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LASERS IN PLASTIC SURGERY

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Abstract: *Lasers are being increasingly used for aesthetic indications in areas where we had very few or no options earlier. A good understanding of the basics of laser functioning and of laser interaction with tissues is necessary to grasp the various uses of lasers and put them to optimal use. Laser resurfacing with the carbon dioxide, erbium or a combination is yet to be exploited to its full potential. Hair removal lasers have gradually improved to manage hirsutism even in the darkest skin types. Q switching has given us the nanosecond capability to treat various cutaneous pigmentary disorders including various tattoos, while the dye lasers remain the gold standard for vascular lesions. Non ablative rejuvenation of the skin is possible with subablative doses of some long pulse lasers and the intense pulsed light device.*

HISTORY

Light has been used for therapeutic purposes by the Egyptians since 4000 B.C. In late nineteenth century, Nils Fincen used light to treat vitiligo and psoriasis. It was only after Einstein propounded the theory of stimulated radiation in 1917 that many workers like T.H.Maiman (1960), and N. Patel and C .Kumar demonstrated 'LASER' and CO_2 laser respectively. Later, the acronym 'LASER' was coined for light amplification by stimulated emission of radiation. Three years later, Polanyl and coworkers reported surgical use of CO_2 laser and over the next several years, histological studies revealed the ability of this laser to seal lymphatics and nerve endings, and to coagulate vessels up to 0.5 mm. in diameter. Other variants of lasers were discovered subsequently; Helium Neon laser (1960), Nd:Yag Laser (Neodymium-Yttrium Aluminium Garnet, in 1964), Argon laser (1964), and KTP laser (Potassium Titanyl Phosphate, in 1981).

In late 1970s and early 1980s CW (continuous wave) CO_2 laser found applications with plastic surgeons, dermatologists, otolaryngologists, gynaecologists and neurosurgeons. But, soon the enthusiasm went down because of unwanted complications like thermal injury and scarring. In early 1990s, the Coherent Medical Group developed a 0.2 mm diameter CO_2 laser with high frequency pulse beam which was an improvement. This reduced the thermal effect on surrounding tissue and the edges of the wound. Laser surgery could now be compared with standard scalpel surgery.

The end of 21st century is focusing a lot on aesthetic applications of lasers in non ablative resurfacing and rejuvenation of the face.

LASER PHYSICS

The light is passed through a medium by which it gets stimulated (fig.1). The source of light is a flash lamp, an arc lamp or a tube light. The medium is either gaseous, liquid, solid crystal or a semiconductor as follows:-

Solids: *Ruby, Nd:Yag*

Gases: *Helium-Neon, Argon, Carbon Dioxide.*

Liquids: *Organic dyes - (Rhodamine, Coumarin)*

Semi-conductors: *Diodes (Aluminium, Gallium, Arsenide)*

The unit of light is a proton. It is stimulated in presence of a medium, and is then called an electron. An electron in the orbit (fig.2) around the nucleus of an atom is excited from its baseline state to an unstable higher orbit, and in the process, it stores an exact quantum of energy. Since the excited state is unstable, the electron returns spontaneously to its baseline state immediately, releasing the energy in the form of light or protons, depending on the characteristic of the atom and the energy level involved. According to Einstein's theory, another photon can stimulate the release of this energy from the unstable, excited electron. Large numbers of atoms can be stimulated to the excited states by the introduction of light, thereby causing a situation known as *population inversion*. Since one photon stimulates the release of stored energy of an excited electron (fig.2) in the form of another photon, the wavelength, and the phase of the paired photons are identical. *The result is lasing.* These photons are reflected in the chamber by the reflecting surface (fig.1). Their speed is accelerated and they pass out through a hole on the non-reflecting side, as a radiated beam of *Laser*. This laser radiation is of low frequency as compared to the radiation of x-rays and gamma rays, which have high frequency and very small wavelengths, less than 10 nanoseconds. The laser has no irradiation hazards as compared to the x-rays and gamma rays. Being coherent and collimated, laser light has an ability to focus to the spot sizes as small as a single organelle within a living cell. Fiberoptic cables, which are able to transmit laser light, can pass through the endoscopes and catheters for operative procedures. The infrared lasers need special coated optic fibers or else they are transmitted to the hand-piece and then to the target, by the mirrors in the articulated delivery arm.

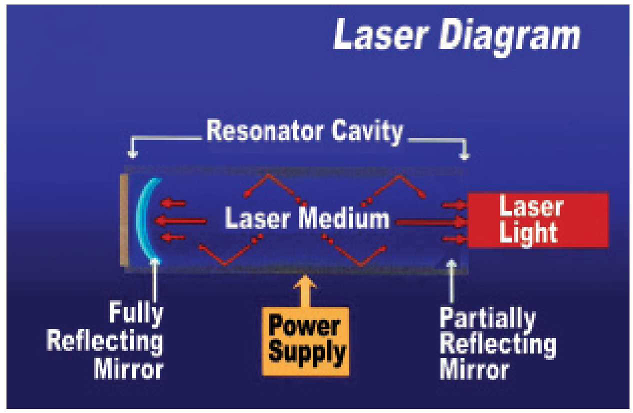

Fig.1 Showing the mechanism of laser generation in a chamber with lasing medium and power source.

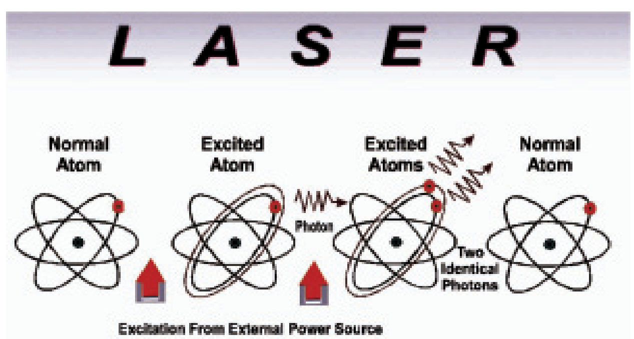

Fig.2 Showing a chain reaction of excited atoms releasing photons of light.

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EFFECT OF LASERS ON TISSUES

The factors influencing the effect of laser on tissues are:

(A) The type of laser (quality i.e. wavelength); (B)The dose of laser (quantity i.e. the time for which the laser is in contact with the tissue (or the contact time) and the energy (in Watts). The energy also varies with the spot size of the laser beam;.

(C) The mode of delivery of laser.

