

# USE OF INTENSE PULSE LIGHT TECHNOLOGY FOR VARIOUS DERMATOLOGICAL CONDITIONS ON INDIAN SKIN – A DESCRIPTIVE STUDY

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## **CERTIFICATE**

Certified that this dissertation entitled **“Use of intense pulse light technology for various dermatological conditions on Indian skin - a descriptive study”** is a bonafide work done by Dr. Saritha. M, Post graduate student in MD Dermatology, Venereology and Leprosy, Madras Medical College, Chennai-600003, during the academic year 2005 to 2008. This work has not formed the basis for the award of any degree previously.

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# INTRODUCTION

The use of light in the treatment of various dermatological conditions is known to human beings since ancient times. Light was used by Hindu and Greek physicians along with plant extracts in the treatment of Vitiligo. Neils Finsen was awarded the 1903 Nobel Prize in Medicine for establishing the scientific basis of using light to treat skin disease <sup>3</sup>. Since then light therapy has advanced in leaps and bounds with the advent of lasers, photodynamic therapy and phototherapy.

Lasers were first conceived in 1917 through the vision of Albert Einstein, when he hit upon the possibility of stimulated emission of radiation. The world had to wait another ten years for the first laser –the RUBY laser to be built by T.Maiman. Lasers expanded into medicine in the early 1960s with focus on the skin and eye, as they were easily accessible. Lasers have now revolutionized the practice of dermatology, promising innovative treatment for a host of skin conditions including vascular and pigmented birthmarks, tattoos, scars, rhytids and unwanted hair.

Intense Pulsed Light (IPL) technology burst into the scene in the mid 1970s. They were first introduced for the treatment of vascular disorders, but are now popular among both cosmetologists and physicians for the treatment of unwanted hair, pigmented blemishes and more. Unlike lasers, they use broad band non coherent light: Like lasers, they work on the principle of selective

photothermolysis of target chromophores. In spite of their extreme popularity, they do have limitations, which has to be kept in mind .They are not a panacea for all cosmetological skin conditions.

Most studies based on IPL published in the literature stem from the western world and use patients with Caucasian skin types. There are a few reports on Asian skin from the Far East. Unfortunately, there are almost no published studies of IPL done on Indian skin types. Even as the popularity of IPL increases, lack of such vital data is of concern to all.

This study aims to be a preliminary study gauging the effect of these light systems on Indian skin. It aims to ascertain the efficacy, the tolerability and the adverse effects of IPL when used for patients of Indian skin types. We hope to obtain preliminary data, comparing the study results with western data. IPL is becoming extremely popular and widely used in India these days. Hence the knowledge of this data is essential to Indian Dermatologists.



# INTENSE PULSED LIGHT (IPL)

## HISTORY

Intense Pulsed Light is high intensity polychromatic light. Unlike laser systems, these flash lamps work by incoherent light in the wavelength range of 515 – 1200nm. By the use of different filters, a wide range of wavelengths are possible for IPL systems <sup>1</sup>. IPL technology has been available since the 1970s. In 1976, Muhlbauer et al first described the thermocoagulation of capillary hemangiomas and port wine stains by means of polychromatic infrared light <sup>2</sup>. In 1990, Goldman and Eckhouse began developing new high intensity flash lamps for vascular anomalies. IPL systems were thus first developed to thermocoagulate vascular malformations. Though initially treated with caution, now they have been openly welcomed by the public, dermatologists and cosmetologists. They have achieved a high level of popularity as a result of their versatility <sup>3</sup>. In the mid 1990s, the first intense pulsed light sources were marketed to physicians <sup>15</sup>. Now, they are used to treat a variety of skin conditions.

## PHYSICS

Intense Pulsed Light sources are polychromatic, broad band (500 – 1200nm) flash lamps equipped with multiple filters that allow preselected wavelengths to reach the skin, targeting multiple chromatophores. They work on the principle of “Selective photothermolysis” like most new laser systems. They

have been used to treat hirsutism, vascular lesions like telangiectasia and varicose veins, pigmentary disorders like lentigenes & melasma, photoageing, acne vulgaris and rosacea. Advantages of IPL are that they are user friendly, have few adverse effects and have minimal patient down time. On the other hand, multiple treatment sessions are required <sup>3</sup>, which is a drawback to their use.

Traditional IPL systems have used long xenon lamps as light source. At least 4 different types of filters are incorporated into the system. These cut-off filters eliminate short wavelengths, so that only the longer, more deeply penetrating wavelengths are emitted <sup>4</sup>. This is used best in photoepilation and treatment of vascular lesions. A single pulse or multiple pulse mode, with varying pulse and delay intervals can be used. It is capable of fluence upto  $90\text{J}/\text{cm}^2$  and a pulse duration of 2 -100msec. These pulsing options and the range of energy that can be used, have all been incorporated into the machine in the form of software. Thus, the programmed machine offers a range of 15 programmes that can be chosen by the operator, depending on the patients skin type and hair colour, making IPL extremely user friendly.

Recently, newer IPL systems have been developed, that combine the broad band light with 1064nm laser light <sup>4</sup>. These devices allow treatment for a wider spectrum of hair and skin colours. Some systems have incorporated contact cooling. More recently, a combination of bipolar radiofrequency and IPL has been used effectively for hair removal <sup>5</sup>. Cooling is achieved in one of 2 ways;

a thick layer of transparent cooling gel is used to couple the quartz prism to the skin or a cuff of cold water is affixed to the prism cooling both the skin and the prism, thereby protecting the epidermis <sup>6</sup>.

## **THE THEORY OF “SELECTIVE PHOTOTHERMOLYSIS”**

It was introduced in 1983 by Anderson & Parrish <sup>8</sup>. The theory of selective thermolysis refers to laser energy being absorbed by a target chromophore without significant damage to surrounding tissue <sup>8</sup>.

Selective photothermolysis can be achieved by <sup>9</sup>

1. Producing a beam of light with a wavelength that is preferentially absorbed by that chromophore.
2. Keeping the fluence high enough to thermally alter the target
3. By shortening the pulse duration to less than the thermal relaxation time of the chromophore, thereby allowing it no time to cool by conducting heat to surrounding tissues – thus preventing damage to them.

This is particularly useful in hair removal for selectively targeting hair cells in the dermis and sparing the epidermis.

The thermal relaxation time is the time needed for the chromophore to cool to half of its peak temperature after laser irradiation, which is proportional to the size of the chromophore. Smaller objects cool faster than large ones (e.g.

melanosomes of size 0.5 – 1  $\mu\text{m}$  have TRTs of 1 $\mu\text{s}$  whereas capillaries of 10 – 100 $\mu\text{m}$  size have TRTs of 1ms).

### **THE “EXTENDED THEORY OF SELECTIVE PHOTOTHERMOLYSIS”<sup>11</sup>**

This theory distinguishes between an ‘absorber’ chromophore (in which heat is generated) and a ‘target’ located at a distant site, to which heat is transmitted and which gets damaged as a result.

For e.g., in hair removal, melanin in the hair shaft, and matrix cells may act as the absorber, whereas the stem cells of the isthmus (and possibly the blood vessels in the dermal papilla) act as the distant target. The time to achieve selective damage to the target is the thermal damage time (TDT). This is the time required for the entire target, including the primary chromophore and distant target to cool by 63% and it is longer than the TRT.

“Thermokinetic selectivity” has been developed as an outcome of this theory wherein manipulation of the light source is done to selectively damage larger structures as they cool slowly. Therefore, in photoepilation, a pulse is used which is longer than the TDT of melanin containing epidermis (1msec) compared with the melanin containing hair follicle (30 – 100msec). This allows energy to accumulate in and damage the hair follicle, thus protecting the epidermis as it has time to cool.

## **I PULSE TECHNOLOGY**

The conventional IPL systems have a rectangular long treatment head, available in 2 sizes, 8x45mm and 10x45mm. The disadvantages in this are:

1) Difficulty in accessing uneven areas like the axilla. 2) Loss of energy emitted from the lamp by absorption by the sides of the glass block (perimeter loss).

The ipulse system employs a multi-lamp array (patent pending) consisting of 2 short, low voltage lamps that require less energy and less cooling. Also, this allows use of a large (8.9 cm<sup>2</sup>) square treatment head. In this system, none of the light emitted between the 2 lamps is lost and the ratio of the sides to the total treatment head area is far lower than in the conventional IPL system, radically reducing perimeter loss.

## **CONSTANT SPECTRUM**

In conventional IPL system, the current surges through the lamp like a wave, producing a rising, then falling pattern of current. As a result, the spectrum output varies constantly throughout the pulse. At the peak, the spectrum output is inappropriate for treatment and must be filtered out, leading to wastage of energy.

The i pulse system employs circuiting that creates a constant current (“a square pulse”). Throughout the pulse, only the optimum spectrum is produced

without variation. As a result very little energy is wasted leading to a more efficient operation.

Other advantages are:

1. It has a more user – friendly interface
2. Smaller and cheaper unit
3. Lower shot-counts for different anatomical areas

Back            220 pulse

Lower leg      125 pulses

Underarm      8 pulses

Upper lip      4 pulses.

## **IPL IN HAIR REMOVAL**

The removal of unwanted hair is a daily chore and a challenge for men & women all over the world. Traditional techniques for hair removal include shaving, waxing, tweezing, depilatories and electrolysis. Most of these methods have their own unwanted side effects and are temporary. Electrolysis, though permanent, is time consuming and technique dependent.

The search for an ideal method for hair removal that is time efficient, painless and permanent continues. Lasers and pulsed light sources have filled the void to a certain extent.

**Unwanted hair falls into four main categories:** <sup>4</sup>

1. Hypertrichosis :defined as increase in hair growth that is not androgen dependent e.g. phenytoin induced, PCT, malnutrition / anorexia nervosa.
2. Hirsutism :growth of terminal hair in women on androgen dependent areas of the body, the most common cause being PCOD
3. Hair bearing flaps
4. Facial or body hair in excess of the cultural norm.

Intense pulsed light sources work on the principle of selective photothermolysis. The presumed chromophore is melanin, produced by melanocytes in the hair matrix.

Choosing a wavelength that will be maximally absorbed by melanin in the hair follicles, rather than by melanin in the epidermis, will target the hair follicle for destruction and protect the epidermis from pigmentary changes. Longer wavelengths penetrate more deeply into the dermis. Shorter wavelengths appear

to be more effective for blond or red hair. The optimal pulse duration should be more than the TRT of the epidermis, but shorter than that of the hair follicle. Anagen follicles contain melanin; hence are more susceptible to IPL. A mouse model has shown that pigmented, actively growing (anagen) hair follicles were effectively eradicated by selective Photothermolysis, but catagen and telogen stage follicles were resistant to it (probably due to absence of melanocytes) <sup>10</sup>.

Several clinical studies have been done to check the effect of a single application of IPL. Compiled data from these studies show a 52% reduction in hair counts at an average. Treatment of patients with black hair and light skin resulted in a 62% reduction in hair counts. The most common side effect was perifollicular erythema, lasting several hours to days after treatment <sup>10</sup>.

Studies have also suggested that multiple treatments increase the efficacy of pulsed intense light source in hair removal. Hair regrowth of lesser density is seen to occur in some patients though, on longer follow-up. An animal study has revealed that hairs in early anagen phase are most susceptible to light assisted hair removal. But a human study has not shown similar results. Another 3 month prospective study showed that pulse durations longer than 15 ms showed no additional effect on efficacy of hair removal. <sup>10</sup>

### **Patient selection**

The ideal candidate for laser hair removal is a patient with fair skin and dark, coarse hair.



The following questionnaire can be helpful while evaluating patients : <sup>4</sup>

1. Presence of conditions that may cause hypertrichosis :

Hormonal, familial, drugs (corticosteroids, hormones, immuno suppressives, use of minoxidil), ovarian or adrenal tumours & others.

2. History of local or recurrent skin infections
3. H/o herpes labialis.
4. H/o herpes genitalis (important when treating the pubic area).
5. H/o keloids / hypertrophic scarring
6. H/o Koebnerising skin disorders such as vitiligo and psoriasis
7. Previous treatment modalities – method, frequency, date of last treatment, as well as response.
8. Recent suntan or exposure to tanning or light cabinet
9. Onset of hair regrowth
10. Presence of Tattoos or nevi
11. Patients' expectations
12. Patients' hobbies or habits which might interfere with treatment
13. Present medication :

Photosensitising medication

Retinoid intake within the past year.

