malfunctioning (e.g., disease, medication, stress, diet, or some other life-altering situation), can move from the vellus stage, dropping down into the follicle and activating as new terminal hair. Even such events as the beginning of menstruation or pregnancy can create this movement.

Terminal hairs are characterized as having not only the three phases of cycling - ***anagen*** (growing), ***catagen*** (intermediate phase of growth), ***telogen*** (resting), but containing pigment; they are attached to a dermal cord, can become very coarse, are activated by androgens or other steroidal activity, and have a defined root structure. These are the hairs which will be the object of our work in most instances.

Ambisexual hairs are found in the axillae (armpits), lower pubic triangle region, and are stimulated by low circulating levels of androgens. The ***male sexual terminal hairs*** are found on the face, upper pubic triangle, upper and lower back, and are stimulated by high circulating levels of androgen. (Again, review Figure 1). It must be remembered that even though we speak of "male sexual terminal hairs," females can experience male hair

growth patterns if the endocrine system does not function properly. (Note: males and females produce both androgen and estrogen -- something many men and women do not realize).

The vellus hairs are converted by circulating hormones into terminal hairs when puberty is reached. Ambisexual hair is usually under the stimulation of the adrenal gland where the male sex areas require high levels of androgen. Please remember: in women these higher levels of androgen can be obtained only from abnormalities of adrenal or ovarian production. (If this surprises you, it should not -- the ovaries also produce androgen. It is the **level** that will tell the story of hair growth.)

Why does such hair growth occur? There are two main culprits:

1. An excess production of the male-type hormones (hirsutism)
2. An increased sensitivity of the hair follicles to the normal circulating levels of androgen (hypertrichosis).

This excess production accounts for almost 90% of women with hirsutism, while the increased sensitivity accounts for only 10%. What we are recognizing more and more frequently is that the majority of the cases of hirsutism which we treat are a combination of the two: both the ovaries and the adrenal glands are responsible for the increased production of either androgens or androgen-type hormones.

When there are elevated androgens (i.e., male hormones) in women, hormone-dependent hair grows thicker and darker; the body hair will likewise grow thicker and darker. Dormant hair follicles can suddenly become active, although scalp hair can thin and the hairline recedes.

High prolactin levels from the pituitary can also cause hirsutism. In addition, certain drugs, such as dilantin, minoxidil, diazoide, cyclosporine, steroids, anabolic steroids, and birth control pills also can bring about abnormal hair production (especially on the face). Finally, when all known causes fail, there is a class of hirsutism called "idiopathic." This is a generic term to denote "unknown causes" or "no clear pathogenesis." Examples might be stress, change in diet, major life cycle change or crisis, etc.

But no matter the definitions or the wording, the chief culprits for unwanted hair are the androgens or male-type hormones.

It must be noted that, while a physician can remove the known cause or androgen excess, any hair which currently is activated or growing can only be removed by permanent hair removal methods. The physician can treat the cause; the laser specialist or electrologist can remove the hair created by the androgen production.

Also, overweight people should be encouraged to lose excess weight, since it is known that fat tissue adds to the androgen load of the body. Anti-androgen therapy also can be initiated (e.g., spironolactone - flutamide and cyproterone are used outside the United States).

How can you tell which type of hair growth you are seeing? Since the body is completely covered with hair **(except for the lips, palms of the hands and soles of the feet)**, the number of follicles is **fixed before birth** and the number of hair-making follicles is the **same for both men and women**.

How can we determine whether we are dealing with hirsutism or hypertrichosis? Low-level androgen types of hormones produce pubic, axillary and nipple hairs in a woman. When greater levels of circulating hormones (androgens) are present, terminal hair appears over the shoulders, sacral area, and upper abdomen (an extension of the normal pubic triangle). It should be noted that terminal hairs on the arms and legs is not a reliable indicator of hirsutism. Likewise, the amount of terminal hair increases with age. In the normal woman, androgen production does not increase as the years go by, but the estrogen production decreases so that the exposure of years to androgen will bring about increased hirsutism in the menopausal and post-menopausal years.

Another point to be made is to replace the older notion that only the adrenals can produce male-type hormones. In fact, the ovaries also can produce an excess of the male-type hormones. And, not to be forgotten, is that the peripheral sites (e.g., muscle and fat) can convert precursors to active androgens.

A final word about the endocrine system. Each of the glands of internal secretion has a part to play in the ***homeostasis*** (body balance) process. Basically, steroids are produced which are the androgenic source of face and body hair. The body produces more than just "sex" hormones. "Hormones" is a generic word to describe the products of the endocrine system which, in turn, are responsible for coordinating and bringing together

all of our body activities. This is a marvelously intricate system and one which works most of the time in an impeccable manner. Sometimes it misfires and maladies such as unwanted hair emerge. This great internal secretion system is intricate to our health and well-being. An onslaught of unwanted hair is but one way in which this system can misfire or warn us of certain needs.

NOTE: you are never to diagnose or provide a prognosis of any kind. You are not a licensed medical person. You can, however, be quite able to determine some indicators which will bring you to an ethical conclusion that your client must see a medical professional to isolate the cause. When the cause is determined and addressed, then your work of permanent and complete hair removal can be accomplished.

For example, extremely high testosterone levels in a woman are likely associated with adrenal or ovarian tumors. With very mild elevations (idiopathic or benign), the androgen levels are often normal. Since testosterone can originate in either the adrenal cortex or the ovary, an elevated testosterone level does not reveal the gland of origin.

Finally, hair growth can be ***congenital*** (i.e., ethnic or DNA-coded from familial origins); or, it can be ***systemic*** (i.e., caused by the endocrine system malfunctioning which we have discussed throughout this chapter); or, it can even be, on occasion, ***topical*** (i.e., restricted to one area by reason of friction or chafing or some localized malfunctioning body part). In all instances, your work will depend first upon your accurate assessment of whether you are dealing with hypertrichosis or hirsutism. That assessment may well be **the difference between accurate and satisfactory work or miscalculating the amount of time** the client will be coming to you.

In summary, the difference between ***hypertrichosis*** and ***hirsutism:***
Hirsutism is the **excess male-pattern terminal hair on a woman due to androgen dependency.** Note that the key words are "***androgen dependency***." ***Hypertrichosis,*** on the other hand, is an **excess of androgen-independent vellus hair, not following a male sexual pattern.**

The value of knowing the difference between hypertrichosis and hirsutism lies in the fact that it helps the technician to help the client. It provides information that may help the technician to identify the underlying causes of hair growth, which may ultimately make the treatment more effective and/or successful.

Chapter 7

SKIN & ITS APPENDAGES

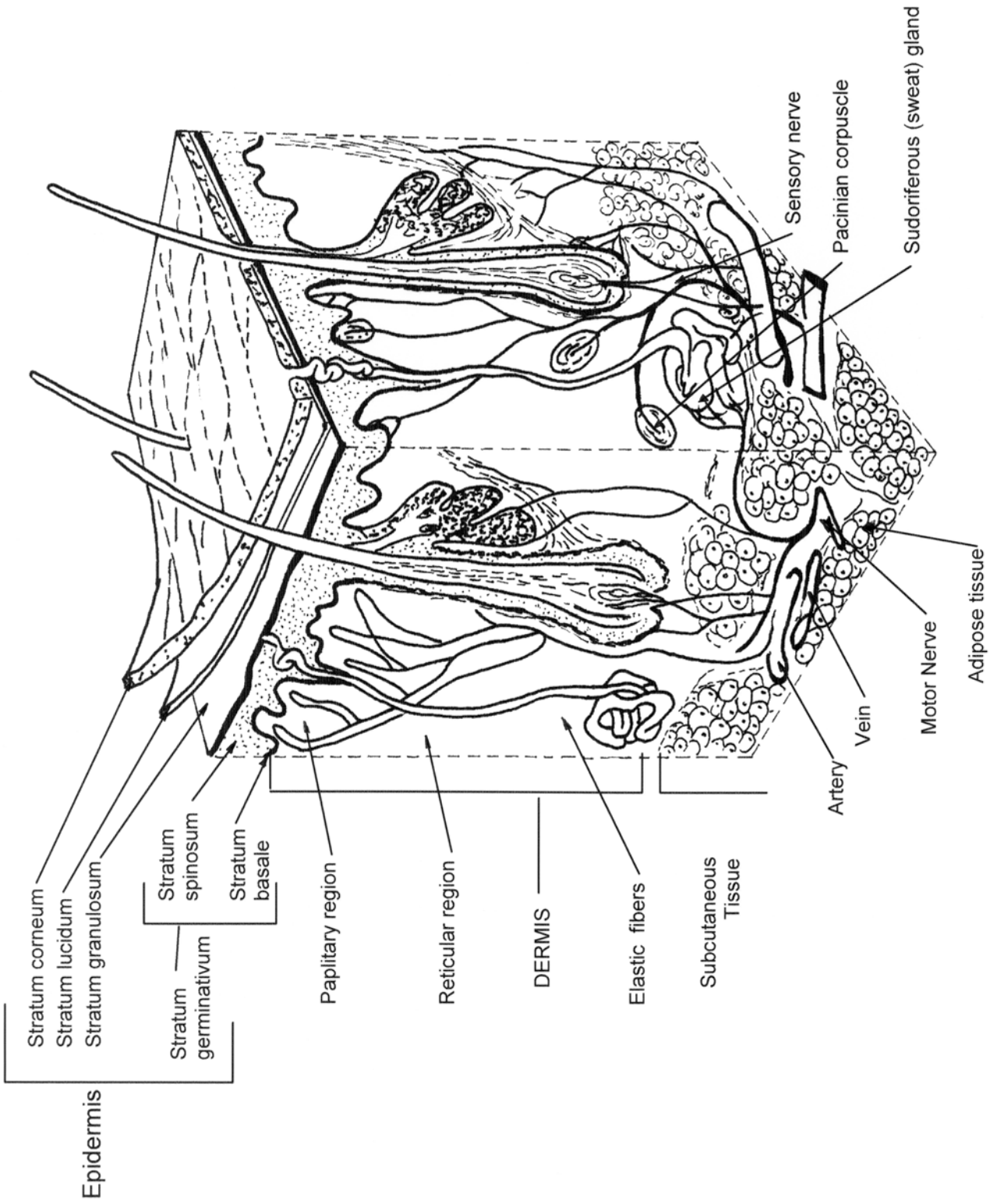
Traditionally, skin has been described as a flexible membrane some 14 - 20 square feet in size. Our reason for review of this important area is that we will be utilizing the skin for follicle entry and we will, in the course of our treatments, be creating some micro lesions. We will, as Figure 1 will show, be involved with both the dermal and epidermal areas of this membrane. It is incumbent upon us to be at least aware of some major issues surrounding skin.

THREE LAYERS OF THE SKIN

There are those who say that the skin has three basic layers: ***epidermis***, ***dermis***, and ***subcutaneous tissue***. Other authors combine the latter two and simply speak of the epidermis and dermis. For the purpose of this manual, we shall adopt the tri-layer view since it seems important to distinguish between the more stratified epidermis-dermis and the loose, adipose area called the subcutaneous tissue.