Type of laser

The laser is named by the medium through which it passes. For example, CO_2 laser is called so because the light is made to pass through carbon dioxide gas before it comes out as laser light. CO_2 laser is highly absorbed by water. The human tissues consist of 80 % water. By its characteristic quality CO_2 laser is absorbed into the skin or the tissue it comes in contact with. Heat is transferred into the water of the skin, which is the chromophore for CO_2 laser. Integral structures like ribonucleic acid, deoxyribonucleic acid and other structures melt at 50^0 to 100^0C . The result is penetration of laser into the skin. The effect of the laser will depend on the temperature which is reached in the tissues. This effect is produced by the power of the laser (fluence) and the duration for which the laser touches the skin (contact time). If the temperature produced is around 40^0C , its effect is warming and the result is a reversible coagulation. Such a dose of the laser has been used for experimental tissue welding. There is gross alteration of the extra cellular matrix with various temperature-heating time combinations. It is worth remembering that laser surgery consists of controlling where and how much laser injury is likely, due to the heat produced by laser. Cutting is possible by continuous lasers like CO_2, diode, and Argon lasers. The quasi-continuous (rapid-pulsed) lasers such as copper vapor and KTP (potassium titanyl phosphate) also produce milder effects of cutting. In contrast, there are lasers which do not damage or ablate the skin layers, but only transfer heat to any part of the skin tissue selectively, like cells of the hair follicles, pigment cells or the red oxyhaemoglobin in micro vessels. These are called non-ablative lasers. The CO_2 and Erbium lasers which are ablative lasers can also be used as non-ablative lasers by change in the fluence and pulse duration or the contact time.

When the absorption of the photon of laser into the chromophore occurs, the photon ceases to exist and the chromophore becomes excited. It may undergo the following changes:

a) Photochemistry (photochemical reaction)

b) May dissipate energy as heat (photo-thermal reaction)

c) May cause remission of light (fluorescence); d)Photo-optical disruption, when the optical force is with high energy and short duration, as in Q-switched mode of laser.e)Photo-mechanical reaction, as in Erbium:YAG laser, where it removes the ash by force of several atmospheric pressures, along with thermal ablation.

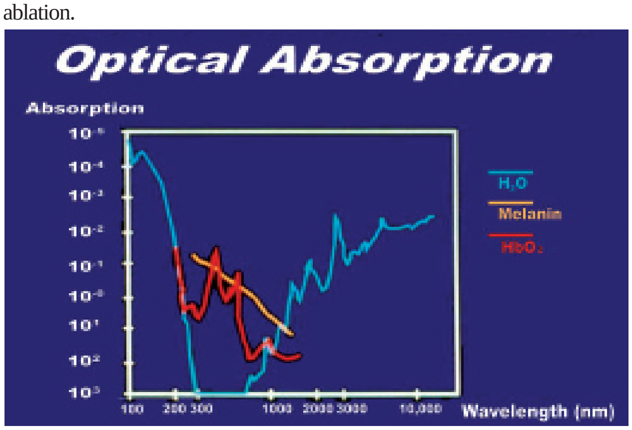

Fig.3 A graphic representation of absorption spectra of major chromophores of the skin, water, melanin and haemoglobin.

The absorption spectra of the major chromophores of the skin must be known to study the effect of lasers (fig.3). The coefficient also depends on the concentration of the chromophores present. The process of selective photothermolysis (SPTL) works in this situation. Selective photothermolysis is the process of controlling tissue reaction by controlling three factors: energy, pulse duration and the wavelength to target a selected tissue. Melanin highly absorbs a wavelength of 694nm (Ruby laser) and the wave length of 755 nm (Alexandrite laser). The absorption of oxyhaemoglobin in the blood vessels exhibit strong bands in the ultraviolet (Excimer), blue (Argon), green & yellow (dye lasers) and 532nm (green) bands. These tissues could be made targets, if a proper selected pulse duration and energy is utilized in the most suitable mode of the laser. For example, the Ruby laser in a Q-switched mode with nanoseconds pulses could target a black chromophore of a nevus of the skin.

A scattering of laser light occurs when the photons change their direction. 5 % of the laser light striking the skin is reflected back, while 95 % of the photons that enter the skin are either absorbed or a part of them are scattered. This scattering is by the collagen fibers and it varies with the wavelengths of lasers. This scattering is responsible for the causation of collagen shrinkage and treatment of fine wrinkles.

Optical penetration

This is governed by a combination of absorption and scattering. In the shorter wavelengths, the penetration is more in the white skin than in darker skin. With the longer wavelengths of lasers, scattering and absorption is dependent on the thickness and water content of the skin. The colour of the skin makes no difference at higher wave lengths. The most superficial penetrating wavelengths are in the far ultraviolet region (protein and water absorption), and far infrared regions (water absorption). For example, the excimer (193nm) penetrates only a fraction of a micrometer into the stratum corneum and CO_2 laser (10,600 nm.) penetrates only 20 to 75 microns, hence they are useful for cutting and vaporization; CO_2 laser for the skin and excimer for the cornea of the eye. The CO_2 laser penetrates more when it is focused to a spot. When it is defocused the spot size increases, the intensity decreases and hence the penetration decreases (fig.4). In case of non-ablative lasers like the long pulse Nd:Yag laser, the penetration is more when the spot size is bigger. With the smaller spot size, the penetration through the skin is less as compared to the bigger spot size.

Thermal injury to cells

This is dependent on the combination of temperature and the contact time. These two parameters control the coagulative process and thermal cell damage. The thermal denaturation is a rate process. As the heat increases it hastens the process to necrosis. This is reversible in the initial stages. Most human cells can withstand prolonged exposure to a temperature of 40^0 C. Selective photothermolysis, as explained earlier, is set by the high power of laser causing high temperature in a selected tissue for a very short duration. In such selective and individual cell

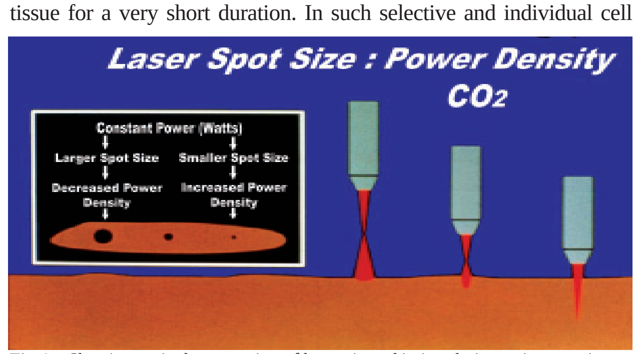

Fig.4 Showing optical penetration of lasers into skin in relation to its spot size.

heating, there is little risk of scarring because the gross dermal heating is minimized.

Dermal coagulation occurs when the critical temperature is reached. There is a histological boundary of dermal coagulation, which defines laser from other burn injuries. The vaporization (boiling) temperature of water at one atmospheric pressure is 100^0 C. With continuous wave laser (CO_2) the surface of the skin gets desiccated and charred at temperatures of 120^0 C to 200^0 C. This temperature can go to several hundred degrees. During cutting and ablation, the thermal injury can occur up to 1 mm depth because of heat conduction, in spite of 20 µ depth of penetration of CO_2 laser. In case of ablation there is a layer of coagulation below the ash, the residual tissue damage (RTD). Beyond the coagulative layer there is tissue shrinkage caused by heat dissipation. Here there is reversible tissue coagulation. In contrast, short pulses of high energy (5 - 10J /cm^2) called superpulse or ultrapulse can remove tissue with greater efficiency and less thermal damage. If the entire energy needed for vaporization is delivered in the time equal to or less than the thermal relaxation time of the most superficial layer of the skin the heat remains confined to this thinnest layer. Thus, only this thin layer is vaporized without much heat transfer to the underlying tissue.