## **Before treatment**

Patients who seek optimal results should avoid plucking, waxing or electrolysis. Shaving and use of depilatory creams will not interfere with results. Patient is asked to shave the area to be treated a day before treatment, after physician's assessment.

Use of broad spectrum sunscreen is advised; patient is asked to avoid tanning and to practice sun avoidance. Use of prophylactic antiviral such as valacyclovir, acyclovir may be started on the first day of procedure in patients with previous history of herpes simplex or herpes genitalis. Topical anesthetics are usually not needed for the procedure. If needed, topical EMLA can be applied under occlusion at least an hour before treatment.

## **Day of Treatment**

The area is wiped clean of make up. The areas to be treated are marked with a white pencil. A cooled coupling gel is applied to the skin to cool the epidermis. Overlapping of shot areas is avoided. Patients feel a stinging sensation similar to a rubber band striking the skin. If patient develops erythema, cool ice packs can be given to the area after the procedure and if needed, mild topical steroids can be prescribed.

## **After treatment**

Patient is instructed to use sunscreens and not to go swimming or expose himself to sunlight for 2 days. Generally, the average number of treatments required to achieve significant reduction of excess hair is between five and seven treatments, performed at an interval of 1 month. Treatment parameters have to be varied depending on patient's hair colour and skin type. The 695nm cut off filter is generally used to treat medium brown to black hair; lighter hair may be treated with shorter cut off filters. A longer pulse delay (24 – 30 msec) is selected for patients with tanned or darker skin, which allows epidermis to cool between pulses minimizing epidermal blistering or pigmentation. Grey hair is usually unresponsive to treatment.

Light treatment generally produces complete but temporary hair loss for 1 – 3 months, followed by partial but permanent hair loss <sup>4</sup>.

## **Histology**

Skin biopsies taken after treatment with an intense pulsed light source revealed thermal necrosis of the hair follicles. The epidermis was intact; papillary dermis showed some thermal necrosis. One year after treatment, biopsies showed atrophic hair follicles with dystrophic hair shafts and miniaturised "vellus-like" hair follicles.<sup>13</sup>

## **Adverse effects**

The most common adverse effect is erythema seen immediately after treatment. Post inflammatory hyper pigmentation (PIH) is seen in few patients, usually resolving completely in 3 months.

Paradoxical stimulation of hair growth has been reported with IPL in untreated areas and is an area of concern <sup>3</sup>.

## **IPL IN NON ABLATIVE SKIN RESURFACING**

Aging of skin can be due to an extrinsic or intrinsic process <sup>14</sup>. Intrinsic ageing refers to those processes that result purely from the passage of time. These effects are usually visible around the age of 30 – 35, mainly in the non sun-exposed areas of the skin. They include pallor, fine wrinkles, loss of elasticity and sagging of the skin which are due to thinning of the epidermis, hypocellularity of the dermis and a decrease in the number of dermal blood vessels, collagen & elastic tissue.

Extrinsic ageing is due primarily to the effects of environmental ultraviolet radiation. Sun exposure is said to be the single most important factor in extrinsic aging of the skin or photo aging. These changes include fine to coarse wrinkling, laxity, leathery and coarse skin texture progressing to atrophy in severe photo damage, irregular pigmentation, dry scaling, roughness of skin surface, telangiectasia, sallowness, as well as easy bruisability.

Topical retinoids, alpha-hydroxy acids, topical Vitamin E and topical Vitamin C were the agents initially used for photo rejuvenation <sup>15</sup>. Chemical peels, microdermabrasion & dermabrasion were more effective. Then occurred a revolution with the advent of lasers. Initially ablative lasers like CO<sub>2</sub> and Er-YAG were used and are still considered the best by many <sup>16</sup>. Later, non ablative techniques like IPL arrived and have taken over the market by storm.

In skin resurfacing too, IPL system works on the principle of selective photothermolysis. IPL system can be used to simultaneously treat both pigmented and vascular lesions unlike lasers, which target a single chromophore. In the treatment of rhytids the mechanism of action of IPL is thought to be light-induced thermal denaturation of dermal collagen, leading to a reactive cascade of inflammatory mediators and subsequent collagen synthesis. IPL have also been used to treat large pore size <sup>15</sup> and telangiectasia.

The advantage of the IPL system over the more aggressive lasers used for rejuvenation is the decreased frequency of side effects and hence the minimal patient down-time. They are said to be excellent for treatment of lentigenes, telangiectasia, mild rhytids and mild to moderate poikiloderma.

Some of the earlier studies on IPL for facial rejuvenation stressed that it is best done for patients, who are unwilling to undergo prolonged convalescence. It was also found that extensive pigmentary changes did not improve with IPL. Later studies emphasized that by using shorter filters, all signs of photo aging can be improved in a gradual manner. They have demonstrated an increase in

type I & III collagen and elastin in the skin 6 weeks after treatment. A comparison between IPL and 1064nm Nd:YAG laser showed similar modest improvements with both <sup>17</sup>.

Newer innovations with IPL and other technologies are being evaluated every day <sup>15</sup> for e.g. the combination of IPL and bipolar radiofrequency is being studied for the treatment of photo damage as well as for white hair photo epilation. IPL with an 810nm diode laser is being evaluated for the treatment of wrinkles. Also, the application of aminolevulonic acid (ALA) prior to IPL treatment has been found to increase the synthesis of type 1 collagen when compared to IPL alone.

### **Patient selection**

Patient selection for photo rejuvenation is based on an evaluation of the individual's degree of photo damage and aging. Clinically photo damage is classified into 3 types: <sup>15</sup>

- Type 1 – lentigenes, telangiectasia, increased coarseness, symptoms of rosacea.
- Type 2 – rhytids, laxity, dermatochalasis
- Type 3 – Actinic keratoses, non-melanoma skin cancers.

The ideal patient is 35 – 55 years old with moderate signs of photo damage (i.e. upto type 2). IPL is not advisable in patients with deep rhytids, severe laxity and those with dark skin.

Other exclusion criteria:

- Oral retinoids intake – within 6 months
- Ablative resurfacing – within 6 months
- Chemical peels – medium or deep, within 6 months.
- Active skin disease within the treatment area.

In patients with H/o herpes simplex, pretreatment prophylaxis with antiviral drugs should be started.

## **Treatment**

IPL treatment begins with a consultation to define the patient's goals. Patient's expectations should be within reasonable limits. Parameters are decided based on skin type and target tissue. The skin is wiped clean to remove make up or any material that may interfere with or absorb the IPL energy. In most patients, topical anaesthesia is not required. Appropriate eye protection in the form of dark glasses is given to the patient and the operator.

The skin is covered with a layer of pre-cooled coupling gel and the hand piece is placed over this, maintaining uniform contact. The patient experiences a brief sensation of pain and heat when the pulse is fired. When treating the

forehead, care is taken to avoid touching the eyebrow hair and the hand piece has to be placed at least 1mm away from hair bearing areas. In patients with moderate to severe signs of rosacea, low fluences are used to avoid unexpected side effects like intense pain, prolonged erythema and second degree burns.

Treatment endpoints for vascular lesions are edema, erythema, evanescent purpura, intravascular coagulation, and temporary blanching of vessels. Treatment endpoint for pigmented lesions is immediate hyper pigmentation.

Side effects are usually not seen. Patients develop transient erythema which resolves in a few hours. Other effects like purpura, dyschromia, blistering, burns and scaling are extremely rare.

## **IPL FOR VASCULAR LESIONS**

Vascular lesions form one of the most common indications for laser treatment in dermatology.

The target chromophore in the treatment of vascular lesions is oxyhemoglobin. The peaks of oxyhemoglobin absorption are at 18nm, 542nm and 577nm. Initial lasers tried for vascular lesion were the 488nm and 514nm continuous argon laser, the argon pumped tunable dye laser, the copper vapour and the copper bromide laser. Though effective, they had a number of adverse effects like permanent pigmentation, atrophic or hypertrophic scarring, crusting



and blistering. The introduction of the pulsed dye laser in 1989 revolutionized the treatment of vascular lesions. Currently available pulsed dye lasers emit a wavelength of 585 or 595nm with longer pulse durations. Modified PDLs with pulse duration of 1.5 ms have higher fluences with lower peak energies, thereby decreasing adverse effects while enhancing efficacy. Other laser systems currently used to treat vascular lesions are the KTP, diode, alexandrite, and Nd:YAG laser.

A limiting factor of the PDL is the depth of penetration. Histological studies have shown poor coagulation of dermal vessels beyond 1.16 mm in depth after PDL treatment. Longer wavelengths penetrate deeper, but at those wavelengths the absorption by oxyhemoglobin decreases. Hence higher fluences are necessary to compensate for the poor absorption.

### **Advantages of IPL**

Intense pulsed light systems, based on the principle of selective photothermolysis, emit broad band light that is capable of targeting vessels at various depths. IPLs use long wavelengths and high fluences for effective heating of superficial and deep vasculature. By using cut off filters that filter out shorter wavelengths and allowing emission of longer blue green to yellow wavelength, selective damage to cutaneous vessels is achieved. IPLs also have larger spot sizes that permit treatment of vascular lesions over large areas. Also, the longer pulse durations used in IPL lead to more uniform heating and coagulation throughout the vessel <sup>18</sup>.

## **Hemangiomas**

Hemangiomas are the most common vascular anomaly, affecting upto 12% of all children by 1 year of age <sup>18</sup>. Various therapeutic options have been explored for the treatment of hemangiomas like cryosurgery, sclerotherapy, surgical excision, the PDL, KTP laser, Nd:YAG and alexandrite laser.

Hemangiomas that are resistant to other treatment modalities are said to respond to the IPL system. Between 75% to 100% clearance has been reported after one to four treatments. The disadvantages of this system are the greater number of treatment sessions required, higher degree of discomfort during the procedure and potential for adverse effects.

## **Facial telangiectasia**

Telangiectasia can be classified into four types: simple or linear, arborizing, spider or star, punctiform or papular <sup>19</sup>. Red linear and arborizing telangiectasias are often seen on the face, especially on the nose, mid cheeks and chin. They are around 0.1 – 1.0 mm in size. They result from a variety of factors, including genetic predisposition, chronic sun exposure, surgical or physical trauma, hormonal considerations such as corticosteroid use, pregnancy, alcohol & estrogen ingestion.

The treatment of facial telangiectasias and erythema is one of the most common indications for cutaneous laser therapy.

The IPL systems are very effective in the treatment of facial telangiectasia. Good to excellent clearance of facial telangiectasia has been reported after one to ten sessions with the IPL <sup>18</sup>. Between 75% and 100% clearance was achieved in 82% of patients having poikiloderma after three treatments with Photoderm VL <sup>18</sup>.

### **Poikiloderma of civatte**

Poikiloderma of civatte is a variant of telangiectasia having, in addition, the features of atrophy and pigmentary irregularity of upper chest, lateral neck and occasionally the lateral cheeks. It is induced by sun exposure. Poikiloderma is unresponsive to most standard forms of therapy. The argon laser has been used, but can have severe side effects like scarring and hypopigmentation. The pulsed dye laser has been used effectively for treatment of this condition.

IPL is also extremely helpful in the treatment of poikiloderma of civatte. An improvement of 50-75% was seen after an average of 2.8 treatment sessions <sup>18</sup>.

### **Port wine stain**

Port wine stains are congenital vascular malformations composed of superficial collections of ectatic vessels. They grow in size commensurately with the growth of the child. The vessels are located in the papillary and superficial reticular dermis, at a mean depth of 0.46mm.

Post wine stains were initially treated by other laser modalities like the argon laser, CO<sub>2</sub> laser, Nd : YAG laser and copper vapour laser. Later the pulsed dye laser was used and was found to be very effective.

Intense pulsed light systems are said to yield good results. An average of four sessions led to complete clearance of pink lesions. Darker, purple lesions became 70 – 99% light after four sessions<sup>18</sup>. Another retrospective study also showed good and complete clearance in 28 out of 40 port wine stains treated with IPL, with best results for purple port wine stains<sup>34</sup>.

### **Venous malformation**

Venous malformations are low flow vascular lesions that typically present as bluish masses at birth, and increase in size proportionately with the growth of the child. The PDL and KTP laser have been used with modest results for the treatment of this condition.