The ***epidermis*** is made up of stratified epithelial cells. The outer layer or ***stratum corneum*** is hardened and made up of dead cells. Scabs are seen most visibly on this layer. We should note that the epidermis is also called the "scarf skin."

The ***dermis*** (also called the true skin, corium, cutis, or derma) has two distinct layers: the ***papillary layer*** and the ***reticular layer***. The papillary layer contains little nipples or papillae which bind to the epidermis. This layer also contains nerve endings and blood vessels. The reticular layer is a thick layer of fibrous substances (mainly collagen and elastin) which extends into the subcutaneous tissue and anchors to the body, providing elasticity to the skin. In addition, becoming more important to us, the reticular layer also harbors lymphs and fat cells which are known to store androgens. Thus, if a person is overly heavy (obese), there is a possibility that the hair which we are trying to remove may be activated constantly by these androgenic "storehouses", thus making our work extremely difficult - not to mention almost never-ending because, in such persons, it may well be that we are proceeding at the proverbial "two-steps-forward-one-step-back". It may well be ethical and professional to ask an overly heavy person to have an endocrinology check-up before treating the patient.


Epidermis
Stratum corneum
Stratum lucidum
Stratum granulosum
Stratum germinativum
Stratum spinosum
Stratum basale
Papilitary region
Reticular region
DERMIS
Elastic fibers
Subcutaneous Tissue
Artery
Vein
Motor Nerve
Adipose tissue
Sensory nerve
Pacinian corpuscle
Sudoriferous (sweat) gland

FITZPATRICK SKIN TYPES

Thomas Fitzpatrick, MD, Ph.D., of Harvard Medical School, developed a classification system based upon skin pigmentation. Refering to the Fitzpatrick Skin Type chart (see Figure 2), the hair removal technician can determine the likelihood of any particular patient being burned with the laser.

FITZPATRICK SKIN TYPE	***CHARACTERISTICS***
I	Always burns, never tans (extremely fair skin, blonde hair, blue/green eyes)
II	Usually burns, sometimes tans (fair skin, sandy to brown hair, green/brown eyes)
III	Sometimes burns, often tans (medium skin, brown hair, brown eyes)
IV	Rarely burns, always tans (olive skin, brown/black hair, dark brown/black eyes)
V	Never burns (dark brown skin, black hair, black eyes)
VI	Never burns (black skin, black hair, black eyes)

Figure 2

The Skin Type Worksheet on the following page (Figure 3) is used to accurately score and determine a particular patient's Fitzpatrick skin type.

Fluence is usually reduced as skin pigmentation increases, in order to decrease laser absorption and heating of the epidermis. Cooling of the skin, in most cases, is necessary to avoid epidermal damage, especially in tanned or darker skinned patients. For darker skin types, larger pulse widths are another technique that can be utilized to decrease epidermal damage.

According to some studies, particular precautions are to be taken before treatment of patients who have Fitzpatrick skin types IV and V. Because complications are likely with Fitzpatrick skin type VI (Afro-Caribbean), treatment is usually contraindicated. In one study, it was found that pretreating patients (10 days prior to treatment) with 2%

hydroquinone and glycolic acids and sun block for two weeks after treatment significantly decreased complications.

The entire area of the follicle and the sebaceous gland is called the ***pilosebaceous unit*** (pilos means hair and sebaceous means containing oil or sebum). In order to use our terminology correctly, the term ***hair shaft*** is used for any portion of the hair itself which protrudes **above** the epidermal level of the skin. The ***hair root*** is the entire portion of the hair which **lies below** the epidermal surface. The ***hair bulb*** is that portion of the hair root which is enlarged and which covers the ***dermal papilla***. (See Figure 4).

The dermal papilla, itself not a part of the follicle but of the skin, and contains a blood supply and other substances essential for the growth of hair. The papilla is a separate organ of the body and is not part of the pilosebaceous unit itself.

SKIN TYPE WORKSHEET

PATIENT NAME:					***DATE:***	
SCORE		***0***	***1***	***2***	***3***	***4***
	What is the color of your eyes?	Light blue, gray, or green	Blue, gray, or green	Blue	Dark brown	Brownish black
	What is the natural color of your hair?	Sandy red	Blond	Brown, chestnut, dark blond	Dark brown	Black
	What is the color of your skin (unexposed areas)?	Reddish	Very pale	Pale with beige tint	Light brown	Dark brown
	Do you have freckles on sun-exposed areas?	Many	Several	Few	Incidental	None
	What happens when stay in the sun too long?	Painful redness, blistering, peeling	Blistering, followed by peeling	Burns sometimes followed by peeling	Rarely burns	Never burns
	To what degree do you turn brown?	Hardly or not at all	Light color tan	Reasonable tan	Tan very easily	Turn dark brown quickly
	Do you turn brown several hours after sun exposure?	Never	Seldom	Sometimes	Often	Always
	How does your face respond to the sun?	Very sensitive	Sensitive	Normal	Very resistant	Never had a problem
	When did you last expose yourself to the sun, tanning bed, or self-tanning creams?	More than 3 months ago	2 -3 months ago	1 -2 months ago	Less than 1 month ago	Less than 2 weeks ago
	Do you expose the area to be treated to the sun?	Never	Hardly ever	Sometimes	Often	Always
TOTAL SCORE: _____ SKIN TYPE:	SCORE 0 - 7 8 - 16 17 - 25 26 - 30 Over 30	FITZPATRICK SKIN TYPE I II III IV V - VI				

Figure 3

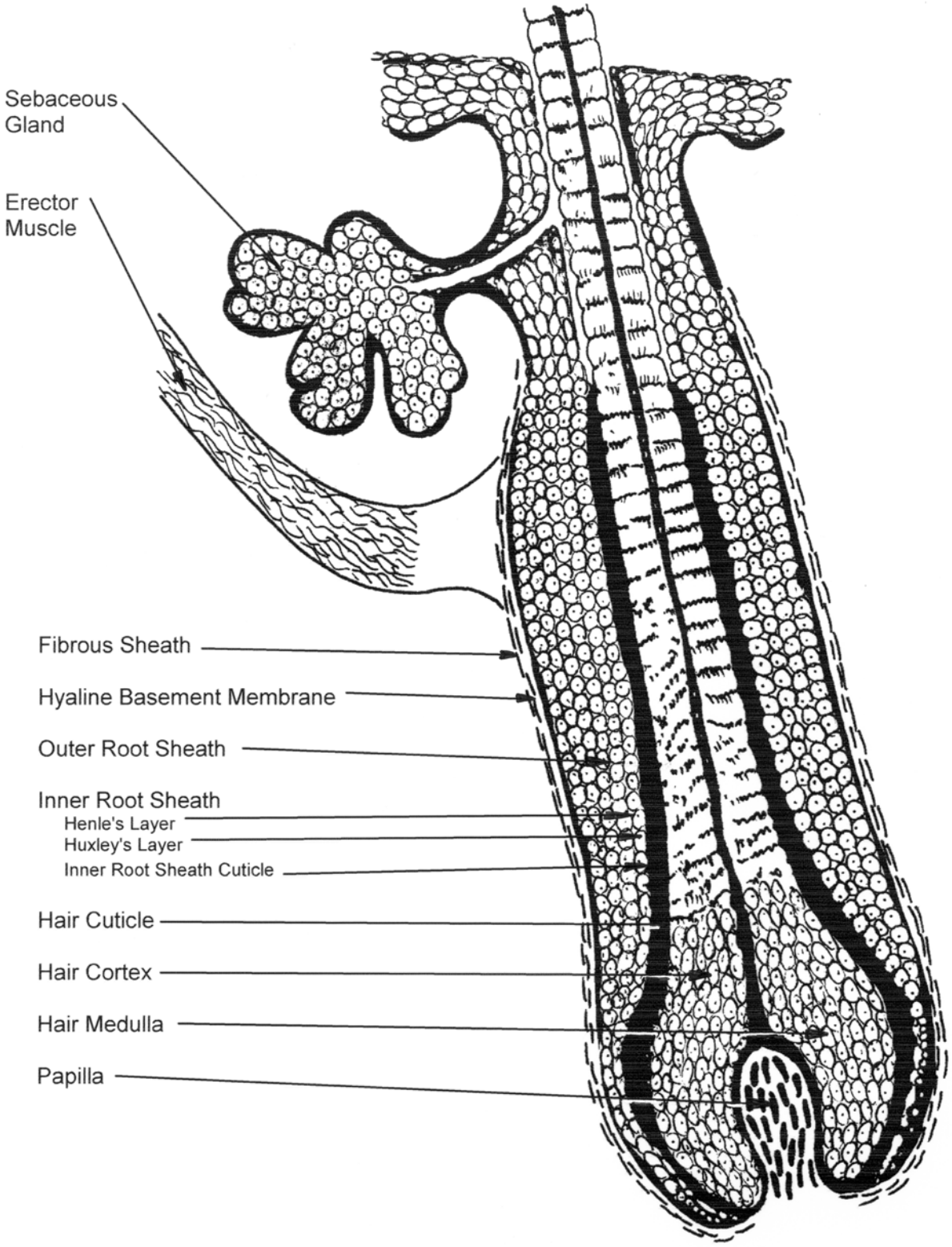

Sebaceous Gland
Erector Muscle
Fibrous Sheath
Hyaline Basement Membrane
Outer Root Sheath
Inner Root Sheath
Henle's Layer
Huxley's Layer
Inner Root Sheath Cuticle
Hair Cuticle
Hair Cortex
Hair Medulla
Papilla

Figure 4

LESIONS

A lesion is a structural or functional change in the tissue caused by disease or injury. Classically however, there are pre-existing lesions about which you should be aware:

1. **Moles** are example of macules (patches of skin altered in color but usually not elevated). In general, it is safe to say at the outset that any inflammation must be avoided in treatment in all areas to be discussed. **Note:** under no circumstances should you treat any hairs located in a mole **unless you have the patient's physician's written permission**. Treatment of hairs on moles should be avoided if you practice in a city or state where the law specifically prohibits such treatment.

2. **Papules** are raised, solid lesions lacking fluid. These can range from small pimples to nodules to tumors. If they contain pus, the papule becomes a ***pustule***. For example, warts, actinic keratosis, psoriasis, are examples of papule-pustule eruptions.

    a) **wheals** are papules which are itchy and usually associated with mosquito bites, etc. These are generally not harmful to work on.
    b) **nodules** are medium-sized pimples which lie deeper in the skin. Birthmarks (nevi) and some forms of syphilis are examples of nodules.
    c) **tumors** are the largest of the papules and should be approached with care.

3. **Vesicles** are raised lesions containing fluid. From the Latin word "vesicula" (blister) these are associated with such dermatological eruptions as contact dermatitis, herpes simplex (fever blisters, cold sores) and other assorted problems which can occur due to injury, friction, or heat. No vesicle which is active should be worked on or near.

4. A **crust** is a scab-like accumulation of blood serum and pus at the surface. These are always secondary lesions (i.e., occurring as a result of the primary lesion). A honey-colored, small crust appearing after a treatment is nature's form of protective bandaging. The patient must be reminded to use good after-care and not pick off these crusts.