Dose of laser

Light is either transmitted, reflected or is absorbed into the target or the tissue. The absorbed energy from the beam of laser transfers heat to the tissue. The heated tissue may be destroyed or show changes such as thermal, chemical, mechanical etc. The time taken by the tissue to cool by 50% is called its *thermal relaxation time* (TRT). The concept of *selective photothermolysis* was propounded by Anderson and Parrish in 1983. A tissue is selectively destroyed if the duration of the pulse of laser is less than its thermal relaxation time. For example, the TRT of hair root is 10 to 100 milliseconds, with some variation depending on the wavelength of the laser. If the pulse of the laser is less than 100 milliseconds it will destroy the hair root by accumulating sufficient laser energy in the hair.

Low power lasers may produce a biochemical change, but a high power laser may be used to create non-linear optical effects, like optical breakdown, thermal effect, an explosion or "plasma" formation.

Mode of delivery

The lasers are delivered in continuous mode or in the pulsed mode. In the continuous mode (fig.5) the laser can cut the skin, or it can vaporize or char a mole or a similar lesion on the skin. In the pulsed mode its effect is different and variable. The principle of selective photothermolysis revolutionized laser treatment. The thermal relaxation time of the skin is about one millisecond or one thousand microseconds. If the pulse duration of the CO_2 laser is less than 1000 microseconds, it will not char or damage the skin surface. By reducing the time and energy a thin layer of the skin can be removed or resurfaced. Laser pulses are of various types:

1. *Chopped pulse* (fig.5): If the continuous laser is cut or divided by small gaps, the effect will remain the same.
2. *Ultrapulse or Superpulse*: It is a pulse of high energy and short duration. The effect will be graduated and controlled by increasing or decreasing the energy.
3. *Scanning* by a continuous rain of pulses of short duration is also very useful. The scanned area is smooth and uniform. A beam of laser as a continuous rain of pulses of high energy are delivered to the target so rapidly that the tissue is vaporized before any carbonization occurs, each pulse being within the thermal relaxation time. The scanning of the skin can perform asmooth abrasion or resurfacing of the skin layers. One can also resurface the skin layer by layer. Since there is no bleeding fromthe surface of the skin, the layers can be identified.

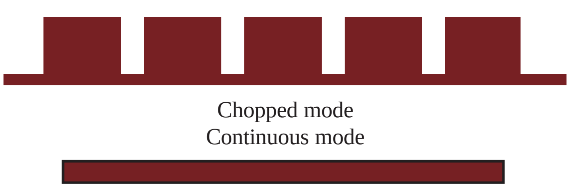

Fig.5

Following a CO_2 laser the experienced eye will see first the pink layer, and then the tanner colour of the upper papillary layer. The reticular layer of the skin looks smooth or coarse and is dirty yellow. In case of Erb:YAG laser the corresponding colours are yellowish brown after the first pass. The papillary layer looks pink. When reticular layer is reached dermal bleeding is noticed. The short pulsed Erb:YAG does not have any thermal energy and thus cannot coagulate blood vessels. The long pulsed Erb:YAG has a thermal component, which can lead to collagen shrinkage and vessel coagulation.

Effects of lasers depending on mode

If the continuous mode is cut into pulses, causing chopped pulses, the effect on the tissue does not change unless the duration of contact time or the exposure time can be reduced. These chopped pulses cannot produce the effect of selective photothermolysis and cause a selective damage of the chromophore, like pulsed lasers. The chopped pulses and the continuous beam laser would increase the thermal damage by excessive heat transfer. The CO_2 pulsed laser with high fluence and short duration would remove the tissue with greater efficiency and can be controlled layer by layer.

A CO_2 laser (continuous wave), if scanned rapidly enough along the tissue can also produce intense short exposure conditions needed for the pulsed laser effects. Conversely, a short pulsed laser, when operated at a subablative pulse fluence at repetition rates of about 50 to 100 Hz. will produce deeper injury and charring, usually associated with a continuous wave form laser. Hence, more understanding is necessary regarding the fluence, the contact time, the type of laser, its wavelength, and the spot size of the delivery hand-piece. Therefore, in continuous wave scan, contact time of each unit pulse is important to achieve a uniform resurfacing. In pulsed laser, even if the contact time is short enough, and less than the TRT of the skin, resurfacing is neither uniform nor controllable.

ABLATIVE LASERS

The lasers which ablate the surface of the skin are called ablative lasers. CO_2 and Erbium: YAG lasers are highly absorbed by water, as water in the skin is the chromophore for these lasers. The chromophore absorbs the thermal energy and gets heated up. This causes thermal change on the skin surface. On reaching a certain temperature, the skin surface layer is vaporized and looks as if it is abraded like in dermabrasion. Following reepithelialization it leads to *skin resurfacing*.

Erbium: YAG laser gets absorbed in water ten times more than by CO_2 laser. Hence, it removes a very thin layer of the skin surface in one pass or in one layer treatment. This laser does not heat the surrounding tissue. CO_2 laser ablates or vaporizes a layer thicker than Erb:YAG and it disperses the heat to the surrounding tissue, heating the collagen of the dermis. It causes the skin to shrink, due to the shrinkage of the collagen and laying of neocollagen. The CO_2 laser in a continuous mode can cut the tissue like a knife, when it is focused to a point, but Erb:YAG laser cannot do this as it cannot be used in a continuous mode. The CO_2 laser coagulates a blood vessel of diameter of 0.5mm, and therefore, in deep resurfacing of the skin by CO_2 laser there is no bleeding. While deep resurfacing by Erb:YAG laser leads to bleeding from the deeper layers. During ablation the *plume* (gaseous material) comes out and has to be sucked to avoid inhalation by the surgeon and the patient. The ash remaining on the surface of the skin has to be wiped with wet saline gauze or a pad. During resurfacing by Erb:YAG laser the ash is thrown in the plume by the optical blast of the laser. The plume of the *Erb:*YAG would contain more of the toxic material hence the suction should be more powerful.

The effect of heat on the skin surface is as on any living tissue. The tissue vaporizes at 100^0 C. If the laser pass is repeated at the same place without removing the ash, the temperature rises in the ash and the tissue is charred black. If the energy is adjusted in such a way that the temperature on the skin surface reaches between 40^0 and 50^0 C, the collagen of the skin is heated up, which may be reversible, and cause collagen shrinkage.

NON ABLATIVE LASERS

The non ablative lasers do not affect the epidermis in normal course. There is a so called dermal window between 400 - 1400 nm wavelengths. At these wavelengths the lasers can pass through the skin and affect the dermal structures. The epidermis is saved by surface cooling. The wavelength around 700 nm has affinity for black pigment and those between 480-600nm are better absorbed by red pigment. The heat of the lasers if dissipated, non-specifically, affects dermal collagen and can rejuvenate the photo-damaged skin. There are various lasers in this range which have been used for rejuvenation of the skin. Intense Pulse Light (IPL) has also been widely used in this regard. In addition to the wave length, the mode and dose of the intense light or that of the laser is important.

These lasers can perform *various functions* can be beneficia in.

- Hair removal by targeting the hair root structures.
- Treatment of pigmentary lesions of the skin by selectively affecting the melanosomes and melanocytes. Lasers can also target any other pigment like the colours of tattoos.
- Treatment of vascular lesions of the skin like portwine stains, telengiactasis etc.
- Facial Rejuvenation by collagen shrinkage.
- Management of acute acne by targeting the bacteria P. acnes.
- Tissue welding.
- Photodynamic therapy.
- Limited role in hypertrophic scars and keloids.