The IPL system has been found to be useful in the treatment of small venous malformations. In one report, there was 70 – 100% clearance of such lesions after two – eight treatments with fewer treatments being required for smaller lesions. The cut off filters used were 550nm, 570nm & 590nm, depending on the depth of the malformation. The treatments were given in the form of triple pulses with an average fluence of 80J/cm<sup>2</sup><sup>18</sup>.

IPLs are said to yield excellent response in the management of venous lakes, which are varicosities usually resulting from weakening of pre-existing vessel walls <sup>18</sup>.

### **Treatment recommendations**

Preoperative and postoperative care recommendations are the same in the treatment of facial erythema, telangiectasia, vascular malformations and hemangiomas.

Use of topical anaesthesia is discouraged as it can cause local vasoconstriction, skin pallor and lightening of the target chromophore. The most likely range of blood vessel sizes for effective treatment with IPL is 0.1mm and 0.3mm. Very large arborizing blood vessels (> 1mm) or very fine vessels (<0.1mm) do not respond to IPL <sup>20</sup> Patients are advised to avoid sun exposure for 2 weeks before the procedure. Significant pre cooling and post cooling of the skin is necessary.

Purpura is immediately evident in the treatment of vascular malformations and hemangiomas and lasts 7 – 10 days. Mild erythema and swelling lasting for 1 – 2 hours can occur following the treatment of facial telangiectasia or erythema <sup>18</sup>.

Treatment can be repeated every 4 – 6 weeks for facial telangiectasia, facial erythema and vascular malformations. For proliferating hemangiomas, treatment is done every 3 weeks until clinical regression <sup>18</sup>.

## **IPL IN LEG VEINS**

Venulectasia on legs occurs in 29 – 41% of women and 6 – 15% of men in certain parts of the world <sup>21</sup>. Lasers have been used to treat leg veins since 1970s although success was limited, until the advent of the pulsed dye laser in 1980s. In the 1990s the development of lasers with longer wavelengths and longer pulse widths ushered a better and consistent clinical outcome and thus a niche was created for lasers in the treatment of leg veins.

The most common motivation for patients with leg telangiectasia to seek treatment is cosmetic improvement, although 53% of patients have associated symptoms <sup>22</sup>. When large varicose veins are present, the associated telangiectasia cannot be treated without treating the underlying incompetence. Incompetence can be diagnosed by devices like Doppler, duplex ultrasound and plethysmography. After surgical correction of venous incompetence, the telangiectasia can be treated with sclerotherapy or with laser or light based devices. In patients with only isolated telangiectasia without pressure problems, laser / light therapy may be used primarily. Patients should be counseled at the outlet about the possibility of incomplete, partial resolution and side effects like dyspigmentation, ulceration or scarring.

### **Target selection**

Vessels that do not respond to sclerotherapy, or are too small to be injected or that remain after sclerotherapy should be considered for laser and

light treatment. Another indication is telangiectatic matting. Lasers that have been used for leg veins are KTP laser, pulsed dye laser, long pulsed alexandrite laser, diode lasers and the long pulsed Nd : YAG 1064nm laser.

IPLs can be used effectively to treat leg veins. Multiple filters are available in the IPL, ranging from 560 – 755nm. The filters most useful for vascular lesions are 550 and 570nm filters that deliver primarily the yellow and red wavelengths with some infrared. The broad band light of the IPL takes advantage of the dynamic optical properties of hemoglobin<sup>21</sup>. As the size increases from 0.1 to 1mm, and the depth increase from 0.3 – 1mm, the peak absorption of hemoglobin shifts from 600 to approximately 900nm. Hence, the broadband IPL with wavelength ranging from 500 – 1200nm makes it possible to target the smaller superficial vessels and the larger deeper vessels simultaneously. Another advantage of IPL is the larger spot size that facilitates rapid treatment.

Initial studies have shown clearance of 90% in vessels less than 0.2mm, 80% in vessels of size 0.2 – 0.5mm and 80% in vessels 0.5 – 1.0mm in diameter<sup>21</sup>. Adverse effects are few, with transient dyspigmentation occurring in up to 3% of patients. The study used separate parameters depending on the size of the vessels. Another protocol combined the long and short pulses in a single treatment, using the versatility of the IPL system. The shorter pulse targeted the smaller vessels while the longer pulse targeted the underlying larger vessels. This protocol has allowed 74% clearance in 2 treatments with 8% incidence of dyspigmentation<sup>21</sup>. Another study reported 50% clearance in 94% of completed

cases after 1 to 5 treatments at 2 to 4 week intervals. The risk of hyperpigmentation and scarring was lower than with other treatments and the pigimentary alteration that did occur resolved within 1 – 3 months<sup>19</sup>. New contact epidermal cooling devices also improve treatment results by allowing higher fluences with less risk to the epidermis<sup>22</sup>.

## **IPL IN ACNE VULGARIS**

Considered the most common skin disorder, acne vulgaris can be a challenging condition to treat. Acne vulgaris accounts for 30% of patient visits to dermatologists<sup>23</sup>. As the problem of acne is not confined to skin alone, but also affects the psyche in the form of social phobia, lowered self-image and depression, there is always a pressing need for therapies that are effective, non invasive, cost efficient and convenient.

Acne is a common, multifactorial, inflammatory disorder of the pilosebaceous follicle. There are 4 factors that are important in the pathogenesis of acne namely:

1. Greater sebum production
2. Follicular hyperkeratinization / hypercornification
3. P. acnes colonization
4. Perifollicular inflammation.



There are treatments galore used in the present day, for the treatment of acne. They range from topical antimicrobial creams, and benzoyl peroxide to systemic retinoids, antibiotics and dapsons. Widespread resistance to antibiotics compounds the problem in acne management. Other therapies also have various side effects like skin irritation, mucositis and teratogenicity (retinoids). Also, these treatments require prolonged therapy for 6 – 8 months with high patient compliance. Often multiple drugs have to be combined, raising safety issues for the patient.

The combination of antibiotic resistance, the adverse effects of topical and systemic anti-acne medication and the desire for 'high tech' approaches have all lead to new enthusiasm for light based acne treatments.

Sunlight has always played a beneficial role in many patients with acne. Hence the interactions of light and acne were studied in more detail. It was found that *Propionibacterium acnes*, the primary organism implicated in acne, produces endogenous chromophores called porphyrins, primarily protoporphyrin IX (Pp IX) and coproporphyrin III in the course of its normal metabolism. When porphyrins are excited by light absorption, they form singlet oxygen radicals and other reactive molecules that destroy the organism.

Porphyrins show greatest absorption to light wavelengths more than 400nm, with the highest absorption peak (soret band) occurring at the blue light of 415nm. Additional, weaker absorption bands occur at longer wavelengths between 450 and 700nm. Therefore, violet and blue lights should theoretically

be the most effective visible lights to photo activate P.acnes. However these shorter wavelengths do not penetrate well into the skin. Red light, with its longer wavelength, is less effective at activating the endogenous porphyrins, but it can penetrate deeper into the skin. It is also thought to have anti-inflammatory properties by mediating cytokine release from macrophages. Ultraviolet light, on the other hand, has only a minimal effect on acne.

Elman and Libzelter described four factors that influence the photo inactivation of P. acnes: the concentration of endogenous porphyrins, the concentration and wavelengths of photons released and the temperature of the environment when the reaction occurs<sup>23</sup>. Current laser and light therapies target some of these factors, though they cannot affect all four.

The lasers that have been used in acne treatment with moderate to good results are

- 532nm potassium titanyl phosphate laser
- 585nm PDL
- 1450nm diode laser
- 1540nm Er: Glass laser.

In addition, photodynamic therapy with topical 5-aminolevulonic acid and indocyanine green along with the diode / pulsed excimer laser and 803nm diode laser respectively has been tried successfully, with significant reduction of inflammatory lesions and successful remission<sup>23</sup>. Therefore, lasers, though they

rarely achieve complete acne clearance, have a significant therapeutic effect on acne.

Four broad approaches are used in the electromagnetic wave based treatment of acne, as seen below:<sup>24</sup>

1. Pure photochemical – UV, visible light
2. Combined approaches – possible synergy between photothermal and photochemical mechanisms.
3. Photosensitizer assisted photochemical and / or photothermal approaches-- ALA with light, Indocyanine green dye with light.
4. Pure photothermal approaches – mid infrared lasers.

Intense pulsed light systems used in the treatment of acne employ the second approach – they mediate a slight temperature elevation as well as a possible photodynamic therapy mediated antibacterial effect<sup>24</sup>.

IPLs have been used in two scenarios in acne treatment. The first uses high settings that are normally used for rosacea and photorejuvenation. Published studies of IPL with high fluences have shown a reduction in redness and acneform papules. They achieve this effect with or without ALA. Two potential mechanisms might be operative at these settings namely:

1. Temperature elevation in the hyperemic acne lesions as well as the dermoepidermal junction.

## 2. Photo activation and singlet O<sub>2</sub> creation with killing of P. acnes.

The second scenario uses lower settings. IPL systems with considerable violet / blue and or green / yellow light spectra are used. In a split face study comprising four weekly treatments, patients were randomised into green yellow light and 'violet light' groups. Both groups showed 85% inflammatory lesion reduction composed to 30% reduction in control sides. However remission did not last long. However in another study using the same device with both violet and green yellow light, the authors achieved remission of upto 6 months duration.

Another flash lamp device using green yellow light and a heat pulse to reduce inflammation showed 50% reduction in inflamed lesions in a study of 50 patients.

It is said that Demodex can be selectively coagulated using the IPL, most probably through light mediated heating of the melanized chitinous exoskeleton. This might also contribute to the success of IPL treatments<sup>24</sup>.

### **Treatment guidelines**

The ideal patient is one who might achieve 40 – 50% improvement with non oral medical therapy. Patients must understand that the likelihood of complete acne resolution with any light based technology is small. Overall, small papules and pustules seem to respond best to light. Comedones and cysts respond poorly<sup>24</sup>. Patients are advised to avoid sun exposure prior to treatment.

They respond best if primed before and during therapy with various topical antibiotics and cleansers<sup>23</sup>.

## **IPL IN TATTOOS**

IPLs are not very useful in tattoo removal. Tattoos treated with intense pulsed light devices using millisecond duration pulses result in excessive scarring while leaving much of the tattoo behind<sup>25</sup>.

## **IPL IN PIGMENTED LESIONS**

Benign pigmented lesions like lentigenes, nevi of ota and Ito and café au lait macules (CALMs) can be treated with laser efficiently. The efficacy of light based therapy on other benign melanoses like melasma and nevocellular nevi is not yet firmly established. Lasers presently used for pigmented lesions are the Q – switched 532nm Nd: YAG laser & the Q – switched ruby laser.

Intense pulsed light systems can be effective but less predictable than the Q-switched laser due to the wide range of wavelengths being used in the treatment of lentigenes<sup>26</sup>. Lentigenes immediately after treatment turn a slightly dark chocolate brown colour and then peel off in 7 – 10 days.

A study on 60 patients with facial lentigenes who were treated 3 – 5 times with an IPL source showed that 48% of patients had more than 50%

improvement and 20% had more than 75% improvement. Ephelides responded slightly better than lentigenes in this study <sup>26</sup>. Another study conducted on 18 patients with lentigenes who were treated with a single sitting of IPL revealed an average lentigo clearance of 74% <sup>26</sup>.

In the treatment of melasma, a study of 20 patients treated with 2 – 4 sittings of IPL, a clearance of 76 – 100% was seen in superficial melasma, a fair clearance of 80% was seen in deep pigmented lesions and PIH was seen in patients with mixed melasma <sup>29</sup>. Another study on 33 patients with refractory melasma concluded that this modality is safe and efficient for refractory melasma, though additional sittings were required to maintain results.

### **Treatment Guidelines**

Establishing the correct diagnosis of the benign pigmented lesion is necessary prior to starting treatment. If needed, a biopsy can be done from the lesions, especially if melanoma or any other malignancy is part of the differential diagnosis. Lentigenes usually resolve completely in one to three treatments. However CALMs, post inflammatory hyperpigmentation and nevi of ota and Ito may require multiple treatments, as many as 5 – 10 in numbers. Patients may develop lentigenes later even after complete resolution with treatment due to repeated sun exposure.

It is advisable to perform test spots in all patients prior to treating an entire lesion to determine the exact fluence needed. Test spots should be evaluated after 6 – 8 wks. It is important to ensure that the patient is not tanned. Patient must be instructed to strictly avoid sun exposure. History of taking oral retinoids in the previous 12 months must be asked and light based therapy should not be performed in such patients. Oral antiviral prophylaxis should be given for patients with history of herpes simplex.