5. **Scaling** is an accumulation of epidermal flakes and is usually not serious. Psoriasis and seborrheic dermatitis are examples of chronic problems in this area.

6. An **ulcer** is an open sore on the skin. Great care must be taken with anything that resembles an ulcerated condition.

Again, it is not our intention or goal to approximate a short course in dermatology. It behooves the ethical, professional technician to follow a simple adage: if the area is inflamed, irritated, red, blistery or oozing in any way, that area must not be treated.

7. **Keloids** are elevated fibrous hypertrophies (scar tissue) and should warn the technician that treatments by you may result in further keloiding. A keloid is a permanent lesion and treatments should not be undertaken without a small "patch" test (i.e., a small area away from the site should be worked on for a few minutes; the patient should then be told to watch this area for healing; and an appointment should be made for 10 days to two weeks later to see how the healing has progressed.) Keloids are a sign that your treatment could create a further problem. Patients who have darker skin types have more melanin in their skin and, therefore, will tend to keloid much more easily.

POST-TREATMENT

Advise the patient not to scratch, rub, or irritate the treated area until the skin has had a chance to begin its healing process. Skin is resilient. It will repair itself if left to heal properly. Additional information regarding post-treatment suggestions and care will be found at the end of Chapter 9, Laser Hair Removal.

Chapter 8

MICROBIOLOGY

This chapter will touch the areas related to asepsis/antisepsis behavior by the laser hair removal professional. Personal service technicians must practice sound infection control. The safeguard of both the patients and ourselves is at stake. In this day of litigation and concern about issues such as AIDS/HIV, it behooves the practitioner to develop and follow sound procedures.

The real issue in the matter of disinfection and antiseptics is to develop what we would call an "***asepsis logic***." This means that one acts consistently and logically from start to finish with the proper procedures. There is also a legal and ethical responsibility to provide sound standards of care to one's patients.

INFECTION CONTROL

To begin this section, a few terms that relate to concern about infection control. We live in a world in which a single bacterium may yield as many as sixteen million descendants in a half a day! This rather astounding figure should pique our interest in being concerned about our disinfection, and antiseptic "behavior" while pursuing our work of permanently evaginating follicles.

1. **Antiseptic** - a substance safe for use on the skin; stops or inhibits the growth of microorganisms. Does not destroy spores.

2. **Asepsis** - the state of being free of pathogenic organisms.

3. **Bacteria** - one form of one-celled microorganisms lacking chlorophyll and non-fungal in nature. Bacteria are of three basic forms: spherical (**cocci**), rod-shaped (**bacilli** - spores are mainly bacilli in nature), and spiral-shaped (**spirilla**).

4. **Disinfectant** - safe for use on inanimate objects (e.g., instruments). Inhibits micro-organisms but does not destroy spores.

5. **Microbiology** - the study of one-celled microorganisms (i.e., too small to be seen with the eye but seen only under a microscope.) Bacteria, fungi, viruses, protozoa, scabies, etc., are all included but the majority of our attention will be given to bacteria.

6. **Non-pathogens** - one-celled microorganisms which are harmless and/or beneficial (e.g., penicillin).

7. **Parasites** - one-celled microorganisms which live at the expense of some other organism or host.

8. **Pathogens** - deadly bacteria which, while constituting the minority of one-celled microorganisms, produce the majority of the disease and problems in both plant and animal tissue. They require living matter to grow.

9. **Sanitation** - 99.9% germ-free status based on Board of Health standards.

10. **Saprophytes** - one-celled microorganisms which live at the expense of dead matter, causing it to decay.

11. **Sterilization** - 100% complete absence of all microbial life, including viruses, bacteria, spores, and fungi.

DISINFECTION/ANTISEPTIC PROCEDURES

Disinfection, by definition, is the process of removing microbial life except spores. A disinfectant is safe to use on inanimate objects such as tables, lamps, cabinets, etc. It is not to be used on human tissue (e.g., diluted lysol, sidex, etc.). All such environmental surfaces should be cleaned after each patient.

Antiseptics, by definition, are also products which destroy microbial life, except spores, but are safe to use on human tissue. Seventy percent isopropyl alcohol is an example of an acceptable antiseptic and is considered an appropriate pre-treatment preparation. Other products specifically listed as antiseptics are also to be considered. Patients' allergies to products must be considered.

Post-treatment antiseptics such as witch hazel, hydrogen peroxide, aloe products, etc., can safely be used. Note: any liquids, or lotions must be used so as not to contaminate the container or the patient. All antiseptics must be kept in closed containers.

Patients must be instructed on proper home-care procedures. Such instructions should be written in order to protect the laser hair removal professional and provide the patient with clear understanding about the necessity of proper home care and the products considered appropriate for such care.

As part of universal precautions, it is important to disinfect the laser head and treatment table. Working in an antiseptic environment (i.e., the skin site) is essential. Cutting corners in these areas is not acceptable.

Research has shown that lack of proper **hand washing** is one of the greatest causes of infection breeding. Proper hand washing is not complicated but demands attention and focus.

Hands must be washed before and after each treatment. If bar soaps are used, there must be proper drainage. If liquid soaps are used, the containers should be either disposable or they must be cleaned and fresh soap used (done at least once a month).

The proper technique of hand washing involves soap and water. The hands should not be held under the water but the hands should be vigorously rubbed together (especially the areas under the fingernails and the webbing between the fingers). This should be done for at least 10 seconds. The hands should then be rinsed under the running water and then dried with a clean disposable paper towel. Note: the faucets, contrary to popular belief and practice, should not be turned off with the hands, but with the barrier of a paper towel to keep the hands from becoming recontaminated.

Although the wearing of **gloves** by the operator is not mandated during laser hair removal treatments, if they are worn, some general rules should be followed. A fresh pair of gloves (non-sterile) should be worn during the treatment of each patient. If contamination occurs (e.g., answering the phone or using the gloved hands to change the height of a stool without the barrier of a paper towel), the gloves should be removed, and a new pair of gloves donned.

Gloves are to be used only once. Torn or perforated gloves are to be discarded immediately. Hand washing is necessary before donning gloves and after removing gloves.

Although the laser hair removal professional is not in immediate danger of blood product or protein ejections, **masks** can be worn at the discretion of the operator. (Note that barrier masks are being addressed here, not laser masks which protect against inhalation of smoke/plume). Masks must be worn by the laser operator if/when she/he has a cold or some other non-infectious disease or when the patient has the same. Note: if either the operator or patient has been exposed to or diagnosed as having an infectious disease (e.g., strep, staph, etc.), no work should be done.

Linen products must be used only once and then placed in a closed container to be laundered. Clean linen products must be stored in a closed cabinet or container. Pillows or head rests or back-jacks must be protected by paper or linen products.

AIDS and hepatitis are two issues that are of concern. For those who provide personal services, such as estheticians, nurses, electrologists, laser hair removal operators, and massage therapists, OSHA regulations recommend a hepatitis B vaccination. Hepatitis B is more of an issue than AIDS, in that it is more common and more easily transmitted. The AIDS virus is very fragile - if it is exposed to air, it will die.

Conclusion: asepsis standards are necessary to ensure the safety and well-being of both patient and laser operator. It is necessary, in developing an asepsis logic, to consider each patient as a potential carrier of infection. While neither may occur, one must be prepared to provide the most effective, safe, and practical environment possible.

Chapter 9

LASER HAIR REMOVAL

Laser hair removal systems utilize a process known as ***selective photothermolysis***, which is the local, selective absorption of an intense light pulse at specified wavelengths by desired targets (hair follicles), but not by surrounding tissue. Photothermolysis destroys the follicles through thermal damage

Target tissues contain chromophores, colored bodies which absorb light of specific wavelengths. The melanin content in the follicle is sufficient to act as the chromophore. Melanin absorbs wavelengths throughout the visible and near-infrared spectrums. Since hair follicles are deep in the dermis, the wavelength chosen must be long enough to penetrate the dermis (below the epidermis), but must have adequate melanin absorption. The resulting thermal damage will impede hair growth or, in some cases, totally eliminate hair growth.

A successful outcome depends upon selection of an appropriate laser system, a properly trained and experienced operator, and suitable patient selection.

VARIABLES OF SUCCESSFUL LASER TREATMENT

Selective photothermolysis depends upon the appropriate combination of:

- fluence (laser energy, or "energy density," measured in joules per square centimeter: J/cm^2)
- pulse width, or "pulse duration" (equal to or shorter than the thermal relaxation time of the target), measured in milliseconds (ms)
- repetition rate (number of pulses per second)
- wavelength, measured in nanometers (one-billionth of a meter), (nm), usually between 600 nm and 1100 nm

Of the four variables above, the operator will determine values for the first three (fluence, pulse width, and repetition rate) at the laser unit. In addition, some laser systems allow the operator to select spot size, measured in millimeters (mm). As stated previously in

Chapter 3, Laser Properties & Tissue Interaction, the laser light's penetration can be increased by use of a larger spot size. The laser's wavelength determines the depth of penetration of the skin. Longer wavelengths reduce scattering in the dermis and, thus, achieve greater penetration. Use of a larger spot size will heat deeper without the need to increase fluence. A longer wavelength is safer and longer pulse width and larger spot size are best.

The variables mentioned above (fluence, pulse width, repetition rate, and spot size) will be dependent upon the following:

- patient's skin type
- area to be treated
- hair texture (fine or coarse)
- hair depth (for example, a very large woman's under-arm hair follicles will be much deeper than those of a thin woman)
- sun exposure
- pain tolerance
- the number of laser treatments that a patient has had
- the client's response to any prior treatment or patch test

Note that the wavelength will be determined by the specific type of laser system used and is not a variable that can be set by the operator. As pointed out earlier, wavelength is a function of the particular type of active medium (for example, Nd:YAG - neodymium yttrium aluminum garnet), which is integral to the laser.

(It should be noted that, in contrast to laser hair removal systems, intense pulsed light [IPL] hair removal systems [which utilize non-coherent, optically-filtered light sources: pulsed flashlamps] have ***variable*** *wavelengths [refer to Chapter 1, Hair Removal Synopsis]. However, skin analysis is even more important with an IPL, since the operator must evaluate each area of the skin to be treated before varying the wavelength.)*

With laser hair removal systems, it is the proper application of each of these variables which allows for effective treatment of the target while minimizing damage to adjacent tissues. With a contact delivery system, compression of the skin can also increase light transmission in the dermis.

FOUR MOST COMMON HAIR REMOVAL LASERS

The four most common lasers utilized for hair removal today are detailed below.

Ruby

Employing a ruby crystal as the active medium, this was one of the first systems cleared by the FDA for laser hair removal. This solid-state laser emits high peak powers in short bursts; its wavelength is 694 nm (the red light section of the visible spectrum), which is nearly transparent to oxyhemoglobin while highly absorbed by melanin. The two notable disadvantages to ruby laser technology are:

1. They have shown successful and safe hair removal only for Fitzpatrick skin types I and II. With skin types III, IV, V and VI, hyperpigmentation (abnormally increased pigment or skin color) and hypopigmentation (abnormally decreased pigment or skin color) have been frequently reported.
2. They generate inordinate amounts of heat (necessitating specific air conditioning requirements) and are quite large in comparison with other units.