Intense Pulsed Light (IPL)

The intense pulsed light is essentially a non ablative light working like a laser. It has wavelengths between 500-1200nm. The required wavelength is obtained by an appropriate filter. The tissue effect behaves in a manner following the theory *of selective photothermolysis*. Hence, it has to be used in the pulsed mode. The pulses are divided into two or three pulses with a delay time in between. This delay helps in reducing the heat transfer to the skin and takes precaution against any probable complications of the epidermo-dermal component.

The continuous energy of the flash lamp and the wavelength is computer controlled. The longer wavelengths have deeper penetration than the shorter wavelengths. An appropriate filter is used at the tip of the hand-piece. This is rectangular in shape and of various sizes. The use of a cool gel helps in cooling the skin. Division into multiple pulses also helps in saving the skin. The ability to pulse the IPL within the thermal relaxation time of the chromophore accumulates adequate heat in the target to destroy it. The larger size of the tip of the hand-piece helps to treat a larger area at a time and also has a deeper penetration.

Various companies have limited the range of wavelengths of these machines. The machine with 400nm wavelength is used only in cases of acute acne. Sittings are given twice a week for about sixteen weeks or till remission occurs. This may be repeated if the acne becomes acute again. Longer wave lengths are available in Vasculight Plus of Lumenis (formerly ESC). This is a high output device. It specifies an ‘SR mode’ for photorejuvenation, ‘VL mode’ for vascular lesions, ‘PL mode’ for pigmented lesions, and ‘DL mode’ for deeper blood vessels. It also has a mode for hair removal. The computer gives the pulse duration, the number of pulses and the fluence for the type of skin. Necessary filters are used to cut off unnecessary wave lengths. A cool gel is applied on the surface of the skin before pulsing the target.

It is claimed that there are no short term or long term adverse effects of IPL therapy. There may be transient erythema, oedema and pigmentary changes after the treatment. There are no serious long term complications like blistering, scarring and pigmentary dyschromias in Fitzpatrick’s skin type III, IV, V and VI.

Nester et al define the skin changes broadly as Type I and II.

Type I: Include pigmentary changes like lentigenes, post inflammatory hyper-pigmentation, and vascular abnormalities like telengiectasia and persistent erythema.

Type II: Includes solar elastosis, collagen damage, such as loss of texture and dilated facial pores, laxity and rhytids. These are changes of the ageing face. Histologically, there are tangled masses of degraded elastic fibers, decreased collagen fibers, increased ground substance such as glycosaminoglycans and proteoglycans, and some cutaneous changes due to sun damage.

In case of Vasculite Plus of Lumenis, cut off filters used are of 560 nm, 590 nm and 640 nm. Total fluence is 20 to 30 joules. Pulse mode is double or triple. The pulse duration is (2.5- 4.0 / 4.0-5.0 msec). These parameters are set according to the skin type and extent of photo damaged skin. Emla / Prilox cream is applied two hours before treatment to anesthetize the skin. A chilled gel is spread on the surface of the skin. The sapphire hand piece is gently placed on the skin without making contact with it. The shot of the pulse is felt like the snapping of a rubber band. This treatment is repeated at three weeks interval for 4 to 6 sessions. The results are short term and long term, though not permanent.

There are a variety of machines in the market and the frequency of treatment to photodamaged or aged skin of the face depends on the power of the machine, the dosage and the number of pulses per shot. The effect also lasts for a variable period.

CUTANEOUS PIGMENTED LESIONS

Laser treatment should be undertaken only in case of benign pigmented lesions. In case of any doubt, a prior histopathological study must be done. These lesions may be:

A: *Superficial or epidermal.* (Lentigenes, epilides, nevi spilus, café-au-lait, seborrhoeic keratosis, and may include some junctional nevi).

B: *Deep or dermal.* (Nevi of Ota, nevi of Ito and tattoos).

C: *Dermo-epidermal, involving both epidermis and dermis.* (Compound nevi, Becker’s nevi, melasma, post-inflammatory and post-traumatic pigmentations).

The melanin of the skin can regenerate and the ultraviolet rays of the sunlight stimulate it. Therefore, human races of the tropics are the coloured races. Ablative lasers can remove melanin of the epidermis in lentigenes. The pigment of the melanosomes (pigment granules) can only come out if the cell wall bursts. The thermal relaxation time of melanosomes is unknown and is probably in the range of 250-1000 nanoseconds. The rupture of melanosomes is independent of the pulse duration below 100 nanoseconds- occurring even in picosecond and

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femtosecond pulses. Therefore, most of the Q-switched lasers in the market provide pulses in 2-8 or 15 nanoseconds. The immediate effect of the Q-switched laser on the pigmented skin is whitening. Deeper whitening occurs in case of tattoos which have intracellular pigments.

Epidermal lesions

They are amenable to many modalities as almost all injuries confined to the epidermis heal without scarring. The CO_2 laser can efficiently resurface most of the epidermal lesions. However, for lesions not elevated above the surface Q switched Nd:YAG 532 nm laser (5-10nsec) clears many of these in a single treatment. There may be transient hypopigmentation after the treatment. The pulsed dye laser 510 nm has been shown to be effective in lentigines.
Epelides (freckles) respond to sunscreens and sun avoidance. Alfa hydroxy acids and tretinoin application also helps. The Q switched lasers also do well. The same is true for café au lait macules. Nevus spilus is a lesion where if malignant degeneration is suspected, a biopsy should be obtained.

Dermal – epidermal lesions

Becker's nevi show elongation of rete ridges and basal cell hyperpigmentation. Melanocytes appear to be increased and dermal thickening is present. The pulsed dye, Q switched Nd:YAG, Ruby or Alexandrite lasers offer good clearance, but recurrence is common.
Melasma is of two types: *Epidermal* - where melanin is mostly in basilar and suprabasilar areas and melanocytes contain highly melanized melanosomes; and the *dermal* – which has melanophages in the superficial and deep dermis, in addition to the epidermal pigmentation. Examination under a Wood's lamp shows enhancement of pigmentation in the epidermal type. Epidermal ones also have sharp borders. Repigmentation after any clearance by lasers is very common due to a failure in stopping the etiologic mechanism for hypermelanosis. Theoretically, pretreatment and post-treatment with hydroquinones should effectively prevent repigmentation, particularly when combined with tretinoin. Q switched Nd:YAG laser, 532nm for superficial and 1064nm for deep melasma provide good clearance at low fluences and the result has to be maintained by creams, along with avoidance of sunlight. Post-inflammatory hyperpigmentation can also be treated with a similar regime but with lasting results.