Topical anaesthesia is not required, especially in the treatment of lentigenes. As the light from IPL can damage the eye, eye protection in the form of optically coated glasses or goggles is required for both the operator and the patient. IPLs do not produce an immediate visible effect on treatment. Only erythema is seen postoperatively and dressings are not required. Treatments are repeated 6 – 8 weeks apart.

Possible side effects are pigmentary alterations that are usually temporary and can be treated with topical bleaching agents and rarely thermal injury which can be treated with emollients and mild steroids.

## **IPL IN PHOTODYNAMIC THERAPY**

Photodynamic therapy has evolved since its inception at the beginning of the 20<sup>th</sup> century, when it was first defined as an oxygen dependent reaction between a photosensitizing dye and light. The concept of photochemotherapy

originated in ancient Egypt, India and Greece for the treatment of vitiligo and psoriasis. The inception of modern photodynamic therapy is credited to a German medical student in 1900.

Initially, topical ALA was used in combination with red light, laser in the red and blue range, and with blue light, which however bore the disadvantages of discomfort, erythema and localized phototoxic reactions. The combination of alternative light sources, especially, the long pulsed dye laser and intense pulsed light with topical ALA has achieved the advantages of enhanced efficacy and rapid treatment and recovery, while diminishing unwanted side effects.

The use of the intense pulsed light (IPL) for PDT is logical as it spans a broad spectrum of wavelengths, therapy exciting PpIX on many of its successive peaks of absorption. The combination with ALA has expanded its application to include actinic keratoses, photo damage and most recently, acne; the advantage being its versatility and disadvantage the variable response.

### **Actinic keratoses**

The term 'photodynamic photorejuvenation' has been applied to the use of IPL in the treatment of actinic keratoses and photo damage. One study of 17 patients treated with two ALA – IPL treatments for actinic keratoses showed a clearance rate of 87% till 3 months of follow up. Crusting was seen though, which resolved in a week. A retrospective study reported 68% clearance of actinic keratoses after one treatment <sup>27</sup>. In another study, topical 5-fluorouracil



was given for 1 week, followed by topical ALA for a 45 minute incubation and IPL. The result was 90% clearance of AKs at one year follow up. Another study showed 50% clearance clinically and 42% histological clearance. The variable results have been attributed to varying incubation times and different IPL devices used.

### **Photorejuvenation**

IPL also rejuvenates the skin, independent of ALA. But various split-face studies have been performed comparing the use of IPL alone to IPL used in combination with topical 5 – ALA for photorejuvenation <sup>36</sup>. Most studies have shown marked improvement of the ALA treated side, especially a decrease in erythema, dyspigmentation and to a lesser extent, fine rhytides.. 50% improvement in telangiectasiae and texture was seen after a single treatment. <sup>27</sup> Side effects like crusting were observed, though, in some trials. Overall, IPL with ALA therapy holds promise in the field of photorejuvenation. Preliminary studies have shown good results with short contact ALA & IPL too <sup>30</sup>.

### **Acne**

The use of photodynamic therapy in the treatment of moderate – severe acne has been studied recently. A study has shown around 70% clearance of lesions. Treatments were weekly administered, were well tolerated with no recurrence in the follow up period. Early studies suggest that IPL – mediated

PDT with short incubation (15 – 30min) topical ALA may be an effective, well tolerated treatment of acne; however large studies are required <sup>27</sup>.

## **PROBLEMS IN ETHNIC SKIN**

- Dark skinned patients have a significantly higher epidermal melanin content, which acts as a competing chromophore during photoepilation etc.
- Higher fluences may be required to produce a desired cosmetic effect.
- Photoaging changes tend to be more pigmentary with less wrinkling. A Korean study showed pigmentary changes to be more common; with seborrheic keratoses being the most common in men; and lentigenes being the most common in women.
- Certain conditions are more common in Asians while being rare among Caucasians.
- Post inflammatory hyperpigmentation(PIH) as a complication is more common in dark skinned people.

Non ablative skin rejuvenation using IPL is the first line treatment for photorejuvenation in patients with ethnic skin because other procedures have higher risk of post inflammatory hyperpigmentation. On the other hand, IPL is

not a first choice in the treatment of vascular lesions in dark skinned patients. Higher epidermal melanin content in the skin increases the risk of complication with IPL. For hair removal with IPL, more number of treatment sessions are required in dark skinned patients; though results have been good in some studies<sup>5</sup>. Larger studies are therefore required.

Significant degree of improvement in telangiectasia has been shown in studies done on ethnic skin, with optimal cooling parameters and techniques playing a crucial role in efficacy<sup>5</sup>. Radiofrequency with IPL has been tried with good result in some patients.

A study on Asian patients with melasma using IPL showed an effective response. However repigmentation occurred indicating maintenance therapy may be necessary<sup>32</sup>. IPL has also been effectively used on Asian skin for lentigenes with low risk of PIH<sup>33</sup>

In all dark skinned patients, presence of a sun tan is a contraindication to IPL treatment. They should be advised use of physical sunscreens for at least 2 weeks before the procedure. The use of topical bleaching agents like hydroquinone, AHA, kojic acid and azelaic acid before and after the procedure is important. In conclusion; IPL sources are quite effective in dark skinned patients, when performed with adequate cooling and skin preparation.

## **INDICATIONS FOR IPL USE**

- 1) Permanent Hair growth reduction
- 2) Active Acne (moderate to severe)
- 3) Photorejuvenation
- 4) Epidermal pigmented lesions
  - cafe au lait macules
  - Lentigenes
  - Ephelides
  - Melasma
  - Becker's nevus
  - Some dermal lesions; nevus of ota and Ito
- 5) Vascular lesions
  - Telangiectasia
  - Leg veins
  - Acne rosacea
  - Poikiloderma of civatte
  - Hemangiomas
  - Port wine stains.

## **CONTRAINDICATIONS**

- Tanned skin
- Pregnancy
- History of keloid scarring
- History of photosensitivity or consuming any medication that may induce photosensitivity in the skin
- History of skin cancer
- History of poor wound healing including type 1 DM
- Any inflammatory skin condition at the treatment site
- Treatment over certain areas like tattoos, moles, make-up, vermillion border of lip or mucous membranes
- Vitiligo

## **POTENTIAL SIDE EFFECTS AND MANAGEMENT**

### **1) Excessive pain**

Treatment is to be stopped. Cooling with ice packs is given and emollients applied. The patient is reviewed after 24 hours and treatment may be repeated. Likely causes for increased pain are high fluence, tanned skin, stress, menstruation and tiredness.

## **2) Persistent heat and erythema**

Cooling with ice packs is given. Topical emollients and mild topical steroid application is advised for 2 – 3 days. This usually resolves spontaneously in 24 hours.

## **3) Edema of Treatment area**

It resolves spontaneously in a few hours.

## **4) Blistering or crust formation**

The area is cooled with ice packs. Topical emollients & mild topical steroids are prescribed.

## **5) Transient hyperpigmentation**

It resolves spontaneously in a few days. Topical bleaching agents may be given after few days. Patient is advised use of sunscreens. A mild glycolic acid peel can be done if necessary 6 – 8 weeks after treatment.

## **6) Transient hypopigmentation**

Patient is advised the use of sunscreens and emollients.

## **7) Purpura after treatment of vascular lesions.**

It resolves spontaneously.

## **8) Rare Reports after IPL hair removal**

- Paradoxical growth of hair in untreated areas<sup>3</sup>.

- Virus inoculation leading to molluscum contagiosum in treated areas<sup>35</sup>.

## **Treatment programs**

The present IPL systems have pre programmed software with various choices of pulse settings that have been formulated taking into account patients' skin type and clinical condition. These are the programs in the IFL i 200 used in this study.

### **Hair removal**

For lighter skin types (Fitzpatrick 1 – 3) single pulse of 25 – 35 msec (program 4 – 6) with energy ranges of 10 – 14 J/cm<sup>2</sup> have proven to be effective in clinical data. In dark skin types (Fitzpatrick 4, 5) multiple pulses (programs 10, 12, 15) with fluence of 10 – 15J/ cm<sup>2</sup> is advised.

### **Pigmented Blemishes**

For lighter skin types (Fitzpatrick 1 – 3) single pulses (program 2 to 5) with energy of 10 – 15 J/cm<sup>2</sup> is advised. For dark skin (Fitzpatrick types 3 to 5), multiple pulses (programs 10, 11, 12, 15) with treatment energy 12 – 15 J / cm<sup>2</sup> is used.

### **Vascular blemishes**

In light skin (type 1 to 3) single pulse (programs 5 – 8) with treatment energy of 10 – 15 J / cm<sup>2</sup> is advised. For small vessels, program 5 is advised and for larger vessels program 8 is advised.

### **Treatment Parameters**

The typical treatment parameters for various indications vary according to the system used in the treatment.



## **AIMS OF THE STUDY**

- To study the effect of broad band intense pulse light source for various dermatological indications.
- To study the efficacy of the intense pulsed light in patients with dark skin types (Fitzpatrick 3 – 5)
- To study the incidence of side effects in dark skinned patients following the IPL treatment procedure.

## **MATERIALS AND METHODS**

This descriptive study was conducted in the Department of Dermatology, Government General Hospital, Chennai during the period of January 2006 to May 2007. A total of 35 patients were enrolled during the study period.

### **INCLUSION CRITERIA**

All patients satisfying at least one of the following criteria were included in the study.

- (1) Patients with moderate to severe acne who are on regular treatment.
- (2) Patients with hypertrichosis / Hirsutism with
  - a. No underlying hormonal pathology
  - b. Regular treatment for underlying diseases which are under control.
- (3) Patients with superficial (brown – black) pigmented lesion like lentigenes, melasma etc with no significant sun exposure (house wives, students etc).
- (4) Patients with vascular lesions like port wine stain, hemangiomas in patients over 18 years of age.

## **EXCLUSION CRITERIA**

- (1) Tanned skin
- (2) Pregnancy
- (3) Age less than 18 years
- (4) Lesions over mucosal areas like lips and over tattoos
- (5) History of keloids / hypertrophic scars
- (6) History of having used systemic retinoids or other photosensitive drugs  
12 months before the procedure
- (7) History of skin cancer
- (8) History of vitiligo / inflammatory skin condition
- (9) Diabetes mellitus
- (10) For patients undergoing treatment for Hair removal:
  - Patients who have bleached / plucked hair 2 weeks before procedure
  - Uncontrolled hormonal pathology.

## **TREATMENT PROTOCOL**

A proforma of relevant questions in history, general examination and dermatological examination was made at the outset which was used in the evaluation of the patients selected for the study.

In the initial consultation, this proforma was completed. Treatment expectations were formulated in discussion with the patient. The following points were explained to the patients.

- 1) How the treatment works.
- 2) The potential for adverse effects and care to be taken to avoid them.
- 3) The length of time before results are noticed.
- 4) Post treatment care.

Written consent was obtained from each patient after giving them the above information. History of prior herpes simplex was asked and if present antiviral prophylaxis with T. acyclovir was started.

Patients were advised to avoid sun exposure from 2 weeks prior to the date of treatment and physical sunscreens were prescribed after the procedure. In some patients (darker skinned) topical azaleic acid was advised prior to procedure for 2 weeks. Patients with acne were advised a daily routine using topical cleansers and antibiotics.

All the patients were asked to grade their satisfaction levels after the procedure as not satisfied, satisfied and very satisfied. Photographic documentation of response was done periodically.

## **Hair removal**

Patients were instructed to shave the hair over the treatment site the day before the procedure. The area to be treated was marked with white marking pencil. A one cm square area grid on the treatment site was used to count hairs at baseline and at subsequent intervals (0, 4, 8, 12, 20 weeks). Pre cooling with ice packs and cooled gel was done. Treatment parameters were program 15 and fluence starting from 10J, slowly increased in each sitting by 0.5 J. Treatment was given for 3 – 6 sittings at a gap of 4 weeks depending on the severity of hair growth. Digital photographs were taken before each treatment session prior to shaving the site. Based on the photographs, improvement was graded. Hair removal efficiency (HRE) was calculated as a percentage of the number of hairs present at each visit compared with baseline count and was graded as mild (0-25%), moderate (26-50%), good (51 – 75%) and excellent (76-100%).