Alexandrite

Its 755 nm wavelength (in the red to near infrared portion of the spectrum) is well absorbed by melanin, but this shorter wavelength limits the skin types it can treat. Adequate skin cooling is a must to avoid pigmentary changes. The scanners (for treating large areas) offered by some manufacturers of alexandrite units use small spots (3 -5 mm), producing more "scatter" and delivering less energy to the target, making them less effective for permanent hair removal.

Diode

The most widely used semi-conductor, diode laser system, the gallium-arsenide, emits a beam with a 800 - 840 nm wavelength (in the infrared portion of the spectrum). With this system, the energy is generated by multiple arrays of semi-conductor diodes. These units are compact, portable, require no cooling or ventilation systems, and require no special electric supply (they operate on standard 120V current). Because the dynamically cooled tip is square, there are no untreated spaces left between pulses (as compared to round-tip configurations). One main issue with these systems is the significant cost of the diodes, which could lead to high replacement cost, as well as high repair costs.

Long Pulse Nd:YAG

This most recent addition to the list of laser hair removal systems, the high powered, long pulse Nd:YAG (Neodymium-doped: Yttrium Aluminum Garnet) boasts a long wavelength of 1064 nm, which has reduced absorption by melanin in the epidermis (meaning less heating and damage to the skin). It is known as the most "skin-friendly" of laser hair removal systems. Thus, more skin types can be treated safely and effectively. The Nd:YAG system may require higher fluences (approx. 50 - 60 joules/cm^2) for suitable energy absorption by the target. With less scatter compared to the other laser hair removal systems and a large spot, the Nd:YAG beam is able to penetrate deeper into tissue.

Some operators use a carbon particle suspension in conjunction with a Q-switched Nd:YAG laser. With this approach, hair is first removed by wax epilation, then the carbon-containing lotion is massaged into the skin and enters the hair follicles. The carbon particles are purported to act as a strong chromophore in the target area, thus requiring only a low-energy Nd:YAG laser treatment. While some technicians have reported effective hair removal with this carbon method, it remains controversial.

POINTS TO REMEMBER

For effective hair removal, a laser system must deliver a particular amount of energy, measured in joules, to a depth of about 4 mm. Points to remember:

- Longer wavelengths penetrate the skin to greater depths than shorter ones.
- The larger the spot size, the deeper the penetration, since there is less scattering of laser light.
- Compression of the skin helps to push hemoglobin or red blood cells from the capillary network and, thus, produce less scattering.
- Reflection is reduced by direct contact of the skin by the laser handpiece.

Those lasers with longer pulse widths (durations) may be more effective in long-term hair removal. Pulse widths should be shortened if hairs are smaller or less pigment is present.

COOLING METHODS

Today there are several methods employed that allow for delivery of laser light to the targeted hair follicles while cooling and preserving the epidermis and reducing patient discomfort:

Passive Cooling - Gel

Prior to laser treatment, the gel is applied to treatment area. There are several concerns with this strategy:

- Possible uneven or inadequate cooling of the skin
- Additional cost
- Inconvenience and messiness of application and cleanup

Active/Dynamic Cooling - Cryogen

A refrigerant, cryogen, is applied to skin prior to laser treatment. These issues are evident:

- Additional significant cost
- Scattering of laser light may be caused by the cryogen's white frost, which is left on the epidermis
- Because of the frost, the amount of laser energy reaching the target follicle may be reduced

Active/Dynamic Cooling - Contact Cooling

This has become, for many operators, the preferred method for cooling the epidermis; it is integrated into the operator's handpiece. With this system, water is supplied to the handpiece through a tube and is cycled back to the main laser unit where it is delivered to a heat exchanger for cooling. Among its advantages are:

- More accurate control of skin temperature
- No additional costs per treatment
- Lack of gels to apply or clean up
- Ease of use, especially for inexperienced operators

HAIR CYCLES

Hairs cycle through three phases - anagen (active growth), catagen (transition or intermediate), and telogen (resting). Hair follicles respond more favorably to laser treatment when they are in the anagen phase because the melanin target is largest at that time. Since hairs in a particular area of the body are not all in the same phase

simultaneously, laser procedures need to be repeated in order to properly treat hairs coming into the anagen stage.

Although the anagen phase fluctuates, it can last up to three years. Catagen, relatively constant, typically lasts three weeks. The telogen phase usually lasts about three months. At any particular time, most follicles (80 - 85%) are in anagen; the remaining follicles are in either catagen (2%) or telogen (10 - 15%).

On some areas, such as the scalp, 90% of the hair can be in the anagen stage. Some studies have shown that only 10 to 15% of the hairs on the brows and ears are in anagen; the chin may have up to 70%, the upper lip 65%, while areas such as the legs and bikini line have only 20 to 30%.
Duration of anagen varies depending upon location. A few examples are:

- scalp - averages two to three years (occasionally much longer)
- chin - one year
- upper lip - four months
- ears and brows - four to eight weeks
- legs, thighs, and bikini line - four months

Laser treatment should be timed so that the largest number of hairs are in the anagen phase. If treatments are spaced one month apart, enough time will pass for progression to the anagen stage.

The two parts of the hair follicle which need to be targeted by laser light are the ***dermal papillae*** (deep in the dermis, typically 3 - 7 mm) and the ***bulge*** (near the insertion of the arrector pili muscle, about 1.5 mm below the epidermis). Contained in both are cells which can regenerate an entire follicle.

The laser hair removal professional should be aware that a number of conditions can cause dormant follicles to begin producing hair. Among them are:

- puberty
- use of birth control pills
- pregnancy
- menopause
- stress

NUMBER OF TREATMENTS

Laser hair removal procedures should be continued until a reasonable hair count is reduced, so that further treatments do not make a significant reduction in hair volume. Four or five procedures will be necessary to achieve a 60 - 100% hair reduction (however, there are many variables that can affect these figures). Following about eight treatments, maintenance may be required. Light, finer hair could require more treatments.

The laser hair removal professional has to adjust the frequency and timing of treatments according to the pattern of hair growth which the patient has set up. For example, the hair of persons who tweeze is in different stages. Some people tweeze daily; these patients are instructed not to tweeze for six weeks prior to a laser treatment. If this directive were ignored and such a patient were treated, none of the hairs she tweezed would be treated by the laser, since there would be no hair to absorb the laser light. It is sometimes difficult to convince patients who tweeze to interrupt this activity, even temporarily, because tweezing becomes a compulsion. Therefore, if a patient did tweeze daily and received laser treatment, she would be asked to return for a subsequent treatment in two weeks (instead of the normal six weeks), because those hairs which she tweezed grow back constantly.

Also, some patients with very heavy hair growth require laser hair removal treatment every week.

LEGAL CONSIDERATIONS

Prior to any laser treatments, including a patch test, it is strongly recommended that the patient be required to read and sign a Consent **and** Release form. Many clinics require that patients sign only a Consent form, but that is inadequate. The "Release" part of the form is essential in today's litigious society; in that section, the patient agrees to hold harmless and release from any liability the company (i.e., laser clinic) or any of its officers, directors, or employees for any condition or result, known or unknown, that may arise as a result of any treatment that he or she receives. (For an example of a Consent and Release form, see Figure 1).

PATIENT SELECTION

The ideal patient has a combination of very light skin and very dark hair. Treatment is challenging as hair color lightens and as skin color becomes darker. Generally speaking,

Fitzpatrick Skin Types I through III possess less melanin in the skin, resulting in fewer pigmentation changes. Types IV through VI present increased treatment difficulties.

CONSENT AND RELEASE

I acknowledge that the practice of skin care, including microablation, microdermabrasion, electrolysis, facials, body treatments, laser treatments, various beauty treatments, and many others is not an exact science and that no specific guarantees can or have been made concerning the expected result. I understand that some clients experience more change and improvement than others. In virtually all cases, multiple treatments are required in order to realize a difference.

I also realize that the following risks and hazards may occur in connection with any particular treatment - included but not limited to: unsatisfactory results, poor healing, discomfort, redness, blistering, nerve damage, scarring, infection, changes in the skin's pigment, and increased hair growth. I understand that even though precautions may be taken in my treatment, not all risks can be known in advance.

Given the above, I understand that response to treatment varies on an individual basis and that specific results are not guaranteed. I also agree to hold harmless and release from any liability _____ or any of its officers, directors, or

(Name of your company)

employees for any condition or result, known or unknown, that may arise as a result of any treatment that I receive.

_____ _____

Patient Signature *Date*

_____

Print Name

Figure 1

Cautious patient selection is vital to successful laser hair treatment. Suitable selection of patients also will reduce the prospect of litigation. Patients should not be misled about the effectiveness of laser hair removal, the commitment from them that will be required, the variability of results from one patient to another or from one treatment area to the next. A fully-informed patient is less likely to be a disappointed one. A complete, proper consultation should be held and should include a discussion of realistic expectations.

During the initial consultation, the laser hair removal professional can take time to ensure that the patient realizes that the procedure requires multiple treatments (see additional information under Question 3 in the next section).

Included in this first meeting should be:

- An interview of the patient
- A question and answer session
- A review of the patient's history
- A physical exam
- An informed reading and signing of a Consent and Release form by the patient
- A patch test (so that the patient may experience the laser and so that the operator can ensure there are no side effects)

QUESTIONS

Typically, patients will only reveal what they think the technician needs to know. Therefore, the laser professional should "read between the lines" and ask important questions concerning the patients history. For example, the patient should be asked if she has a history of cold sores or fever blisters or if he has any darkened pigment in the area of an injury.

Be sure to cover, at a minimum, the following questions:

1. **What will the laser feel like on my skin?**

   The laser may cause a sensation like a pinprick or a rubber band snap for a fraction of a second with each pulse. This can be minimized with a topical anesthetic; the cooling system also will aid in this regard, while it protects the skin during the procedure.

2. **How much time will a treatment take?**

   Some general examples (depending upon the laser system used):

Underarms, bikini lines: 15 - 20 minutes
Full legs: 60 - 90 minutes
Back: 45 - 90 minutes
Upper lip or chin: 5 minutes

3. **How many treatments will be needed?**

   It will be necessary to treat each area several times, as indicated on an average growth table. Hair will respond to laser treatment only during its anagen stage and, at any one time, only 33% of hair will be in that phase. Also, if too much time has been allowed to pass between treatments, a stage may be missed; the hair will then have to pass from the telogen to the anagen phase once more. Four or five procedures will be necessary to achieve a 60 - 100% hair reduction (however, there are many variables that can affect these figures). Following about eight treatments, maintenance may be required. Light, finer hair could require more treatments.

4. **What results can be expected immediately following treatment?**

   There is often no immediate change. The patient may experience some whiteheads or small red marks (which clear up in a few days) on the skin. The treated hair often will appear to be growing. Two or three treatments may be required before reduction becomes obvious. Treated hair will not begin to fall out for two to three weeks with the Nd:YAG laser, two to three with the Diode, and one to three weeks with the Alexandrite.