Dermal lesions

Commonly acquired nevi appear after 6-12 months of age and are sun sensitive, with a higher number in sun exposed areas. Smaller nevi respond better to all Q switched Nd:YAG lasers but many respond partially or recur. Congenital nevocellular nevi are present since birth, with a lifetime risk of 6.3% for development of melanoma in large nevi. Acquired nevi show better results than congenital ones. Because congenital ones extend into deepest reticular dermis, full clearance with pigment lasers is often not possible (fig.6)
Nevus of Ota is a bluish grey macular lesion limited to first and second divisions of the trigeminal nerve, often associated with ocular pigmentation and has a strong predilection for females. The edge of the nevus is not sharply demarcated. Histology shows long dermal melanocytes in the upper half of dermis. Along with the nevus of Ito they respond well to the Q switched lasers (fig.7). Optimal interval between sittings is 6-8 weeks. Superficial lesions respond to shorter wavelengths (510nm, 532nm and even 694nm) whereas deeper lesions respond well to 694nm, 755nm and 1064nm). Larger spot sizes increase penetration depth.

Tattoos

Tattoos are pigmented lesions. The pigment is forced into the skin either by trauma or for decoration. Pigment is found in the keratinocytes, phagocytes and mast cells. Tattoo removal is done after they are 9 -12 months old, and the pigment is set in cells, otherwise the color may run at the edges. Earlier, they were treated by dermabrasion etc. and also by non selective lasers. These destructive modalities resulted in scarring. The Q-switched (1064nm) Nd:YAG lasers are effective in removing the blue and black pigment in multiple sessions. In our experience they are especially useful in darker skin (fig.8). The

Fig.6 Profile view of a patient with giant hairy nevus in right temple and malar areas which was partly treated with serial excision & laser (top left- untreated nevus, centre - partial excision, bottom right- treated by 6 sittings of Q-switched, 1064nm, Nd:YAG laser).

Fig.7a A patient with nevus of Ota in the left malar and cheek areas.

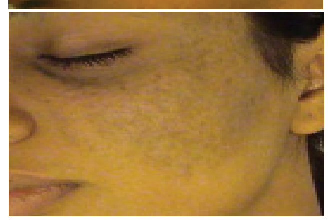

Fig.7b Showing significant clearing of pigment after four sittings of Q-switched, 1064nm, Nd:YAG laser treatment.

hypopigmentation seen after treatment is transient. Frequency doubled (FD) Q-switched Nd:YAG (532nm) laser is able to target the red and orange colours. The yellow colour in tattoos responds poorly. The blue and green colours also respond poorly and are better treated with a Q-switched Ruby laser. Purple, orange and yellow colours can be treated with a flash lamp pumped dye laser in a few sessions.
Amateur tattoos do better than professional tattoos as the pigment volume and depth is more in the latter. Treatments should be spaced 6-8 weeks apart and it may require 2 - 20 treatments for clearance. The desired endpoint for both nevi and tattoos (with Q switched Nd:YAG laser) is whitening, and punctate bleeding means higher fluences are being used. A 3 or 4 mm spot size is used, and one should start with lower fluences and work upwards. The rate is adjusted as per convenience from 0.5 – 10 Hz. Post-operatively, an antibiotic cream with steroid is used till completely healed. Bleaching creams or keratolytic creams are advised rarely after the healing of the laser wound. They may be used in some cases under supervision and followed up every week or 10 days.

Fig.8a A patient with a decorative professional tattoo on the flexor aspect of left wrist after two sittings of treatment with Q-switched, 1064nm, Nd:YAG laser.

Fig.8b More improvement and color fading can be seen in the tattoo after another three sittings with same laser. The result shown is at one year after the last sitting.

CUTANEOUS VASCULAR LESIONS

The haemangiomas and vascular malformations must be investigated regarding their extent, depth and whether there is any venous communication (arterio-venous malformation). The presence of a murmur or a bruit is noted. Other investigations which are useful are CT scan, MRI, colour doppler studies and a CT or MRI angiography. If there are any deeper connections the case may be sent for embolization to an interventional radiologist. The concept of selective photothermolysis has opened the door to the dermal window in the visible spectrum. The oxyhaemoglobin in blood vessels is targeted by the appropriate laser to heat up and destroy the endothelium.

In 1988, Mulliken, classified the vascular birthmarks as; haemangiomas and vascular malformations.

Haemangiomas have endothelial dilatation and hyperplasia. These may be superficial (capillary) or deep (cavernous). The colour of the overlying skin suggests whether it is superficial or deep. Haemangiomas appear a few months after birth, and they proliferate with time and with the age of the child. Majority of them regress or involute as the child grows.

Vascular malformations are abnormalities of the vascular channels with more or less normal endothelium. They may be; capillary, arterial, venous or lymphatic depending on the vessels involved. It may be a combination of these vessels. They are usually present at birth or, may manifest later in young age. The low flow lesions are capillary (port wine stain) or venous and the high flow lesions are arterial and lymphatic. The high flow lesions are treated by embolization and surgical excision.

Port wine stains are capillary malformations. They do not regress with the growth of the child and should be differentiated from nevus flammeus neonatorum which is a faint 'salmon patch' and it disappears or fades in a few months of life. These lesions may be associated with other medical problems like glaucoma, other vascular abnormalities or neurological disorders, which should be investigated if necessary. They may be associated with crusting, oozing or dermatitis. The superficial lesions are pink in colour, but the deeper lesions are darker with bigger vessels with thicker walls. They become thicker as the child grows older. Hence, the response to treatment is better in a younger age. The flash lamp pulsed dye laser (FLPDL) was specifically designed to treat small vessels in childhood. In general, children under 4 years of age had better results than those over 4 years. Some advocate beginning the treatment as early as 7-14 days of age so that 3 treatments can be completed by the time the child is 6 months old. This can lead to a 50% improvement in three sittings. Very superficial lesions clear much quicker than deeper ones, latter needing up to 10 treatments or more (fig.9). Also, darker skin patients require more sittings. Goldman and Fitzpatrick recommend fluences of 5.75 – 7.75 J/cm^2 with a 5mm spot, and correspondingly lower fluences of 4-5 J/cm^2 for larger spot sizes of 10 mm. The KTP laser (532 nm) has also been used. At out centre, using the 532 nm(KTP) wide pulse laser in darker skinned patients, the energy (fluence and pulse duration) is adjusted depending on the diameter being used, the contact time being 50 milliseconds. For superficial vessels the contact time is reduced gradually to 35, 25 and 15 milliseconds, in subsequent sittings. Sometimes in the same lesion, the darker portion is treated with longer contact time than the lighter part of the lesion. The treatment is always done after application of Prilox or Emla cream for topical anaesthesia. Usually some cooling is added by using ice packs or air cooling. The end point to be noted is a whitish or grayish white appearance. The purpuric or dark grey end point is not very desirable and it indicates that too high an energy has been chosen. The penetration of the non ablative lasers in white skin is more with lasers between 400 to 900 nm wavelength. Above 900 nm the absorption is more or less the same across all skin types. This may be the reason why there are better results in the vascular lesions in lighter skin. A newer laser called LBO (Lithium Triborate) 532nm with pulse duration in milliseconds, has recently been reported as a vascular laser with better results.

Fig.9b Showing improvement after six sittings of treatment with KTP 532nm laser. Sittings were carried out at six to eight weeks interval.

Fig.9a Portwine stain in left lower cheek region in a 20 year lady.