## **Acne**

After cooling as described above, treatment was given with program 12 and fluence starting from 9J upto 13J. At every visit, lesion count (No. of comedones, papules and pustules) was taken. Percentage reduction in the number of lesions was calculated at each visit and graded as mild (0-25%), moderate (26-50%), good (51 – 75%) and excellent (76-100%). Digital photographs were taken before each treatment session and based on the

photographs, improvement was graded. Patients were given emollients for 2 days post – procedure and asked to resume topical antibiotics after 2 days.

### **Pigmented lesions**

Similar cooling and mapping procedures were employed. Strict sun avoidance was advised. Treatment parameters were program 15 and fluence of 10 – 15 J. End point was darkening of treated area. Digital photographs were taken before each treatment session and based on the photographs, improvement was graded. Patients were advised emollients for 2 days and to resume topical bleaching agents after 2 days.

### **Vascular lesions**

Maximum cooling was given to the treatment area. Program 15 and fluence 10 – 14 J was used.. Digital photographs were taken before each treatment session and based on the photographs, improvement was graded.

. Ice packs were used for pre procedure cooling and post procedure cooling. Transparent cooled gel was also used for this purpose. Goggles prescribed by the manufacturer were used for eye protection for the patient and physician. Physical sunscreens and emollients were applied on the treated area immediately after the procedure.

## OBSERVATIONS

A total of 35 patients were included in the study. 12 patients took treatment for hair removal, 10 for active acne vulgaris, 11 for various pigmentary lesions and 2 patients for vascular lesions. Of the above, 4 patients dropped out of treatment after a single session.

The age distribution of the patients was as follows:

**Table 1: Age distribution of patients.**

INDICATION	AGE (years)			TOTAL
	15-25	25-35	35-45	
Acne	7	3	-	10
Hair removal	6	4	2	12
Pigmentation	2	7	2	11
Vascular	2	-	--	2
<b>TOTAL</b>	17	14	4	35

Most of the patients were less than 35 years as is expected because patients having acne and hirsutism were predominantly in the 15- 25 age group.

The sex distribution of patients is as follows. A female predominance was noted.

**Table 2: Sex distribution of patients.**

	<b>MALE</b>	<b>FEMALE</b>	<b>TOTAL</b>
<b>INDICATION</b>			
<b>Acne</b>	7	3	10
<b>Hair removal</b>	-	12	12
<b>Pigmentation</b>	7	4	11
<b>Vascular</b>	2	-	2
<b>TOTAL</b>	16	19	35

Most patients involved in our study were employed in occupations that did not involve sun exposure, or were home makers. This was significant as sun exposure is said to increase the incidence of adverse effects.

**Table 3: Occupations of study patients.**

<b>INDICATION</b>	<b>OCCUPATION</b>			
	<b>Student</b>	<b>House wife</b>	<b>Professional</b>	<b>Others</b>
<b>Acne</b>	8	1	1	-
<b>Hair removal</b>	8	2	2	-
<b>Pigmentation</b>	2	2	6	1
<b>Vascular</b>	1	-	-	1
<b>TOTAL</b>	19	5	9	2



The number of treatment sessions done varied according to the indications and the compliance of the patient. The mean number of treatment sessions were as follows:

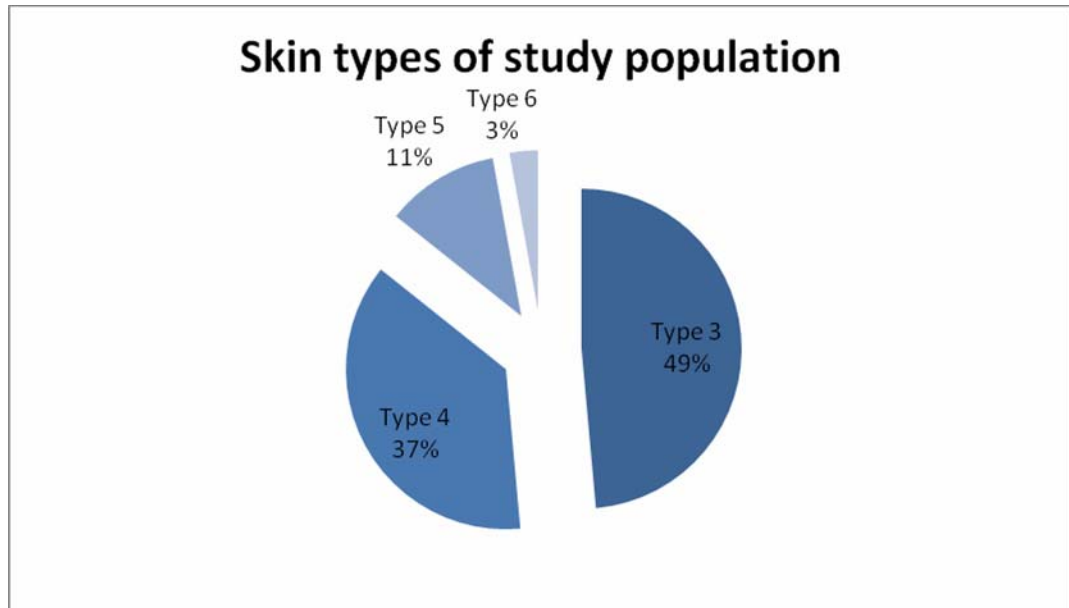
**Table 4: Treatment sessions of study patients.**

INDICATION	No. of SITTINGS						Mean
	1	2	3	4	5	6	
Acne	2	-	2	4	2	-	3.4
Hair removal	1	3	2	4	1	-	3.3
Pigmentation	-	4	4	2	-	2	3.3
Vascular	1	1	-	-	-	-	1.5

Darker skinned patients or those with recent tanning were excluded from the study. Hence most patients had Fitzpatrick skin type 3 or 4.

**Table 5 Skin types of study patients.**

INDICATION	SKIN TYPES			
	Type 3	Type 4	Type 5	Type 6
Acne	5	4	1	-
Hair removal	7	4	1	-
Pigmentation	5	4	1	1
Vascular	-	1	1	-
<b>TOTAL</b>	17	13	4	1



The response of the patients to IPL treatments for each indication was separately assessed and graded and inputs on patient satisfaction with the treatment were also graded for each indication.

## HAIR REMOVAL

Hair removal using IPL was done for 12 patients. 2 patients had PCOD, for which they were on regular treatment. The patients sought treatment for excessive hair growth on face including upper lip, chin and neck.

**Table 6** Sites of Excessive hair growth in the study group

<b>SITE</b>	<b>No. of patients</b>
<b>Cheek, chin, neck and Upper lip</b>	2
<b>Upper lip</b>	6
<b>Chin and Upper lip</b>	4

In our study, 83% of patients had good results and a similar percentage of patients were satisfied with the treatment results. Of this, 75% of patients had excellent results. Results did not vary depending on the treatment site. Also, there was no relationship between results and skin type or hair colour because most of the study patients had skin type of either type 3/4 and all had dark coloured hair. No adverse effects were seen.

**Table 7: Break up of treatment sessions in patients who had excellent response (n=9)**

<b>No. OF SESSIONS</b>	<b>NUMBER OF PATIENTS WITH EXCELLENT RESPONSE (n=9)</b>	<b>PERCENTAGE</b>
2	3	33.3
3	4	44.4
4	2	22.2

Most patients who responded excellently had either 3 or 2 treatment sessions. On average, 2.9 sessions were needed for excellent response.

**Table 8: Patient satisfaction for hair removal.**

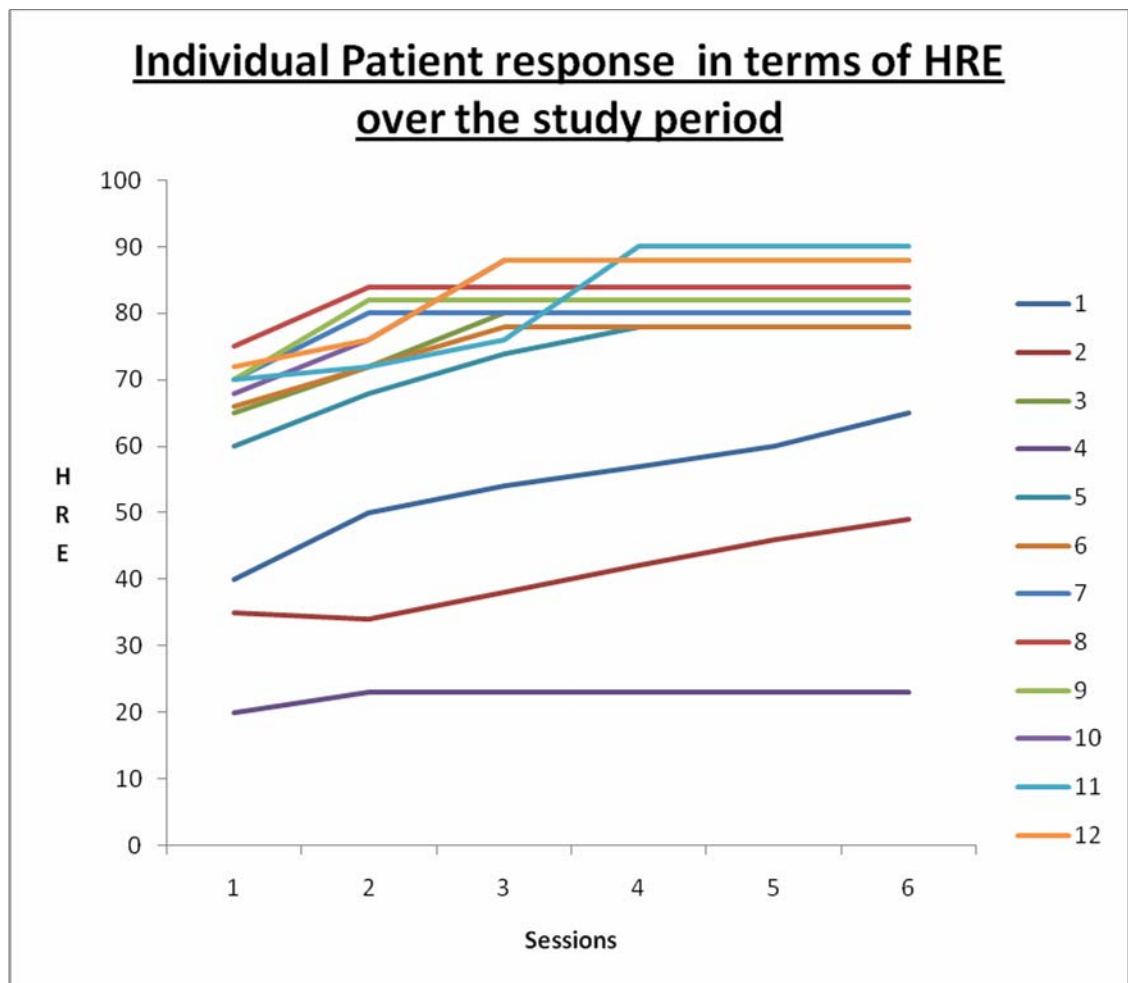
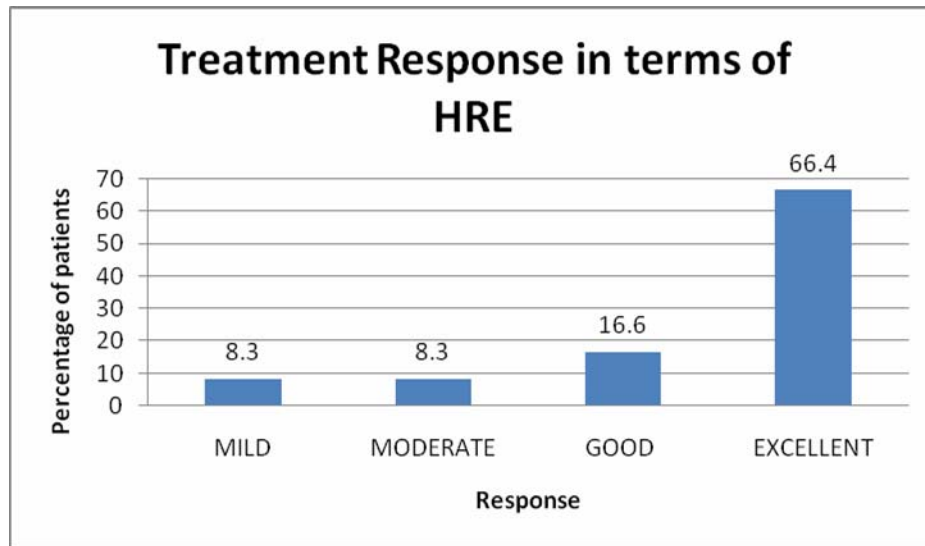
<b>SATISFACTION LEVELS</b>	<b>No. OF PATIENTS (n=12)</b>	<b>PERCENTAGE</b>
<b>Not satisfied</b>	2	16.6
<b>Satisfied</b>	-	-
<b>Very satisfied</b>	10	83

Of the two patients who were dissatisfied with the procedure, one patient had PCOD and the other middle aged patient had some admixed grey hair.