5. **Is the treatment permanent?**

   While some patients will experience a marked reduction of hair after four treatments, others may only realize a reduction in the frequency with which they shave or tweeze. All patients eventually will have some regrowth; however, the hair that grows back will tend to be finer, softer, lighter in color, and more sparse.

6. **How do laser treatments compare to other hair removal techniques?**

   Waxing, shaving, and depilatory creams are temporary techniques. Electrolysis is tedious and more technician-dependent, with a success rate of 40 to 85%. Laser hair removal is quicker and longer-lasting; it also is much less dependent upon the technician, if proper fluences are used for hair and skin color and if the operator uses proper procedures. There will be areas that are missed, but these can be treated in a follow-up treatment and can be shaved until that time.

7. **How does a laser operate?**

   The intense, concentrated laser beam is absorbed by melanin in the targeted area and converted to heat, which damages the follicle. After healing, the follicle is

smaller. This miniaturization of the follicle continues until it become a fibrous tract, or a fine blonde or light hair that no longer responds to the laser light.

8. Is the laser procedure safe?

Laser systems used for hair removal employ wavelengths in the visible and infrared spectrum, not the ultraviolet, which has been associated with skin cancer. Lasers have been in existence for over 40 years and we are aware of no cases of cancer that have been reported following laser treatment.

9. Are there side effects?

Temporary redness, swelling, and pain like that of a mild sunburn are common. Other possible conditions are crusting, pigment changes, whiteheads, and blistering. These are uncommon and precautions are followed to ensure they do not occur.

10. Do any medical conditions preclude treatment by laser?

Yes. The following are contraindications to treatment:

- Pregnancy
- Nursing
- Skin infections
- Diabetes
- Chronic heart, lung, liver, or kidney disease

The following are relative contraindications to treatment which should be discussed on an individual basis:

- Active herpes infections (if this type of area is treated, the infection could be spread)
- Shingles
- Any skin area that appears raw or irritated
- Obvious rash
- Sunburn
- Open wound
- Autoimmune disease
- Diseases which cause immunosuppression
- emotional issues

Emotional instability is a contraindication to any kind of treatment.

PATIENT HISTORY

The patient must fill out a general history questionnaire which must be reviewed by the laser hair removal professional prior to testing and treatment.

The following issues should be covered:

- **Allergies**. If the patient is using any medication for analgesia, anesthesia, or viral infections, it is important to know specific allergies.
- **Suntans**. With ruby, alexandrite, and diode lasers, patients with tans should not be treated until after the tan has faded. Tanning must be avoided for six to eight weeks before laser treatment. With suntanned skin, side effects (crusting, blistering, and temporary pigment changes) are increased.

  With Nd:YAG lasers, treatment of persons with suntans is permissible. However, the deeper color of the skin, due to the suntan, must be taken into consideration when determining the skin type (refer to the Fitzpatrick Skin Type classification system and the Skin Type Worksheet in Chapter 7, Skin & Its Appendages). As an example, a patient with a determination of a Fitzpatrick Skin Type II who is tanned should be treated as a Type IV.

  The patient should be asked if she only burns and does not tan. If she tans, does she tan easily?
- **Chemical peels or laser resurfacing treatments**. The skin of those who have recently received either of these two treatments will be more sensitive and will require close monitoring. Following a chemical peel, no laser hair removal treatment should be given until the area is completely healed.

  A healing time of at least three months should be allowed after a laser resurfacing treatment (the goal of this medical procedure, conducted under anesthesia, is to remove the entire epidermis [upper layer of skin]). If a healing time of three months has passed, the laser operator still would be well-advised to conduct a few patch tests and, in addition, suggest that the patient consult with her doctor before proceeding with a laser hair removal treatment. If a healing time of six months has passed, the laser operator can carefully conduct patch tests and proceed with laser treatment, using lower-than-normal fluence settings. For example, with a long-pulse, 1064 nm wavelength Nd:YAG with a predetermined spot size (10 mm - not adjustable by the operator) and contact cooling, the fluence setting for treating a chin would be 50 - 60 joules; that should be lowered to 30 - 40 joules.

  Laser resurfacing patients can have ultra-sensitive skin, even years after complete healing. Their skin will be tight and shiny.

  Other procedures requiring special attention are dermabrasion, plasma ablation, and chemical resurfacing (which is a stronger treatment than a chemical peel).

- **Medications**. Many times patients will note medications without a corresponding illness. An examination of the medications will indicate any unlisted medical conditions. Ask about any use of antibiotics. Also inquire about over-the-counter medications and herbal remedies.
- **Chronic medical problems**. The following conditions require special treatment and consideration:
  - diabetes
  - seizure disorders
  - lupus
  - HIV
  - cardiac disease
  - chronic fatigue syndrome
  - shingles
  - hepatitis
  - hirsutism
  - Stein-Leventhal syndrome (polycystic ovarian disease)
  - melanoma
  - basal cell carcinoma
  - cancer
  - herpes (especially in the areas to be treated)
  - wet acne
  - active pustules
  - Cushing's disease
  - malnutrition
  - anorexia nervosa
  - orphyria
  - hypothyroidism (children)
  - dermatomyositis

Patients with diseases like diabetes, lupus, HIV disease, chronic fatigue, fibromyalgia, and hepatitis have a suppressed immune response and may not do well following a procedure such as laser hair removal. Those with diabetes must monitor their sugar (glucose) level before and after treatment. They should have a private medical doctor who is aware that they are undergoing the laser procedure and can give recommendations for glucose monitoring and treatment.

Persons with a history of seizure disorder are sensitive to flashing light. Since a seizure can be precipitated by repetitive flashing light, extra precautions must be taken to ensure that laser light is not seen at all.

The patient must ensure that he/she has adequate blood levels of medication. A history of herpes, shingles, cold sores, or fever blisters are reasons to prescribe antiviral medications. Antiviral medications are necessary only when treating areas involved in recurring infections.

Cardiac disease is an issue if the patient is using lidocaine or tetracaine anesthesia, as these drugs may cause cardiac rhythm disturbances. Female patients with a male pattern facial hair (hirsutism) may have polycystic ovarian disease and should have a gynecologic or endocrine workup. It is interesting to note, however, that these patients respond very well to laser hair removal.

Certain conditions must be noted in the patient's history as the skin is examined prior to treatment. The first is scarring or pigment changes from recurrent oral herpes or cold sores. Persons with a history of vitiligo who have white blotches on their skin should not be treated, as their hypopigmentation (abnormally decreased pigmentation) is not predictable. Some theorize that laser hair removal may precipitate the disease. Suspicious skin lesions should be pointed out and the patient questioned - do the lesions flake, scale, bleed, change in color or size, or heal and then become crusty once more? If so, these are most likely precancerous or cancerous lesions and the patient should be referred to a dermatologist.

Hyperpigmentation (abnormally increased pigmentation) due to acne, burns, cuts, and scrapes should be noted. Such patients are prone to hyperpigmentation from laser hair removal, especially if they have even the slightest burn. They should always be pretested in the area that will be treated.

Tattoos and permanent cosmetics must be noted and avoided during treatment, as they might be eliminated by the laser.

Keloids or hypertrophic scars anywhere are a sign that the patient could scar if too much fluence is used.

Any areas of active infection - fungal, bacterial, or viral - and any area of dermatitis from any cause should be avoided until treated by a physician and resolved.

Medications affect treatment plans. Persons on oral accutane or gold therapy should not be treated until they have been off the medication at least six months and then should be pretested with the laser.

Patients on retinoic acid or hydroquinone (a bleaching agent utilized to temporarily depigment the skin) must discontinue medication and wait two weeks until the laser hair removal procedure.

Hydroquinone in a strength of 4% is a prescription-strength product. If a client is prescribed this preparation for laser hair removal, the technician should follow the physician's direct orders and not use his or her own judgment.

Those patients on hormonal treatments must be evaluated individually.

It is recommended that those patients seeking laser hair removal who have had hair removed by tweezing, waxing, or electrolysis should wait until the area has healed before laser treatment.

Any recent laser hair removal treatments may be a contraindication to a new treatment at that particular time. Ask the patient when the laser procedure was conducted, by whom, what type of laser system was used, and what skin areas were treated. This information will then be evaluated on an individual basis; and a treatment may be scheduled at a later date.

Women who are pregnant should not undergo laser hair removal or electrolysis on the abdomen or bikini line area.

Photosensitivity may be caused by many medications (such as antibiotics). When used by patients who undergo laser exposure; treatment, should be delayed until the medication has been discontinued.

Ask the patient if he or she has sensitive skin. If so, the laser system operator should take appropriate precautions to avoid unnecessary pain during the procedure, as detailed later in this chapter, under the subheading Treatment Example.

Lastly, the patient should be asked if she is currently consulting a physician for any other medical condition.

SKIN TYPES AND HAIR COLOR

After a patient's history has been evaluated, the skin and hair color must be examined, as these two factors are of prime importance for successful laser hair removal. Remember that the *natural* color of the hair must be determined.

Because of the large amount of melanin in the follicles, dark hair (such as black and brown) is considered ideal. Dark, fine hair and light skin is considered to be the best combination for laser hair removal.

White, gray, red, and blonde hair is not "seen" by laser light. Red hair is not a true melanin and is not recognized by laser, as it is a pheomelanin. Blonde hair does not have melanin.

The Fitzpatrick Skin Type classification system is used by most laser hair removal facilities. A ***Skin Type Worksheet*** can be used in conjunction with this system to generate a "score" for a patient's skin and thus render a more precise Fitzpatrick evaluation. *(For both the Fitzpatrick Skin Type chart and the Skin Type Worksheet, refer to Chapter 7, Skin & Its Appendages).* The laser system operator also should inquire as to the ethnic background of the patient and take this information into consideration when evaluating skin type. For example, if a light-skinned woman reports that she is the only blonde in a dark-skinned Mediterranean family, the operator might increase her "score" on the Skin Type Worksheet.

PHYSICAL EXAMINATION

Following determination of hair color and skin type, the skin should be carefully examined for tan lines, infections, scarring, pigment abnormalities, tattoos, and precancerous, cancerous, or suspicious lesions. Depending upon findings, suitable action should be taken. The patient who exhibits signs of infections or suspicious lesions should consult a dermatologist before proceeding with laser hair removal. For all laser types except Nd:YAG, tanning must be avoided for six to eight weeks before laser treatment; or, patients with existing tans should not be treated until after the tan has

faded; a test then will determine risk. Those with scar or pigment abnormalities must be tested and informed of the potential risks.

Tattoos and permanent cosmetics must be noted and, during treatment, be avoided by a distance of one inch. The patient must be notified that damage to the tattoo and/or permanent cosmetics is a possible result of the laser hair removal procedure.

Since laser hair removal is a cosmetic procedure and not a necessity, only treat patients who are in good physical health. Avoid treating persons who have colds or flu, uncontrolled diabetes or hypertension, chronic heart, liver, or kidney disease, recent seizure, autoimmune disease, immunosuppressive illness, skin problems or diseases, psychiatric problems, or personality disorders.