Venous malformations may be seen in mucus membranes of the mouth, the eyelids or any part of the body and they usually appear as bluish swellings. They respond to oral prednisolone (2-3 mg / kg) but a relapse is more likely. The prednisolone is usually given for 3 weeks but can be continued for 6 months under supervision. We have successfully used long pulse Nd:YAG laser to treat these lesions simultaneously with prednisolone medication, however, a dye laser is probably more effective. Intense pulse light is also effective in these cases.

Besides these other vascular lesions include; angiomas and pyogenic granulomas.

Angiomas are cherry coloured, spider like, and are seen in children. In spider angiomas, the dye laser or 532nm wide pulse laser is likely to benefit. These lesions are rarely seen in our country.

Pyogenic granulomas are acquired lesions with a pedicle. Their endothelium shows proliferation. If it is removed with CO_2 laser, the site of the pedicle must be resurfaced with a very mild pass, using 50 to 100 μs contact time.

LASER HAIR REMOVAL

The need for a rapid, permanent and 'no scarring' method for hair removal has led to the development of various lasers and light sources. These include ruby, alexandrite, diode, and Nd:YAG lasers, and IPL.

Relevant hair anatomy

Each hair has 3 distinct components, ie, the bulb (the extended lower portion of the follicle), the isthmus, and the infundibulum. The bulge is an area near the insertion of the erector pili muscle. Pluripotential cells in the bulb and bulge areas cause growth of the hair follicle. Melanocytes are present in these areas. For most people, the terminal hair bulb is approximately 4 mm (2-7 mm) beneath the surface of the skin in anagen phase, thus requiring considerable laser penetration depth for removal. In contrast, vellus hair bulb extends about 1 mm or less into the dermis.

Hair cycles

Hair grows in cyclic phases: Anagen is the active growth phase; catagen, the transition or shrivelled phase and telogen, the resting phase. The duration of the anagen phase governs the length of hair at different body sites. Scalp hair has a longer anagen phase and can last upto 6 years, the telogen phase lasting only about 3 months. Hair from other body sites like eyebrows, cheeks, ears, arms, legs have much shorter anagen phases i.e. 4 - 7 months, and longer telogen phases. Catagen phase is fairly constant at about 3 - 4 weeks.

The laser is effective only in the anagen phase, during which time hair matrix cells divide rapidly and migrate outward from the shaft, and the melanin load is at its highest. During the catagen phase, mitosis ceases, the hair matrix regresses, the papilla retracts to a place near the bulge, and capillary nourishment diminishes. In the telogen phase, the follicle detaches from the papillae and contracts to a third of its original depth, eventually falling out. The ratio of anagen / telogen follicles varies with body location. Since not all hairs are in anagen phase at any one time, laser treatment must be repeated to capture new hairs coming into anagen. This is fundamental in understanding the need for repetitive hair-removal sessions to completely destroy hair follicles.

Etiology of excessive hair

Hirsutism is defined as the excessive growth of thick dark (terminal) hair in locations where hair growth in women usually is minimal or absent. Such male-pattern growth of terminal body hair usually occurs in androgen-stimulated locations, such as the face, chest, and areolae. *Hypertrichosis* refers to excess hair (terminal or vellus) in areas that are not predominantly androgen dependent. Whether a patient is hirsute often is difficult to judge because hair growth varies among individual women and across ethnic groups. What is considered hirsutism in one culture may be considered typical in another. For example, women from the Mediterranean and the Indian subcontinent have more facial and body hair than do women from East Asia, sub-Saharan Africa, and northern Europe. Given the subjectiveness of this perception, a scoring scale has been developed in which nine body areas are used to grade hair growth on a scale of 0-4. The scores are added for the nine body parts, and a score of eight or more defines hirsutism.

Hirsutism can be caused by abnormally high androgen levels or by hair follicles that are more sensitive than usual to normal androgen levels. Therefore, increased hair growth often is observed in patients with endocrine disorders characterized by *hyperandrogenism.* The disorders may be caused by abnormalities of the ovaries or adrenal glands. Serum levels of free testosterone, the biologically active androgen that causes hair growth, are regulated by sex hormone–binding globulin (SHBG). Lower levels of SHBG increase the availability of free testosterone. SHBG levels decrease in response to the following: Exogenous androgen administration (anabolic steroids, testosterone), in certain disorders that affect androgen levels like polycystic ovarian syndrome (PCOS, ovarian tumors), congenital or delayed-onset adrenal hyperplasia, Cushing syndrome, obesity, hyperinsulinemia, hyperprolactinemia, increased growth hormone levels. SHBG levels increase with higher estrogen levels, such as the levels that occur during oral contraceptive therapy. The resultant increased SHBG levels lower the activity of circulating testosterone. The *idiopathic* category is probably caused by subtle forms of ovarian or adrenal hypersecretion, alterations in serum androgen-binding proteins or androgen metabolism, or most likely, excessive genetic sensitivity of hair follicles to normal androgen levels.

LABORATORY INVESTIGATIONS

After familial and drug-induced causes for hirsutism have been excluded, hirsutism is considered resulting from androgen excess. The clinical picture should guide the evaluation.

Serum testosterone and DHEA-S levels are estimated. Initial screening for total or free testosterone and DHEA-S often determines if further testing is necessary. Whether total testosterone is a better screening test than free testosterone is controversial. The evaluation of simple hirsutism requires only DHEA-S and testosterone levels. If the level of one is abnormal, further testing may be warranted. Complicated hirsutism or virilism requires additional testing to better define a source of hyperandrogenism. No direct correlation exists between the levels of testosterone and the degree of hirsutism, since hirsutism is caused by the action of dihydrotestosterone, which is the more potent testosterone metabolite. Elevated free serum testosterone levels (>80 ng/dl) are found in most women with anovulation and hirsutism. In most patients in whom the total testosterone level is greater than 200 ng/dl (>100 ng/dl in postmenopausal women), a tumor workup is indicated. This workup includes a pelvic examination and ultrasound, which usually are adequate to diagnose PCOS. If the test results are negative, an adrenal computed tomography scan is performed. Serum DHEA-S determinations are used as a marker of adrenal androgen output, since serum concentrations vary less than do DHEA-S levels with diurnal serum cortisol levels. Moderate elevations suggest an adrenal origin for the hirsutism. Tumor workup is indicated in most patients in whom the DHEA-S level is greater than 700 mg/dl (400 mg/dl in postmenopausal women). An increase of this magnitude usually results from adrenal hyperplasia rather than the extremely rare adrenal carcinomas.

Test for androstenedione: Androstenedione can originate in the adrenal glands or in the ovaries and often is elevated in patients with hyperandrogenism. A serum androstenedione level greater than 100 ng/dl suggests an ovarian or adrenal neoplasm.

Test for luteinizing hormone and follicle-stimulating hormone: Often, in women with PCOS, luteinizing hormone (LH) levels are elevated and follicle-stimulating hormone (FSH) levels are depressed, which results in elevated LH/FSH ratios (>2 is common). Women with late-onset congenital adrenal hyperplasia (CAH) usually have a normal LH/FSH ratio.

Test for 17-hydroxyprogesterone: The screening test for late-onset CAH is measurement of morning 17-hydroxyprogesterone levels. DHEA-S and 17-ketosteroids levels are normal or moderately elevated. Testosterone and precursors of cortisol levels are elevated. Urinary 17-ketosteroids also are elevated slightly in patients with PCOS.