**Table 9: Hair Removal Efficiency (HRE) in the study population**

HRE	0-25%	26-50%	51-75%	76-100%
<b>GRADE</b>	<b>Mild</b>	<b>Moderate</b>	<b>Good</b>	<b>Excellent</b>
<b>NO. OF PATIENTS (n=12)</b>	1	1	2	8
<b>PERCENTAGE</b>	8.3	8.3	16.6	66.4



The Hair Removal Efficiency (HRE) was similar to the assessment based on digital photographs. Excellent HRE was noted in 66% of patients.

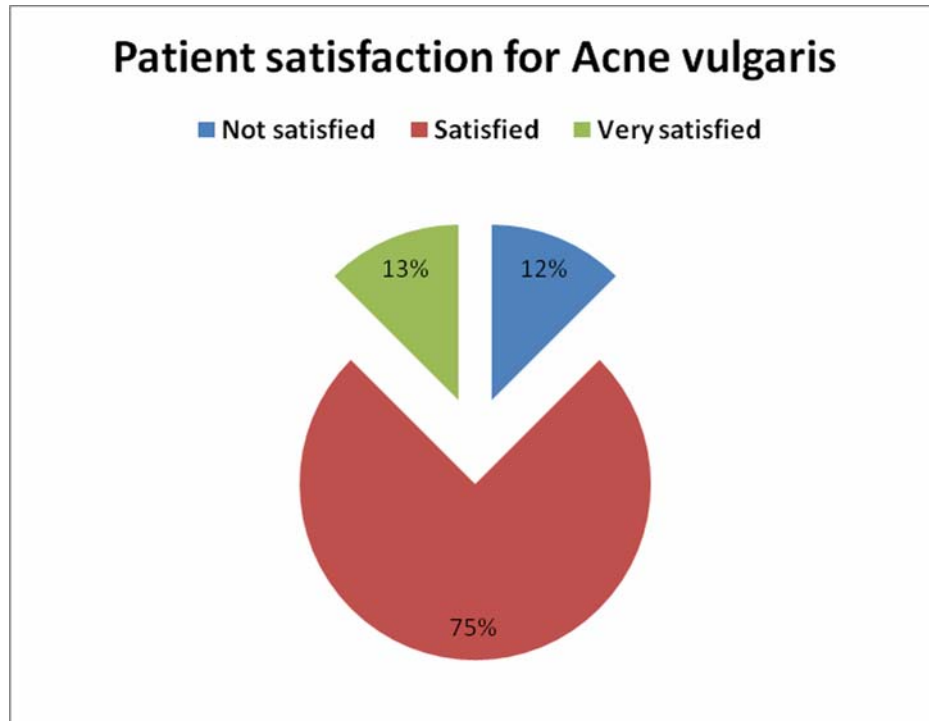
### **ACNE VULGARIS:**

Treatment for acne vulgaris was done for a total of 10 patients. 75% of patients had good results; the others had moderate results. Overall, 87.5% patients were satisfied with the treatment procedure. 2 patients dropped out of the study after a single sitting.

**Table 10: Patient satisfaction for Acne vulgaris**

<b>SATISFACTION LEVELS</b>	<b>No. OF PATIENTS(n=8)</b>	<b>PERCENTAGE</b>
<b>Not satisfied</b>	1	12.5
<b>Satisfied</b>	6	75
<b>Very satisfied</b>	1	12.5

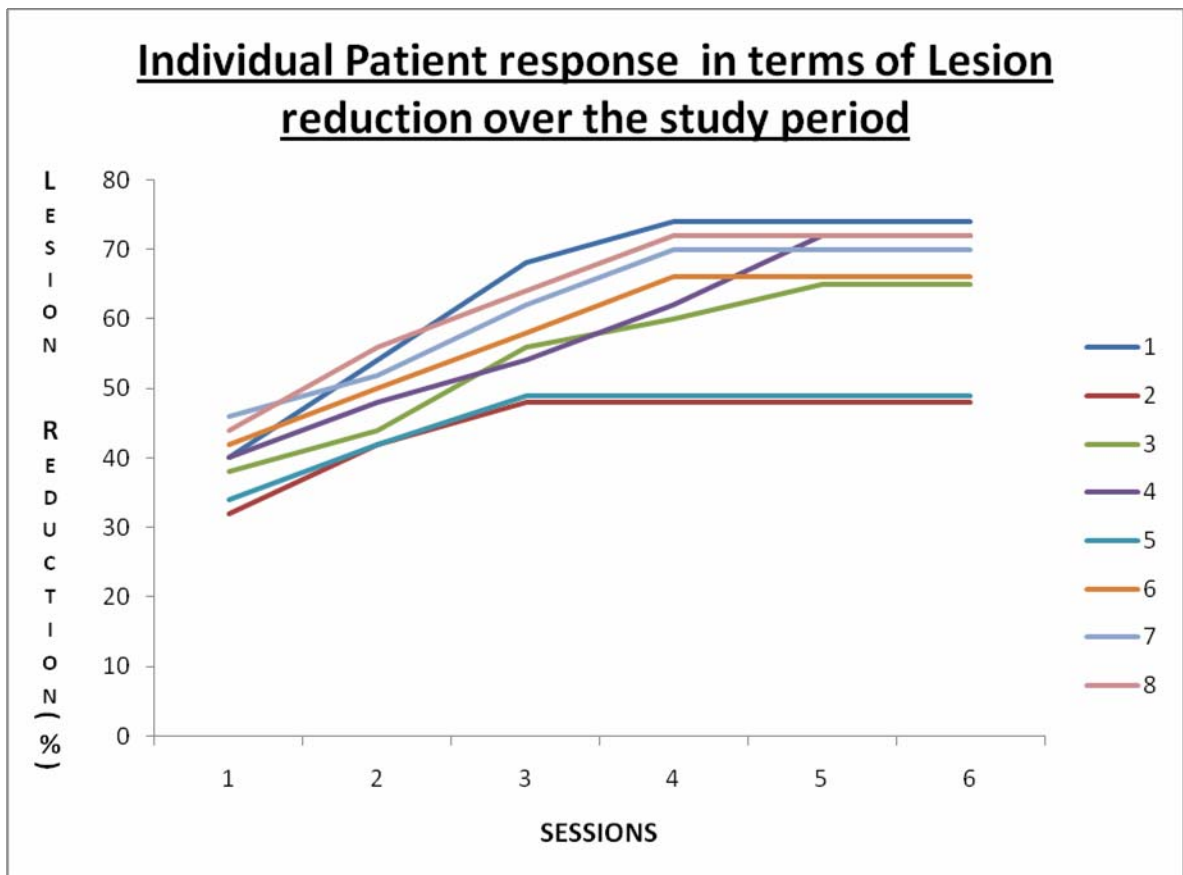
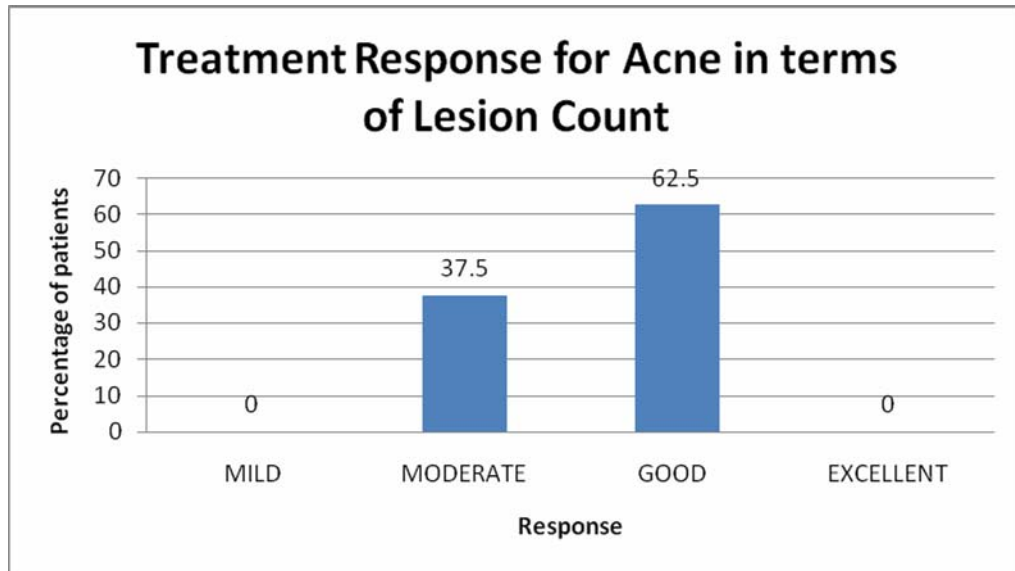
2 patients developed erythema, which was transient and resolved in few hours. No other adverse effects were seen.



**Table 12: Response in terms of lesion count in treatment population**

<b>% REDUCTION</b>	<b>0-25%</b>	<b>26-50%</b>	<b>51-75%</b>	<b>76-100%</b>
<b>GRADE</b>	<b>Mild</b>	<b>Moderate</b>	<b>Good</b>	<b>Excellent</b>
<b>NO. OF PATIENTS(n=8)</b>	-	3	5	-
<b>PERCENTAGE</b>	-	37.5%	62.5%	-

**Dropouts: 2**





**Dropouts: 2**

When the reduction in lesion counts were considered, 62% of patients had good response to the treatment. The response was noted to be least in case of comedones.

**PIGMENTATION:**

A total of 11 patients were treated for pigmentary disorders. The break-up of the patients was as follows:

**Table 13: List of patients treated for pigmentary disorders in the study**

<b>DIAGNOSIS</b>	<b>NUMBER</b>
Lentigenes	1
Freckles	1
Melasma	2
Post acne pigmentation	2
Nevus of Ota	1
Melanocytic Nevus	1
Becker's nevus	1
Post inflammatory pigmentation (others)	2

Of this, one patient (Becker's nevus) dropped out of the study after a single sitting. Good results were seen in lentigenes and freckles. Good results were also seen in post acne pigmentation and in a case of melasma. Moderate

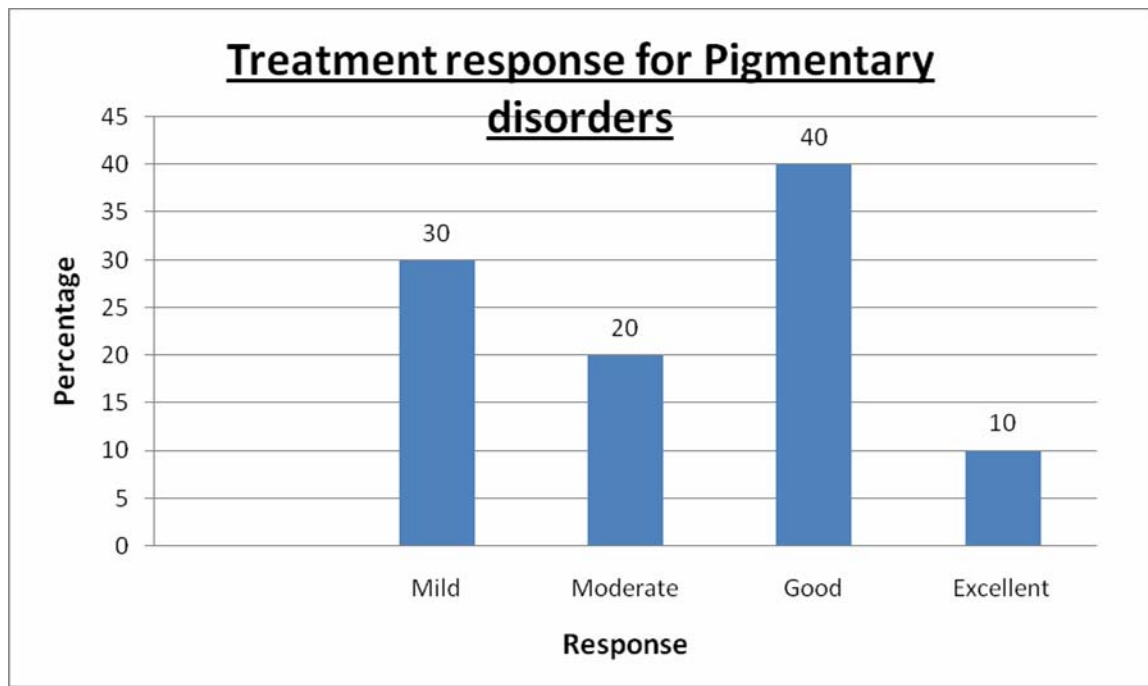
improvement was seen in Nevus of Ota and the other case of melasma. Results were unsatisfactory in melanocytic nevus and post inflammatory hyper pigmentation.