PRE-TREATMENT

As stated previously, for all laser types except Nd:YAG, tanning must be avoided for six to eight weeks before laser treatment; or, patients with existing tans should not be treated until after the tan has faded. The patient should be encouraged to use protective clothing and maximum sunblock after the area is treated. Depending upon the area of treatment, waxing, tweezing, and electrolysis should be avoided for two to three weeks prior to treatment.

Patients with acne might consider the use of Azelic Acid, Erythromycin gel, and Glycolic Acid products to minimize acne two weeks before treatment.

Herpetic lesions have been known to be activated by intense light. If a patient has a history of Herpes Simplex (cold sores) in the area to be treated, he may wish to consider the use of an antiviral agent called acyclovir before, during, and after the laser treatment. Acyclovir should not be used by those who are pregnant.

The skin may need to be depigmented in some cases; this is accomplished by the use of Hydroquinone cream (Solaquin Forte 4% used twice daily) for six to eight weeks before treatment. Solaquin Forte, which also contains a sunblock, may cause some people's skin to redden; hydrocortisone may be added to diminish this redness. Individuals with a known sulfite allergy should not use Solaquin, as it contains sulfites. Before using Solaquin, it is advised to wash with an exfoliant containing alpha hydroxyl. Note: those who are pregnant cannot use hydroquinone.

Hydroquinone, Retin A, Renova, depilatory creams, and bleaching must be discontinued two weeks prior to treatment. Waxing, plucking, and tweezing should be discontinued two to three weeks before the laser procedure.

Prior to treatment, the affected area should be shaved. A clean shave decreases loss of laser energy on the skin's surface; and more of the light is delivered to the follicle. Additionally, shaving decreases the odor and plume from hair on the surface of the skin.

Before the procedure is begun, documentation photos should be taken. Later, if patients should become discouraged with their progress, they will be able to reference the photos as evidence of hair growth prior to treatment.

The patient should wear appropriate clothing which will allow access to treatment areas (such as a white or light colored bathing suit to treat the bikini area), along with loose clothing to wear after treatment.

Patients should be instructed to have someone care for their children during the treatment session. Children should not be allowed in an office with lasers unless they are in the company of an adult at all times; they may not enter the treatment room even with a parent or guardian.

SENSITIVE BODY AREAS

Another issue of which to be cognizant is the sensitive areas of the body. The touch receptors in the skin are not distributed in a uniform manner around the body. And because some parts are more responsive to pain than others, extra care must be taken during laser treatment. For example, when working on such an area, the laser hair removal system operator might begin with a lower fluence than she otherwise would. She might also go to extra lengths to cool that section of skin, or she might use a topical anesthetic.

The most sensitive areas of the body are:

- lips
- face

- neck
- hands
- feet
- fingertips
- knuckles

The least sensitive part of the body is the middle of the back.

BODY AREAS NOT TO BE TREATED

Neither nose hairs nor internal ear hairs are to receive laser hair removal treatment, since sensitive mucous membranes of the nose or internal tissues of the ear could easily be damaged. However, hair on the outside of the ear or on the ear lobe may be treated, with due caution to target only those areas.

The laser hair removal system operator should be careful not to treat the "vermillion" of the lips, since this area is unusually sensitive to pain.

ANESTHESIA

As chromophores react with laser light, the patient feels a sensation similar to a pin prick or a rubber band snapping against the skin. This response is proportional to the amount of fluence and pigmentation in the hair or skin. Cooling systems, in addition to minimizing collateral damage to non-target areas, can reduce this pain, as can topical anesthetics (numbing solution). A topical anesthetic should be used only on those patients who indicate they have sensitive skin or when the area to be treated is sensitive, such as a lip or a bikini line. An "instant"-type of numbing solution may be applied immediately before the treatment, as contrasted with other types that must be applied 20 to 60 minutes prior to a procedure.

If a patient is sensitive to any of the "caine" products (lidocaine, tetracaine, or benzocaine), use of a topical anesthetic should be avoided. In the case of a patient with heart problems, the use of lidocaine is contraindicated (such a patient could use benzocaine or tetracaine).

COMPLICATIONS

The two most common complications from laser hair removal are burns and allergic reactions to a topical anesthetic. The manner of recognizing, dealing with, and preventing burns is detailed near the end of this chapter, under the heading Post-Treatment.

As far as anesthetics are concerned the professional laser hair removal technician must be able to :

1. Recognize an allergic reaction
2. Take appropriate action if an allergic reaction occurs, and
3. Follow proper precautions to avoid allergic reactions.

Minor Allergic Reactions:

Minor swelling, itching, redness, or a localized warm sensation is typical of a minor reaction to anesthetics. In most cases, these reactions are temporary and transitory. Often rinsing the area with cool water and using a topical Benedryl application is sufficient. Do not rub the area to remove the anesthetic as this may further irritate the site. Do not treat the area experiencing an allergic reaction with a laser. In the event the area is hidden, a single pulse of laser light may be used to patch test the area for future treatment.

Major Allergic Reactions:

Severe allergic reactions would include the formation of hives, faintness, excessive swelling, and/or difficulty breathing or swallowing. With these symptoms, there is risk that the client may experience anaphalactic shock. In the event of a severe allergic reaction, call 911 immediately.

Avoiding Allergic Reactions:

While not foolproof, the following procedures will help avoid an allergic reaction to anesthetics:

1. Test the area by applying the desired anesthetic in small quantities one half hour prior to treatment.
2. Never apply a topical anesthetic over a large area (i.e. an entire back or both legs)
3. Do not occlude or cover the area unless specifically directed by the product label.
4. Be sure to obtain a complete client history prior to applying any product to screen out any applicant with a history of allergies.

Compounding Pharmacies:

It should be noted that there are a number of Compounding pharmacies around the country that will prepare topical anesthetics. To be legitimate, these preparations should be obtained by prescription only. Any compound over 4% lidocaine is by law a prescription product. In addition, one has to be careful on combining percentages and anesthetics as these ingredients can be cumulative in nature.

Important elements to the reduction of complications in laser hair removal are proper patient selection and appropriate selection of variables (such as fluence) by a properly trained and experienced operator. Many complications are temporary or even reversible, such as hypopigmentation.

Some authorities recommend the use of 4% hydroquinone by the patient six to eight weeks before the laser procedure, in order to temporarily depigment the skin. However, as stated previously in this chapter, hydroquinone in a strength of 4% is a prescription-strength product. If a client is prescribed this 4% preparation for laser hair removal, the technician should follow the physician's direct orders. If a technician is working without a physician, then he or she should not be using this 4% product.

Other experts suggest that complications can be greatly reduced by pretreating the patient 10 days prior to the laser treatment with 2% hydroquinone and glycolic acids and sun block for two weeks after treatment.

Because of the larger amounts of melanin present in the epidermis, laser treatment of darker colored skin is more prone to producing complications. With Fitzpatrick Skin Types IV and V, suitable precautions (such as the use of lower fluences with skin type V) are called for. Fitzpatrick Skin Type VI (Afro-Caribbean) is a relative contraindication to laser treatment, as complications are probable. Laser light of a longer wavelength is less likely to be absorbed by melanin, a factor which is responsible for the Nd:YAG laser's reputation of being more skin-friendly than others. Darker skins can be effectively treated if sufficient fluence can be used.

Routine and expected complications which have been noted with laser hair removal include perifollicular erythema and perifollicular edema (transient inflammatory reactions), as well as hypo- and hyperpigmentation. Other complications include crusting and vesiculation of the treatment site.

PATCH TEST

Following an interview with the patient, Q&A session, review of the patient's history, physical exam, education, and reading and signing of the Consent and Release form, a patch test should be performed. Once in the laser treatment area, the laser system operator will review safety precautions with the patient (refer to Chapter 4, "Laser Safety & Regulations").

The patch of skin to be tested should be small and close to the area to the area to be treated, but it should be in a location that would not be obvious if a complication were to result.

If necessary, the operator will leave the treatment area to allow the patient to undress; a covering will be provided to the patient to cover exposed areas while he/she lies on the treatment table. The privacy of the patient and the professionalism of the operator must be maintained at all times. After the laser system operator reenters, all doors leading to the treatment area will be closed and locked, the test patch of skin will be shaved, the operator will check the laser system for proper function, everyone in the treatment area will don appropriate eyewear protection, the proper laser system settings will be chosen, and the laser will be placed into the ready mode.

Cooling get will be applied to the skin and the patch area will be tested at two to three appropriate settings. Following this short procedure, the laser system will be turned off and the key removed to a secure location. The skin will be cleaned.

After the patient has been allowed to dress, he/she will be given instructions for follow-up. Within two days, the operator should telephone the patient in order to address any questions or concerns; an appointment for a follow-up treatment should be made at that time. In the interim, the patient should be encouraged to call with any problems or additional questions.

TREATMENT

Prior to the full treatment, the operator and patient should discuss the patch test and the patient's observations. The laser hair removal professional should ensure that the patient knows what to look for after a treatment. The patient should be questioned about side

effects, shedding, and pigment changes. Other important points to cover are tanning, travel plans, outdoor sports, and the use of sunblock.

Prior to the full treatment, a photograph(s) of the area to be treated should be made.

TREATMENT EXAMPLE

For purposes of illustration, an example of a typical treatment session follows. While there is a large variety of hair removal laser systems available today, the one referred to in this example is a long-pulse, 1064 nm wavelength Nd:YAG with a predetermined spot size (10 mm - not adjustable by the operator) and contact cooling (a chilled contact surface located on the handpiece; where water is supplied to this surface through a tube). *It is understood that other laser systems may have different features, controls, and procedures than the one detailed in this example.*

The variables are:

- repetition rate (number of pulses per second. The setting control on the laser unit is marked "Hz" - [Hertz])
- pulse width (the setting control on the laser unit is marked "MSEC" - [milliseconds])
- fluence (the setting control on the laser unit is marked "J/cm^2" - [joules per square centimeter])

On the particular laser system in this example, fluence (joules) will be set first, then pulse width. The machine itself then will determine and set the appropriate repetition rate.

In order for the laser energy to be pulsed, the laser key must be inserted into the laser unit and turned to the ON position, a start switch (a green button) on the laser unit must be pushed, and the operator must depress a foot pedal. The laser unit's control panel also houses a yellow PAUSE button, to put the system into standby mode.

It is understood that all pre-treatment procedural requirements have been met prior to any treatment, including those detailed in this chapter (above) and, most importantly, the safety procedures outlined in Chapter 4, Laser Safety & Regulations. Requirements include:

- Careful patient selection (interview, Q&A session, patient history, physical exam, patch test). Examination of skin and hair type (including use of Fitzpatrick Skin Type classification).