In patients with late-onset CAH, 17-hydroxyprogesterone levels should be less than 200 ng/dl. A 17-hydroxyprogesterone level greater than 800 ng/dl is diagnostic for 21-hydroxylase deficiency, the most common defect associated with late-onset CAH. An intermediate 17-hydroxyprogesterone level (200-800 ng/dl) should also have a dexamethasone suppression test. Women with late-onset CAH usually have normal dexamethasone suppression test results. If a patient is oligomenorrheic, LH, FSH, prolactin, and thyroid-stimulating hormone levels may be useful in the diagnosis.

Perform a 24-hour urinary cortisol or an overnight dexamethasone suppression test if Cushing syndrome is suspected.

Imaging Studies

In patients with suspected PCOS or a possible adrenal or ovarian neoplasm, imaging studies of these organs may be required. Consult an endocrinologist or gynecologist for guidance

Terminology in hair removal

Temporary hair reduction is defined as a delay in hair growth, which usually lasts 1-3 months, consistent with the induction of telogen phase. A *permanent hair reduction* refers to a significant reduction in the number of terminal hairs after a given treatment, which is stable for a period of time longer than the complete growth cycle of hair follicles at the given body site. It has recently been suggested to add another 6 months (i.e. 1 year from date of last sitting) to this post treatment observation time (i.e., the time necessary for a damaged follicle to recover from the laser injury and reenter a normal growth cycle). A distinction needs to be made between permanent and complete hair loss. *Complete hair loss* refers to a lack of regrowing hairs (i.e. a significant reduction in the number of regrowing hairs to zero). Complete hair loss may be either temporary or permanent. Laser treatment usually produces complete but temporary hair loss for 1-3 months, followed by partial but permanent hair loss. Histological observations show damage predominantly in hair follicles with large, pigmented shafts, while hair follicles with small (<25 mm), hypopigmented shafts do not demonstrate any morphological change.

Immediately after laser treatment, the hair shaft shows fragmentation with focal rupture and thermal damage to the surrounding follicular epithelium (fig.10). The extent of thermal damage is dependent on the pulse width but retains confinement on the spatial scale of the follicle itself. One month later, most follicles are in telogen phase while others are being replaced by fibrosis and a foreign body giant cell reaction with phagocytosis of melanin. At one year, most follicles are replaced by miniaturized hair follicles (dominant mechanism), and some are replaced by a fibrotic remnants. Both of these histological findings produce permanent clinical reduction in hair.

Indications and Contraindication

The indication for hair removal is mostly subjective. A desire for hair removal is the only criterion for laser surgery. Relative contraindications are white, gray or blonde hair.

Prelaser Workup

It is essential to differentiate between hypertrichosis and hirsutism. Record a detailed personal and family history (if pertinent) regarding the amount and distribution of excessive hair growth, date of onset, previous treatments, and drug history. Menstrual irregularities, nipple discharge, difficulty in conceiving, scalp hair loss or cystic acne etc. should be reviewed exhaustively. A detailed medical history to exclude photosensitizing disorders, collagen vascular disease, or medications (Accutane, immunosuppression etc.) needs to be recorded. The patient should avoid waxing or plucking the treated area for 4-6 weeks, ideally, prior to laser treatment. Shaving hairs is acceptable. If used earlier, all bleach effect should have weathered off before laser treatment. When treating the bikini area or perioral area a history of herpes simplex infection should be enquired. Still, the patient is administered antiviral medications perioperatively for prophylaxis (eg. acyclovir 400 mg, t.i.d for five days). Patients should avoid sun tanning for at least 4-6 weeks prior to laser hair removal. Check for history of post-inflammatory hyperpigmentation, scarring or keloid formation after any skin injury. One needs to be careful while treating skin darker than Fitzpatrick IV phototype. Obtain a detailed and informed consent. Elements of this consent form should include past laser treatments (if any), availability of alternative treatment options, rationale for treatment, expected results, requirement of multiple treatment sessions, goal of hair reduction (not complete hair removal), potential side effects or complications (crusting, blister formation, burns, dyspigmentation), chances of recurrence in endocrine disorders and the exclusion criteria.

Fig.10 Showing immediate changes in the chin region of a patient treated with long pulse, 1064nm, Nd:YAG(40ms,30J) laser for hair removal. Note the perifollicular edema and popping out hair which is hallmark of adequate fluence and pulse width.

Mechanism of hair removal and chromophores

With earlier lasers at fluences affecting hair follicles the epidermis was severely damaged. The theory of selective photothermolysis has revolutionized laser hair removal and the market has exploded with numerous hair-removing lasers and light sources.

Initial laser systems, such as the Q-switched Nd:YAG (1064 nm, soft light system, Thermolase Corp, California), used a carbon mineral oil suspension to penetrate the hair follicle and act as an energy-absorbing chromophore. An optically filtered xenon flash lamp (Epi Light and ESC Luxar, Energy Systems Corp, Massachusetts) uses filters to select operating wavelengths of light at a cutoff of 690 nm, thus allowing light above this wavelength to pass through to affect hair removal. The long-pulse Ruby laser (694 nm, Epi Laser, Palomar Technologies, Massachusetts and Epi Touch, Sharplan Laser, NJ) uses the principle of selective photothermolysis, in which melanin acts as the target chromophore. The long-pulse Alexandrite laser (755 nm, Photo Genica LPIR, Cynosure Inc, Massachusetts) uses the principle of thermokinetic selectivity to target melanin in the hair follicle. In this way, the epidermis is allowed to cool more efficiently, while the melanin in the hair follicle is heated. Coherent Medical (California) and Palomar (Lexington, Massachusetts) have introduced the Light Sheer, a diode laser operating at 800 nm that has longer pulse durations (up to 30 milliseconds). This technology minimizes laser machine size by eliminating the laser tube in place of a solid-state diode circuitry. Several long-pulsed Nd:YAG lasers, e.g. Fotona (Dualis XP, XP Plus; Slovenia), Laser Scope (Depilase, California), that deliver pulses in the millisecond domain have been approved by the US FDA for hair removal on all skin types. The long pulses (50 milliseconds) are also capable of inducing long-term hair loss, however, high energy is needed to compensate for the lower melanin absorption. One distinct advantage of these systems is their ability to safely treat individuals with dark skin tones.