Overall, 50% of patients had good results and 70% of patients were satisfied with the procedure after a mean of 3.3 treatment sessions.

**Table 14: Treatment response for Pigmentary disorders**

<b>IMPROVEMENT</b>	<b>&lt;25%</b>	<b>25-50%</b>	<b>50-75%</b>	<b>&gt;75%</b>
<b>GRADE</b>	<b>Mild</b>	<b>Moderate</b>	<b>Good</b>	<b>Excellent</b>
<b>NO. OF</b>	3	2	4	1
<b>PERCENTAGE</b>	30%	20%	40%	10%

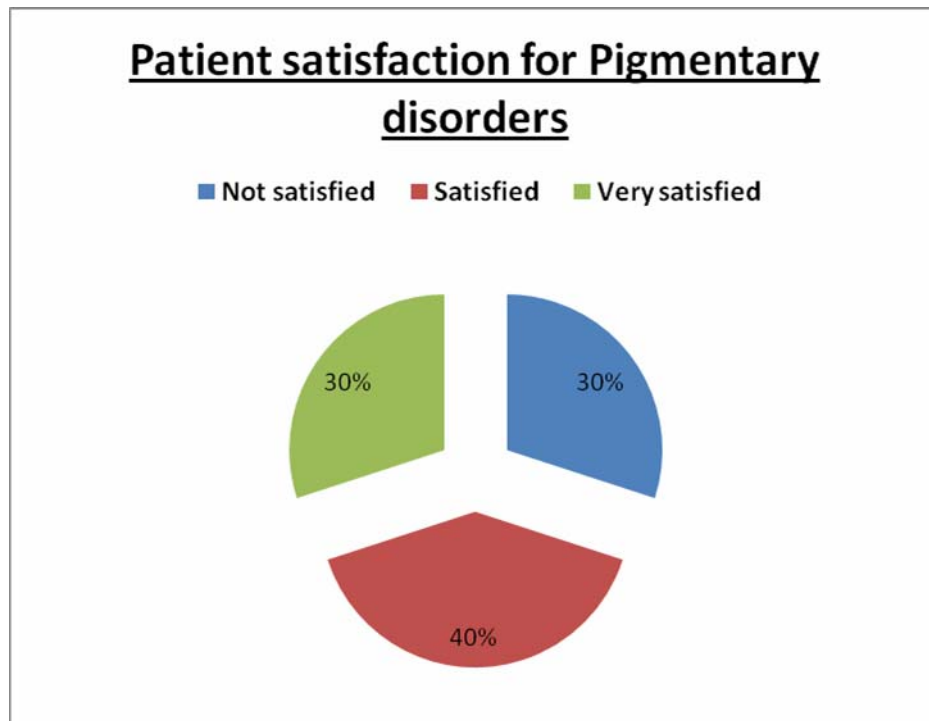
**Dropout: 1**



Dropout: 1

**Table 15: Patient satisfaction for Pigmentary disorders**

<b>SATISFACTION</b>	<b>No. OF PATIENTS</b>	<b>PERCENTAGE</b>
<b>Not satisfied</b>	3	30%
<b>Satisfied</b>	4	40%
<b>Very satisfied</b>	3	30%



One patient developed transient erythema which disappeared in two hours and another patient developed transient pain. There were no instances of post inflammatory hyper pigmentation. No other adverse effects were seen.

## VASCULAR LESIONS:

Two patients were treated for vascular lesions, one patient with hemangioma of size 5x7 cm situated on the face (cheek) and one patient with port wine stain. The patient with hemangioma dropped out of the study after one sitting, while the patient with port wine stain underwent 2 sittings with moderate improvement. No adverse effects were seen.

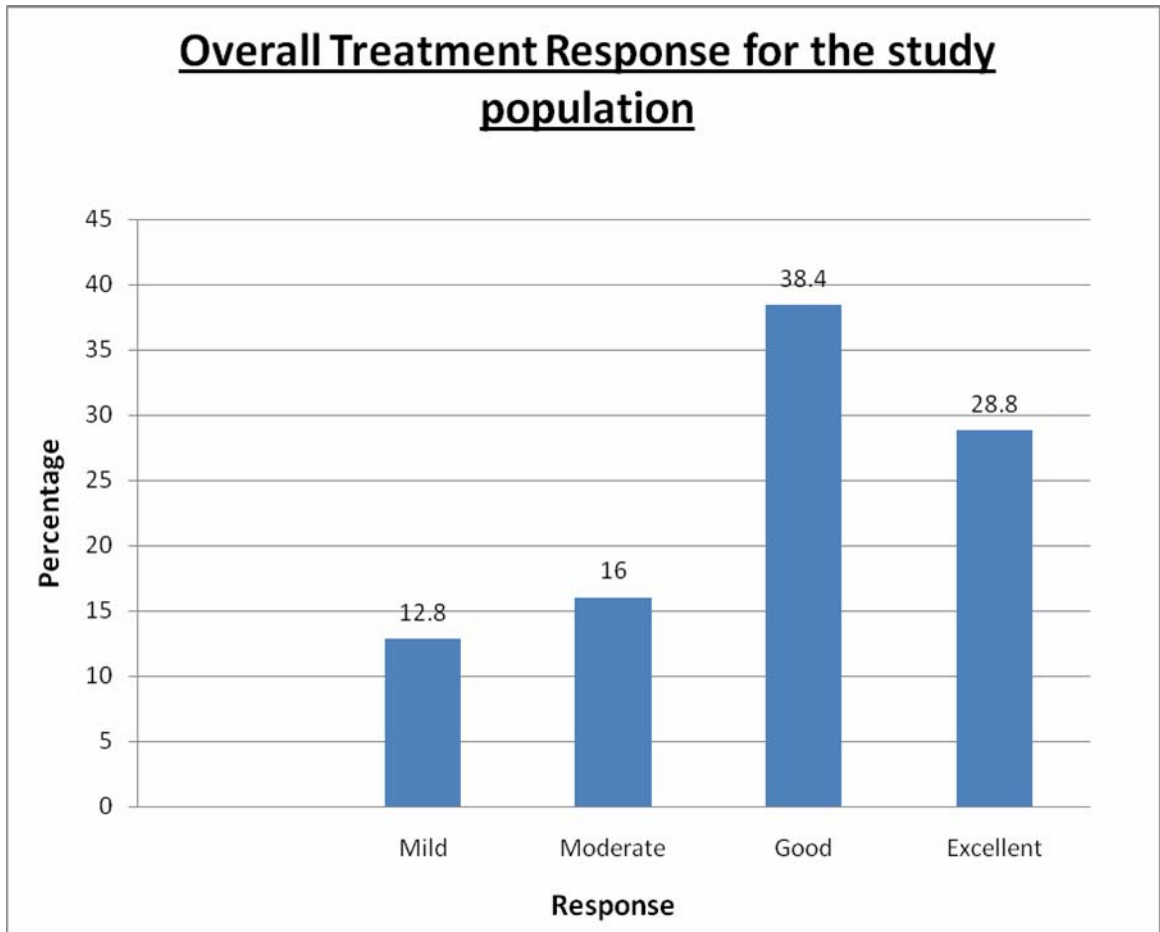
## OVERALL RESULTS:

A total of 33 patients were treated (excluding vascular lesions). 67% of patients had good results, of which 29% had excellent response. 77% of patients were on the whole satisfied with the treatment given.

**Table 16: Overall treatment response for the study patients (n=30)**

<b>IMPROVEMENT</b>	<b>&lt;25%</b>	<b>25-50%</b>	<b>50-75%</b>	<b>&gt;75%</b>
<b>GRADE</b>	<b>MILD</b>	<b>MODERATE</b>	<b>GOOD</b>	<b>EXCELLENT</b>
<b>Hair removal</b>	1	1	1	9
<b>Acne vulgaris</b>	-	2	6	-
<b>Pigmentation</b>	3	2	5	-
<b>Percentage</b>	12.8	16	38.4	28.8

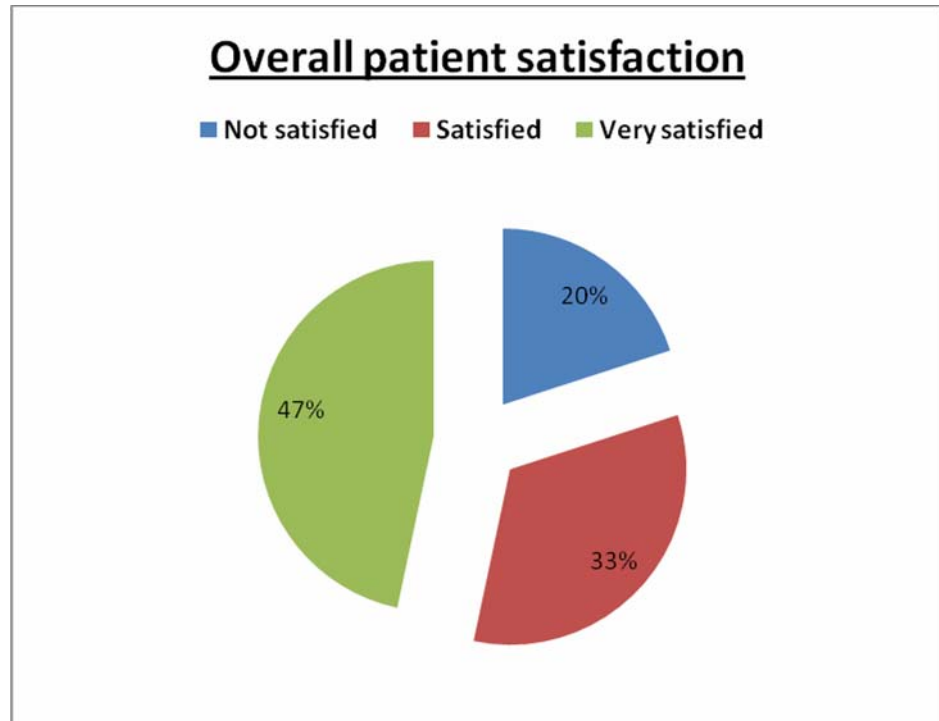
**Dropouts: 3**



**Dropouts: 3**

**Table 17: Overall patient satisfaction (n=30)**

<b>SATISFACTION</b>	<b>NOT SATISFIED</b>	<b>SATISFIED</b>	<b>VERY</b>
<b>Hair removal</b>	2	-	10
<b>Acne vulgaris</b>	1	6	1
<b>Pigmentation</b>	3	4	3
<b>Percentage</b>	19.2	32	44.8