- selection of an appropriate laser system to meet the needs of the patient
- execution of a Consent and Release form
- proper documentation, including photograph(s) of treatment areas
- adherence to requirements of state medical boards (where applicable) for laser system operators
- proper laser operator training including certification, licensing, and/or credentials
- adherence to federal, state, and local regulations, including the ANSI Z136.3 standard
- procurement of liability insurance covering the laser operator
- laser system calibration if necessary
- inspection of laser system electric cords and cables
- maintenance and service of the laser system
- appropriate treatment area ventilation
- steps to prevent accidental ignition of objects in the treatment area (such as removal of combustibles)
- securing of all doors leading to the treatment area
- ocular protection
- covering of windows, mirrors, or any other reflective surfaces in the treatment area
- instruments in the treatment area should have dulled finishes
- area signage
- correct equipment settings made for each patient
- use of protective respiratory masks, where necessary
- proper use and securing of the laser key

In addition to the normal Q&A, including questioning about recent tans and/or burns, the laser system operator can perform a simple "touch" test; that is, she simply touches, with her fingertip, a skin area that the patient claims is not sun burned (but that the operator suspects may be). If the skin remains bright white (blanches), the operator knows that the area has, indeed, been sun burned.

Besides ordinary maintenance and general cleaning of the laser system prior to each treatment, the laser system operator should ensure that the laser lens is clean. If the lens is dirty, laser light could refract and burn the tissue. Laser light can also refract off debris and pit the lens cover. Both the lens and the lens cover should be cleaned with alcohol.

When the above steps have been taken and the patient has been positioned on the treatment table, the laser system operator will use water or witch hazel to clean the treatment area (alcohol is not to be used for this purpose). In addition to general cleaning, the objective is to remove makeup, creams, or deodorant.

The operator will evaluate the hairs in the treatment area. It is advisable that there be one or two days' hair growth in the areas to be treated, for accurate assessment. A lighted magnifying glass can be used to aid in the close examination of hair.

In order to properly determine correct equipment settings for a patient, the laser system operator should refer to a hair removal treatment guidelines chart, such as the one in Chapter 4, Laser Safety and Regulations. Those parameters serve as a guide only; the operator should observe laser-tissue interactions and clinical response to determine appropriate settings.

As stated at the bottom of the above referenced chart, starting fluence should be at the low end of the range, with adjustments made based on epidermal response. Areas with high hair density and/or coarse dark hairs, such as the chin, should be treated at lower fluences than areas with sparse hair. Lower fluences may also be used for treatment over bony areas. Increasing the fluence may provide increased efficacy; however, factors such as skin type, tanning, hair density, and body location may limit the maximum useable fluence that does not result in unwanted epidermal damage. During a patient's first treatment, fluence should be set low; during the second treatment, fluence can be increased. Also, if a patient's hair growth does not respond to the first treatment, fluence can be increased during the second treatment (again, taking other pertinent factors, such as skin type, into account).

Pulse width should be adjusted based on skin type and hair thickness. Pulse width settings near the middle to upper end of the given ranges are appropriate for most treatments. The longer pulse widths provide epidermal safety and are well-suited to coarse hairs. Thin hairs respond best to the shorter pulse widths.

In our Treatment Example, the patient is a female with a Fitzpatrick Skin Type classification of III and the treatment areas are the underarms. The following settings (which are being shown here only for purposes of demonstration of a specific treatment) are made on the control panel of the laser unit:

- fluence: 40
- pulse width: 30 (considering the coarseness of the hair)
- repetition rate: 1.2 (this setting was determined automatically by the laser unit after the first two variables were made by the laser system operator)

The operator then will give the treatment area a close shave, typically using a disposable razor blade (a cleansing cream or lubricant will be used in conjunction with the blade). An electric shaver would be used on large areas, such as the back, followed by a close shave with a razor blade. The cleansing cream or lubricant will then be wiped off.

If the patient has indicated that she has sensitive skin, an ice pack (wrapped in a paper towel or cloth to avoid direct contact) applied to the area will help to cool and comfort; it also restricts blood flow. With such a patient or on sensitive areas, the laser operator may choose to apply a numbing solution (topical anesthetic). If a patient has indicated ultra-sensitive skin, the laser hair removal system operator might begin with a lower fluence than she otherwise would.

The operator then will apply a lubricant (gliding gel), which will aid in the smooth movement of the handpiece and also will serve as a guide to mark areas that have been treated (the handpiece will leave a slight impression in the gel).

The laser system operator should be aware of the position of the fiber-optic cable (between the laser unit and the handpiece) at all times. It can drag on the floor. Care should be taken not to roll over it with a chair or to step on it.

A patch test will then be conducted by the laser operator. If the patient's reaction indicates sensitive skin, the operator will reduce the fluence (J/cm^2). Following adjustment and another patch test, if the patient continues to indicate sensitive skin, the laser system operator will increase pulse width (measured in milliseconds).

The proper contact between the handpiece and the skin is *firm and flat*; the handpiece must be held perpendicular to the skin. If this correct contact is not maintained, the patient will experience more discomfort and the laser light will not be as effective.

The laser system operator pre-cools the first part of the treatment area with the handpiece. With the laser unit on, and the start switch on the laser unit engaged, the operator depresses the foot pedal, causing laser energy to be pulsed. The operator pulls the handpiece *toward* himself/herself, so that the cooling head is the first part of the handpiece to contact each area of skin. The handpiece should be moved approximately ¼-inch at a time, with each new position slightly overlapping the previous one.

As the treatment progresses, the patient should be asked how he/she feels. If the patient feels discomfort, it usually is in the form of heat (which has been trapped in the skin), not pain. If the patient should report a burning sensation, the laser system operator will immediately stop treatment, place a cold pack (wrapped in a paper towel or cloth rag) on the affected area and wait a few minutes. The operator then will ask the patient again how he is feeling before the treatment continues. The operator should be careful not to apply an excessively cold compress that might freeze the skin and create and additional "burn."

Some body parts require specific adjustments to treatment technique. For example, on curved areas (such as the chin), the entire handpiece cannot be in complete contact with the treatment area at one time. Therefore, the cooling section of the handpiece will be drawn over the skin first, followed by the section containing the laser light. When treating the upper lip, the laser system operator, with gloved hands, may insert "lip rolls," which will ensure that the patient closes her mouth while the laser is pulsed, since accidental application of laser light on teeth will cause an inordinate amount of pain.

POST-TREATMENT

The laser system operator will clean the gliding gel from the treatment area with water and a cotton pad; and apply a cold pack (wrapped in a paper towel or a cloth). If the patient experiences discomfort, the operator can apply a small amount of aloe vera gel (if the patient is not allergic to it).

The operator will properly document the outcome of the laser treatment. As part of this protocol, a post-treatment photograph(s) should be made. If the patient has experienced no complications, the settings can remain the same for the next treatment. If the skin is red or if heat is felt by the patient, the fluence should be reduced for the following treatment.

The patient should be advised to keep the treated skin clean by gentle washing.

Some patients may experience superficial crusting, a bruise-like appearance, or blistering. Note that bruising or blistering are rare. These effects are transient and should resolve within one to two weeks. However, in the unlikely event that the above conditions have not begun to clear up within ***three to four days***, it is ***important*** for the patient to contact the laser hair removal professional, who can suggest the use of an over-the-counter antibiotic ointment (such as Neosporin), which can be used to prevent the growth of bacteria. Depending upon the seriousness of the condition, the laser operator might wish to see the patient in person for further evaluation and, in extreme cases, it should be necessary to refer the client to a dermatologist or medical physician. Again, it is important to emphasize that even though a bruise-like appearance or blistering usually resolves within one to two weeks, the patient should not wait that full length of time before reporting a potential problem to the laser system operator.

WRITTEN POST-TREATMENT INSTRUCTIONS

The laser hair removal professional should always provide to each patient a written set of instructions necessary to preserve the treatment site and to avoid any potential post-treatment problems. In addition to instructing the patient to keep the treated skin clean by gentle washing, the laser operator may wish to include some or all of the suggestions listed below.

- The patient should wear loose clothing over the treated skin (for example, denim jeans over a treated area should be avoided)
- If the skin is still red by the time the patient leaves the clinic, the patient should, upon her return home, use a cold cloth (not an ice pack, which could cause an ice-burn) on the treatment area.
- To reduce redness and irritation, a topical corticosteroid or antibiotic ointment (i.e., bacitracin) may be used
- The evening of the treatment, the patient should elevate the treated area, especially the legs
- The patient should use no harsh soaps or irritating medications/chemicals (such as astringents, deodorants, or perfumes) for two to seven days following treatment
- For two to seven days, the patient should use no topical acne medication, glycolic, retinoic, or ascorbic acid
- The patient should avoid picking at or scratching treated areas

- If no blisters are present, the use of make-up is permissible
- When the treated area is no longer tender, exfoliation (loofah, body glove, coarse washcloth, alpha hydroxy acid products, shaving, etc.) should be employed to help mitigate hair shedding and crusting
- The patient should avoid sun exposure without sunblock of SPF 30 or more. Tanning should be avoided.

All patients will shed dead hair for a week to one month post-treatment. Exfoliation methods will aid in this process. Some missed hairs or areas can be expected. While those hairs can be shaved until a subsequent treatment is called for, some patients will wish to treat missed areas before the next scheduled treatment.

The patient should not shave the treated area for a minimum of four days following the procedure. Depilatories should not be used; waxing or plucking should be avoided.

Barring complications treatments should be scheduled four to six weeks apart. Even if no immediate results are realized, there is no advantage to grouping appointments more frequently, since the laser system only targets hair in the growth (anagen) phase.

Chapter 10

MISCELLANEOUS ISSUES

PAIN

Since the laser beam can create a sensation - oftentimes uncomfortable - it is incumbent upon the technician to understand the phenomenon of pain. The handpieces of many of today's hair removal laser systems are equipped with a cooling tip, which not only preserves the epidermis, but increases comfort, even in sensitive areas. Other cooling methods include (a) application of a cooling gel prior to treatment and (b) application of cryogen, a refrigerant, usually in the form of a spray.

Even though most patients will tolerate laser treatment well, they may experience a stinging, tingling, or "pinprick" sensation associated with heat for a fraction of a second, with each pulse. Some patients might feel discomfort similar to a mild sunburn. To further minimize pain, patients have the option of the application of a topical anesthetic.

Pain is a sensation which is intense enough to induce a reaction - withdrawal from the situation, striking back, crying, etc. Below that point, we speak of tolerance. That is, the body can absorb many sensations and until those sensations pass over the threshold, the sensation is said to be tolerable. Beyond that point is pain.

The sensation of intolerance differs from person to person, from one part of the body to another (e.g., centerline areas of the body, where the nerves overlap, is said to be more painful than areas away from that line), from one treatment to the next, from one moment to the next. For example, a change in diet or medication can trigger sensitive reactions which were not previously felt. Stress, anger, frustration, weariness can all contribute to the issue of pain reaction. The technician must be aware of these issues when performing her/his work.

While the issue of pain is generally less in laser hair removal than in electrolysis, it may be helpful, with some patients, to create some form of distraction. Soft music, meditation tapes, or quiet talking (vocal anesthesia) are all ways in which a patient can be distracted from the discomfort and can be helped to relax.