Hair follicles are destroyed by lasers or by light by three mechanisms; *photo-thermal* (due to local heating), *photo-mechanical* (due to shock waves or violent cavitation), or *photo-chemical* (due to generation of toxic mediators like singlet oxygen or free radicals). Lasers and noncoherent light sources have recently been introduced to induce selective damage to hair follicles based on the principles of selective *photo-thermolysis.* Selective thermal damage of a pigmented target structure will result when sufficient fluence at a wavelength, preferentially absorbed by the target, is delivered during a time equal to or less than the thermal relaxation time of the target. In the visible to near-infrared region, melanin is the natural chromophore for targeting hair follicles. Lasers or light sources that operate in the red or near-infrared wavelength region (694-nm ruby laser, 755-nm alexandrite laser, 800-nm diode laser, 1064-nm Nd:YAG laser, and noncoherent light sources with cut-off filters) all lie in an optical window of the spectrum in which selective absorption by melanin is combined with deep penetration into the dermis. Therefore, deep and selective heating of the hair shaft, the hair follicle epithelium, and the heavily pigmented matrix is possible in the 600-1100nm region. However, melanin in the epidermis presents a competing site for absorption. Selective cooling of the epidermis has been shown to minimize epidermal injury. Cooling can be achieved by various means including ice, a cooled gel layer, a cooled glass chamber or sapphire window, a pulsed cryogen spray, or cooled airflow. Laser pulse width also appears to play an important role as suggested by the thermal transfer theory. Thermal conduction from the melanin-rich shaft and matrix heats surrounding follicular structures. To obtain confinement of thermal damage, the pulse duration should be shorter or equal to the thermal relaxation time of the hair follicle. Thermal relaxation of human terminal hair follicles has never been measured but it is estimated to be approximately 10-100 milliseconds, depending on size. Therefore, devices for hair removal have pulse durations in the millisecond region. The normal mode 694nm ruby, normal mode 755nm alexandrite, 800nm pulsed diode lasers, long-pulsed Nd:YAG lasers (fig.11), and filtered flash lamp technology all use this mechanism. The *concept of thermal damage time* has recently been launched in the case of the hair follicle. The melanin-rich hair shaft and matrix cells occupy a relatively small volume, and propagation of the thermal damage front through the entire volume takes 3-20 times longer than the thermal relaxation time of the hair follicle. Super-long pulse heating (>100 milliseconds) appears to allow for long-term hair removal. *Photo-mechanical* destruction of hair has been attempted with very short nanosecond pulses by Q-switched 1064nm Nd:YAG lasers, with and without carbon suspension,

Fig.11a A 30 year lady with polycystic ovarion disease (PCOD) showing prominent hirsuitism of chin and neck region.

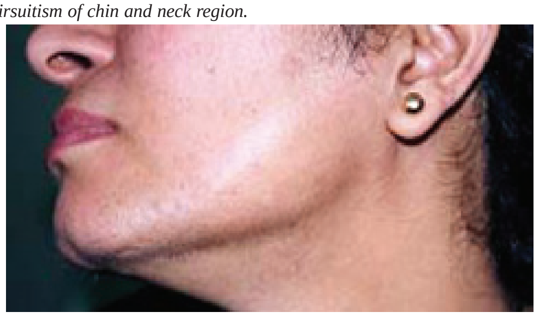

Fig.11b The same patient at six months post treatment after five sittings with long pulse Nd:YAG, 1064nm laser.

however, when these very short pulses are used to target hair follicles, extremely rapid heating of the chromophore (melanin) occurs. This generates photo-acoustic shock waves that cause focal photo-mechanical disruption of the melanocytes but not complete follicular disruption. Therefore, the Q-switched Nd:YAG lasers are not likely to produce long-term hair removal. *Photo-chemical* destruction of hair follicles is the use of light and a photo-sensitizer to produce therapeutic effects.

Hair removal with topical aminolevulinic acid has been reported in a pilot study. Aminolevulinic acid (ALA) is a precursor in porphyrin synthesis and is rapidly and selectively converted to protoporphyrin IX by cells derived from the epidermis and follicular epithelium. Aminolevulinic acid or one of other related drugs is unlikely to prove useful for hair removal.

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IMSA News

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Tamil Nadu Chapter

09-07-06: Dr. R. Thara, "***Over view of Psychiatric Disorders***"
13-08-06: Dr. V. Jayanthi, ***"Portal hypertension"***
10-09-06: Dr. R.Ravikumar, "***Robotic Surgery from concept to reality***"

Delhi Chapter

17-08-06 : Dr. Achal Dhir, "***Good Health & Aging – by Choice and not by Chance***"
: Dr. S.K.Mishra, "***Biological Aspects of Aging***"

Rural CME T.N. Chapter

16-07-06 : Dr. Thiagarajan, " ***Therapuetic Options in common skin conditions***"
: Dr. A. Govindan, "***Recent Developments in Radiology and Imaging***"
20-08-06 : Dr. R.Kandiah, "***Common Opthalmic problems in general practice and current concept***"
: Dr. A. Thiagarajan, "***Therapeutic Options in Common Skin conditions***"

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10-09-06 : Dr. Sheo Kumar Prasad, "***ENT & Genetics***"
: Dr. Dori's Desouza, "***Evolution of Genetics***"
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: Dr. Gopal Prasad Sinha, "***Clinical Application of Genetics***"

IMSACON 2006 at Lahore, Pakistan

Dr. Shaheena Asif, Organising Secretary of the conference has intimated that she has been directed to inform the participants of the conference that they can now apply for visa to Pakistan High Commission in India. As such the persons intending to participate in the conference, may apply for visa to the Pakistan High Commission in India under intimation to IMSA HQ at New Delhi.

IMSACON 2007 at Manipal

IMSA is pleased to inform its Fellows and Members that Annual Conference "IMSACON 2007" will be held at Manipal on 3,4,5 November, 2007. Manipal Academy of Higher Education (MAHE) (Deemed University) will organize the conference. Dr. Ramdas M. Pai, President of the MAHE and Trustee of IMSA will be the Patron.

HONOUR

Dr. R.R. Thukral, Vice President, IMSA, ENT specialist, has been awarded '**Best Worker**' by the Delhi Medical Association (DMA) in its 92nd Foundation Day Function held on 14th August 2006 at New Delhi.
Dr. R. R. Thukral, *Vice President IMSA* has been conferred **"Lifetime Achievement"** Award by ***His Highness Dr. A.P.J. Abdul Kalam, President of India*** on the occasion of "**World Congress on Clinical and Preventive Cardiology**" (WCCPC 2006) organized by Cardiology Society of India, at New Delhi.
Dr. H.K.Chopra, *Secretary General*, IMSA has been conferred **"Lifetime Achievement"** Award by ***His Highness Dr. A.P.J. Abdul Kalam, President of India*** on the occasion of "**World Congress on Clinical and Preventive Cardiology**" (WCCPC 2006) organized by Cardiology Society of India, at New Delhi.

Fellows and Members elected during the quarter July-Sept. 2006

Dr. Vatsla Dadhwal	New Delhi
Dr. (Mrs) Sneh Agarwal	New Delhi
Dr. Satish Sachdeva	Patiala ((Punjab)
Dr. Neeraj Malik	New Delhi
Dr. (Mrs) Ramesh Arora	Noida (UP.)
Dr. Tapan Ghose	New Delhi
Dr. Satish Kumar Sharma	Gurgaon (Haryana)
Dr. Vanita Arora	New Delhi
Dr. Shiv Charan	Amritsar (Punjab)
Dr. Satish Kumar Gupta	Rajasthan
Dr. Satyanarayan Mishra	Annamalai Nagar (T.N.)
Dr. D.P. Manchanda	U.P.
Dr. Anup Mohta	Delhi
Dr. Mamatha Ballal	Manipal (Karnataka)
Dr. Bikash Medhi	Chandigarh.
Dr. Basheer Ahmed	Srinagar (Kashmir)
Dr. Surinder Salwan	Amritsar (Punjab)