A word about topicals or other anesthetics - we are restricted to use of only those products which can be applied to the surface, of the skin and are OTC (over-the-counter) products. If a patient has a prescription lotion, the patient is responsible for both the application and storage of that topical. Whatever can induce the patient to feel more comfortable is acceptable as long as it is the patient who makes the decision.

CLINIC SETTING

It would seem apparent that a clinic setting should be kept clean, free of debris, and indicative of a professional service center. Yet, all too often, one hears of animals in the clinic area (only seeing eye dogs are permitted), uneaten food laying about, ashtrays on the supply table or nearby desk, along with a litany of clinical "errors" related to cloth and paper products used on tables and by sinks. It is unacceptable and unprofessional either to eat or smoke in the treatment area.

Take the time to learn the correct pronunciation of technical terminology related to laser hair removal and use these words in the correct context. Mispronunciation of professional terms indicates deficient training, lack of knowledge, and carelessness.

It would be wise to advise patients to have someone care for their children at home while they are being treated. Children should not be in an office near the laser treatment area unless they are with an adult at all times. They may not enter the laser treatment area with a parent or guardian while that parent/guardian is undergoing treatment.

CONFIDENTIALITY

The ethical laser hair removal professional, while in her/his office, is held liable for breaking confidentiality about one patient (or colleague) to another. The same is true of gossip, whether about another laser professional or another patient. Such breaches are never to be condoned.

TREATMENT OF MINORS

Under no circumstances is a laser hair removal professional permitted to work on a minor without parental or guardian written permission. We are not included in any professional grouping that is able to work on minors without specific parental permission.

POSITIONING

Basically, positioning has to take into consideration three factors: (1) the body posture of the technician (paramount); (2) the body location of the patient; and (3) equipment (i.e., table, chair, lamp, machine) positioning. All too often we speak to the first two, forgetting that much of that hinges on the station layout and the kind of equipment we have chosen to use.

Speaking of the most critical equipment, of course it is paramount that the operator keep the laser head perpendicular to the patient's skin. The cooling plate (on laser systems so equipped) also must be kept in contact with the skin.

Whether one works from the side of the table or the head of the table (or chair) is somewhat inconsequential, as long as the primary rules of technician positioning are followed. Some technicians are short, others tall; some are heavy-set while others are slim. Some patients are stocky; others are thin. Working under a chin on a heavy patient demands greater technician dexterity than working on an arm. No matter which side of the table one is talking about (i.e., the patient's angle or the technician's angle), the key will always be technician posture.

GLOSSARY

A

absorption - transformation of radiant energy to a different form of energy by the passage through, or reflection from, matter.

alopecia - loss of hair, especially on the head. In humans it can result from heredity or hormonal imbalance or certain diseases or drugs and treatments (chemotherapy for cancer).

anagen phase - the growth stage of hair development.

angioma - a circumscribed benign tumor comprised of blood vessels appearing as an irregularly shaped, red discoloration of otherwise normal skin, due to overgrowth of capillaries.

arrector pili - involuntary muscle fibers in the skin and extending down to connect with hair follicles. After specific stimuli, such as cold or fright, the muscle contracts, straightening the follicles and raising the hair.

B

bulb - expanded portion at the lower end of the hair root. Growth of a hair results from the proliferation of cells of the hair bulb.

C

catagen phase - the transition or intermediate phase of hair growth that occurs after the growth (anagen) stage and before the resting (telogen) stage.

chromophore - optically active (colored) material in tissue which acts as the target for the laser light. A colored material in tissue (generally melanin or hemoglobin) that absorbs laser light.

coherence - orderliness or wave patterns in the same phase in time and space.

collimation - waves or rays traveling in a nearly parallel direction, with negligible divergence.

Corpus Luteum - a yellow, progesterone-secreting mass of cells that forms from an ovarian follicle after the release of a mature egg.

cryogen - a refrigerant used to obtain low temperatures at the epidermis.

D

dermis - the layer of skin lying immediately under the epidermis; the middle layer of skin, which is made up of blood vessels, lymph vessels, hair follicles, sweat glands, collagen bundles, and fibroblasts.

E

edema - the presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body.

electromagnetic radiation - the flow of energy consisting of vibrating electric and magnetic fields.

electromagnetic spectrum - the span of frequencies (wavelengths) considered to be light from radio and television waves to gamma and cosmic rays.

electron - negatively charged part of an atom.

energy - a measurement of the capacity to do work. The energy (in joules) produced by a laser is defined as the amount of power (in watts) multiplied by the duration (in seconds) of the pulse.

epidermis - the non-vascular outer four layers of skin.

epithelium - membranous tissue covering internal organs and other internal surfaces of the body.

esthetics - the nonmedical care of the skin.

excited state - an atom with an electron in a higher energy level than the ground state.

F

fiber optics - thin, flexible devices used to carry light or other optical energy.

Fitzpatrick Skin Types - an evaluative system developed by Dr. Thomas Fitzpatrick to assess skin color and a person's tendency to tan or burn.

fluence - energy density. The energy (expressed in joules) of a laser pulse divided by the area of the beam (in cm^2).

follicle - a cylindrical depression of the epidermis, penetrating the corium that holds the hair root.

G

GnRH - (***G*****o*****n***adotropin ***R***eleasing ***H***ormone) The hormone produced and released by the hypothalamus. GnRH controls the pituitary gland's production and release of gonadotropins

Gonadotropins - the hormones produced by the pituitary gland that controls follicle stimulating hormone (FSH) and luteinizing hormone (LH)

H

hertz - Hz; unit of frequency; also known as cycles per second.

hirsutism - a condition characterized by the excessive growth of hair or the presence of hair in unusual places, especially in women. Hirsutism in women is usually caused by abnormalities of androgen production or metabolism.

hyperpigmentation - abnormally increased pigment.

hypertrichosis - an excess of androgen-independent vellus hair growth, not following a male sexual pattern, due to an increased sensitivity of the hair follicles to the normal circulating levels of androgen.

hypopigmentation - abnormally decreased pigment.

I

infrared radiation - electromagnetic radiation having wavelength that lies in the range of 0.7 microns to 1 micrometer.

J

joule - a unit of energy. Laser powers are sometimes described in joules per second. A power of one joule per second is known as one watt and is the rate of energy delivery. 1 joule = 1 watt second.

K

keratin - an extremely tough protein substance found in hair and nails. This protein is found in two forms, hard and soft.

L

laser - acronym for: ***L***ight ***A***mplification by the ***S***timulated ***E***mission of ***R***adiation. A light source which produces narrow, directional, intense, and monochromatic ("pure color") beams.

laser medium - material used to emit the laser light and for which the specific laser is named, i.e., ruby, alexandrite, Nd:YAG, etc.

laser plume - smoke, vapor, and airborne particles that are the by-products of laser vaporization.

lentigo - small, brown macules (spots) or yellow-brown pigmented areas on the skin due to an accumulation of melanin (freckle).

M

macule - a patch of skin that is altered in color but usually not elevated.

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

melanin - pigment which gives color to hair or skin. Exposure to sunlight stimulates melanin production.

melasma - a blotchy, light brown discoloration of the skin usually found on the face; associated with the use of oral contraceptives, pregnancy or hormonal changes.

mode - a term used to describe the distribution of power within the cross-section of the laser beam. Also used to describe the operating mode of a laser, such as "continuous" or "pulsed."

monochromatic - literally, "of one color." Laser light is monochromatic because it consists of electromagnetic radiation having a very small range of wavelengths.

N

nanometer - One-billionth (10^{-9}) of a meter. The usual measure of light wavelength. Visible light ranges from about 400nm in the purple to about 760nm in the deep red. Abbreviated: **nm**.

Nd:YAG - ***N***eodymium: ***Y***ttrium ***A***luminum ***G***arnet. The crystal used as a laser medium to produce 1064nm light.

necrosis - the pathologic death of living tissue.

neodymium - the rare earth element that is the active element in an Nd:YAG laser.

nevus flammeus - a large congenital vascular birthmark having a purplish color; it is usually found on the head and neck and persists throughout life. Synonym: **port-wine mark**.

Nominal Hazard Zone (NHZ) - The space within which the level of the direct, reflected, or scattered radiation during normal operation exceeds the applicable MPE (Maximum Permissible Exposure).

P

papilla - a projection of the corium that extends into the hair bulb at the bottom of a hair follicle. It contains capillaries through which hair receives nourishment.

phagocytosis - the engulfing and ingestion of bacteria or other foreign bodies by specialized cells.

phase - waves are in phase with one another when all the troughs and peaks coincide and are "locked" together. The result is a reinforced wave in increased amplitude (brightness).

photon - the quantum of electromagnetic energy, generally regarded as a discrete particle having zero mass and no electric charge. A small discrete package of light energy.

power -the rate of energy delivery expressed in watts (joules per second).

power density - the intensity of the laser beam, determined by the watts delivered at the tissue site and the spot size of the beam. The power of a laser beam per unit area. It is measured in watts per square centimeter.

pulse - a discontinuous burst of laser output as opposed to a continuous beam. A true pulse achieves higher peak powers than that attainable in a continuous wave output.

pulse mode - operation of a laser when the beam is intermittently on, fractions of a second.

Q

Q-switching - a method of switching a laser on and off in which energy is stored within the lasing medium and then suddenly released in a short, single burst of approximately 30 nanoseconds), resulting in an extremely high peak power output.

R

radiation - the emission and/or propagation of energy through space or through a medium in the form of either waves or particle emission.

rosacea - flushing followed by red discoloration due to dilation of capillaries affecting skin on the nose, forehead, and cheeks.

S

scleroderma - a chronic disease of unknown etiology which causes sclerosis of the skin and certain organs in the gastrointestinal tract. The skin is taut, firm, and may itch, later becoming hyperpigmented.

selective photothermolysis - the targeting of intense laser energy, which has been tuned to selectively destroy specific chromophores, without damaging surrounding tissues and structures.

shaft - the keratinized portion of a hair that extends from a hair follicle and projects above the surface of the epidermis.

signal - a specific anticipated, detectable event, e.g., a laser pulse.

spectrum - the characteristic group of wavelengths radiated by a substance.

stimulated emission - the process of excited state decay with photon emission induced by the interaction with another like photon.

T

telogen phase - the resting stage of the hair growth cycle.

thermal relaxation time - the amount of time required for an object to cool to 50% of the temperature achieved immediately following exposure to laser light. If the thermal relaxation time of a tissue is longer than the duration of a laser pulse, thermal damage will be limited to the tissue treated and will not spread to adjacent tissue.

V

verruca - a tumor of the epidermis caused by papillomavirus which produces a circumscribed, elevated area of hypertrophy. It is essentially benign and may disappear spontaneously in children. Synonym: wart.

vitiligo - condition of chronic pigmentary loss in the skin, usually progressive, characterized by irregular depigmented white patches sometimes surrounded by a hyperpigmented border. It is associated with a dominant inherited predisposition and it has been speculated that autoimmune mechanisms are involved.

W

watt (W) – a unit of power. 1 watt = 1 joule per second.

wavelength - distance from one wave peak to the next.