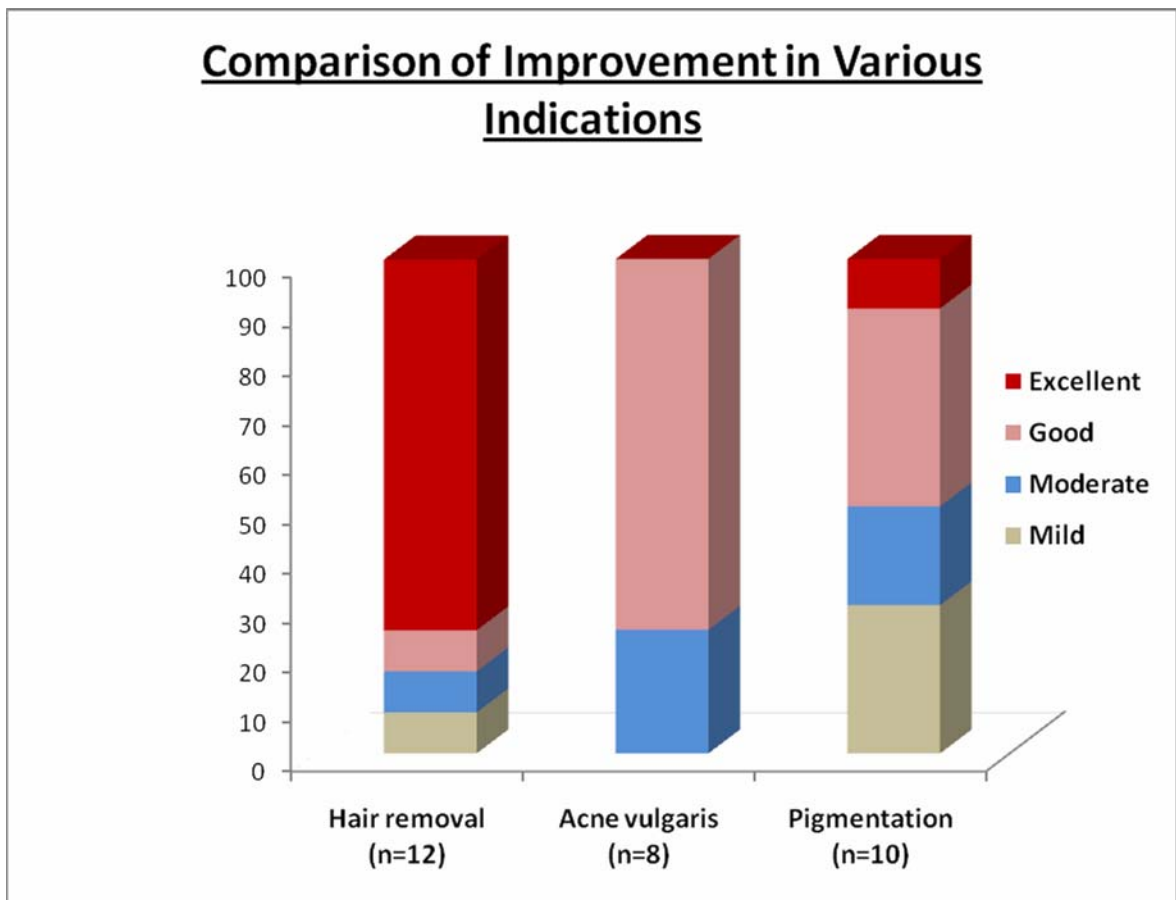


#### **Comparison of response to IPL in various indications:**

IPL was used in this study for 3 main indications, namely hair removal, acne vulgaris and pigmentary disorders. Hair removal had the best results with good results in 83% (excellent response in 75%). Acne vulgaris came next with 75% showing good results. 50% of patients with pigmentary disturbances showed good response.

**Table 18: Comparison of Improvement in Various Indications**

IMPROVEMENT	MILD	MODERATE	GOOD	EXCELLENT
Hair removal	8.3%	8.3%	8.3%	75%
Acne vulgaris	-	25%	75%	-
Pigmentation	30%	20%	40%	10%



**Patient satisfaction:**

83% of patients who came for hair removal were very satisfied whereas 87.5% of patients seeking treatment for acne vulgaris were satisfied. 70% of patients with pigmentary disorders were satisfied.

**Table 19: Comparison of Patient Satisfaction in Various Indications**

<b>SATISFACTION LEVELS</b>	<b>NOT SATISFIED</b>	<b>SATISFIED</b>	<b>VERY SATISFIED</b>
<b>Hair removal</b>	17%	-	83%
<b>Acne vulgaris</b>	12.5%	75%	12.5%
<b>Pigmentation</b>	30%	40%	30%





**Adverse effects:**

Adverse effects were seen in a total of 4 patients. 3 developed transient erythema and 1 patient had transient pain. None of the other reported adverse effects were seen.

## DISCUSSION

Intense Pulsed Light Technology is an effective, user – friendly technique that can be used in the treatment of different conditions, unlike the traditional lasers. In addition, it is comparatively free of side effects seen with the other laser systems. Thus, it is bound to become one of the more popular weapons in the cosmetological armamentarium.

In our study, the IPL source was used mainly in the treatment of unwanted hair, active acne vulgaris and pigmentary disorders.

### **Hair Removal:**

In Hair Removal, IPL is one of the more promising techniques, giving permanent hair growth reduction in the treated areas. Though it does not cause complete alopecia, it has high hair removal efficiency.

In our study, hair removal was done for a total of 12 patients using mean treatment sessions of 3.3. Good results were seen in 83% of patients. 75% patients had an improvement in hair removal of more than 75%. Only 17% of patients had moderate results. This is comparable to studies by Gold et al <sup>37</sup> and Weiss et al <sup>38</sup> showing 60% and 64% improvement respectively after a single treatment. Similarly, Sadick et al <sup>36</sup> has shown 76% mean hair removal efficacy in 34 patients after a mean 3.7 treatment sessions. Further increase in number of sessions does not appear to benefit <sup>36</sup>. In our study too,

patients with excellent response required only an average of 2.9 sessions. Results were better in those who sought treatment for excessive facial hair, than in those who had an underlying hormonal problem. In PCOD, hair re-growth did occur to a limited extent 5-6 months after treatment was stopped. None of the other patients came with such complaints after a similar period. The response was similar irrespective of the site of hair or skin/ hair colour (similar to the study by Sadick et al). No adverse effects were seen, though perifollicular erythema has been reported in literature. Patient satisfaction was good with 83% expressing themselves satisfied with the procedure.

### **Acne Vulgaris:**

Acne Vulgaris is one of the more stigmatizing disorders of adolescence. Umpteen treatments have been tried in the management of acne. IPL is one of the latest to be tried, offering promise in the treatment of active acne papules.

In our study , 75% of patients had good results (50- 75% clearance of lesions) .The results were similar to that obtained by Rojamatina et al who observed a 66.8% reduction in lesion counts in patients treated with IPL alone<sup>39</sup>. Patient satisfaction was high with the procedure with 87% of patients expressing themselves satisfied with the procedure. Among the lesions, good

response was seen with acne papules and pustules. Comedones responded the least similar to certain reports in literature<sup>23</sup>.

An average of 3.4 sittings was used in the treatment of acne vulgaris. Patients were asked to continue topical antibiotics during the course of IPL treatments. IPL does cause good improvement of acne lesions; but whether the improvement is enough to enable the physician to reduce the duration of topical treatment, thereby reducing the total cost incurred by the patient has to be studied. Overall, IPL is an effective treatment for acne vulgaris, but further studies on cost effectiveness and comparing IPL with other traditional therapies are warranted.

### **Pigmentary lesions:**

A total of eleven patients were treated for pigmentary lesions. The patients were treated for various indications ranging from the common melasma to nevus of ota. An average of 3.3 treatment sessions was needed in the treatment of pigmentary disorders.

Of the two patients with melasma, one patient had good improvement (50-75%), while another had moderate improvement (25-50%). This is comparable to the varying results obtained for melasma in different studies<sup>29</sup>. Response varies with the depth of the pigmentation. Patients were asked to start a regimen of

topical bleaching agents and sunscreens and continue it through the course of the treatment. Hence, as in acne, the cost effectiveness of the whole treatment has to be kept in mind while considering IPL.

Fifty to seventy five percent improvement in lesions was seen in the treatment of freckles and lentigenes in one study; quite similar to that of Kawada et al who got 50% improvement in 48% of patients and 75% improvement in 20% of patients <sup>40</sup>. Bjerring et al also obtained 74.2% improvement in patients with lentigenes <sup>41</sup>. Wang et al compared the efficacy of Q Switched Alexandrite Laser (QSAL) and IPL in the treatment of freckles and found the QSAL superior; but post inflammatory hyper pigmentation was seen only in QSAL, making the IPL safer for use in Asian skin <sup>42</sup>.

Post acne hyper pigmentation had good to excellent response similar to that obtained by Pacquet and Pierard who got 80% improvement in facial post inflammatory hyper pigmentation <sup>39</sup>. We did not get satisfactory results in melanocytic nevi though Bjerring et al have reported 66.3% improvement in melanocytic nevi. This could possibly be because of the darker skin color of our patients. Overall 50% of patients with pigmented blemishes have good results and 70% were satisfied with the procedure.

### **Vascular lesions:**

Two patients were treated for vascular disorders and both did not complete the treatment. Moderate improvement was noted in the patient with port

wine stain. Data obtained is insufficient for comparison. Angermeir has reported 75 – 100% clearance of centrofacial hemangiomas <sup>43</sup>. IPL has also been successfully used in the treatment of port wine stains, especially purple ones<sup>34</sup>.

**Adverse effects:**

Adverse effects seen in our study were minimal and transient. Most studies have reported minimal adverse effects with IPL<sup>1</sup>. Even the incidence of post inflammatory hyper pigmentation as reported by Wang et al <sup>42</sup> (more common in dark skinned races) has been low with IPL in our study. Few instances of some uncommon adverse effects like transmission of viruses have been reported in literature <sup>35</sup>. None of them were seen during the course of this study.

Overall, IPL was used for 35 patients in the study. Sixty seven percentage of patients had good results with the treatment. 77% of patients were satisfied by the procedure. Myers P et al used the IPL in the treatment of various dermatological disorders and obtained a physician assessed improvement of 66% in the study. <sup>44</sup> Excellent results were noted in 84% of patients. High patient satisfaction was noted by them, similar to the results of this study.

The results show that IPL is effective in various disorders and can be used safely on Asian skin.

## CONCLUSIONS

1. IPL is an effective and versatile tool in the treatment of different dermatological problems.
2. Efficacy was noted to be highest in the treatment of unwanted hair followed by acne vulgaris and pigmentary disorders in that order.
3. Average number of sessions required for excellent response in hair removal was 2.9.
4. In the treatment of acne vulgaris inflammatory lesions responded the best. Poor response was seen in the removal of comedones. An average of 3.4 treatment sessions was used.
5. An average of 3.3 treatment sessions was used in treatment of pigmentary disorders. Good results were seen in lentigenes, freckles, post acne hyper pigmentation and melasma.
6. Results close to that obtained in Caucasian skin can be obtained in Asians through proper patient selection and strict adherence to pre treatment and post treatment therapeutic protocol.
7. Adverse effects with IPL were minimal and transient. Hence IPL appears to be safe for use on Indian skin.

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## **PROFORMA**

Name:

Address:

Age:

Sex:

Date:

Phone:

Occupation:

Diagnosis:

Fitzpatrick skin type:

Presenting complaints:

Duration:

Precipitating factors:

Previous treatment:

Topical:

Oral:

Procedures:

Frequency:

Last treatment session:

Response:

Previous hair removal method:

Other history:

- H/o herpes simplex / herpes genitalis
- Hypertrophic scars / keloids
- Drug intake (any photosensitizing drug in past 3 months)

- Diabetes
- Pregnancy
- Skin cancer / treatment for skin cancer
- Hormonal disorders – PCOD  
Recent tanning
- Family history
- Local skin infection
- Hobbies / habits that may interfere with treatment
- Psoriasis / vitiligo

O/E

Systems:

D/E

Area involved  
disorders

Koebnerising skin

Fitzpatrick skin type

Baseline lesion count / hair count

Tanned skin

Local skin infections

**TREATMENT RECORD**

<b>Sitting</b>	<b>Date</b>	<b>Area treated</b>	<b>Programme No.</b>	<b>Energy</b>	<b>No. of pulses</b>	<b>Adverse effects</b>

### Hair removal

Sitting	Date	Hair count	Hair removal efficiency.

### Acne vulgaris

Sitting	Date	Lesion count			% of baseline count
		Comedones	Papules	Pustules	

### Photographs of patient

Patient's response:

1. Satisfied
2. Not satisfied
3. Very satisfied



**CONSENT FORM:**

I, \_\_\_\_\_, exercising my power of choice hereby give my consent for IPL technology to be used on my body for the treatment of \_\_\_\_\_. The details of the study have been explained to me in my own language including the effects and adverse effects of the treatment. The nature and purpose of the study has been explained to me and I give my consent for periodic photographing of the treatment areas. All my concerns have been addressed to my satisfaction.

Date:

Place:

Signature of Physician

Signature / thumb impression  
of patient

# **THE IFL i 200 SYSTEM**

The IFL i 200 system (manufactured by Cyden) marketed by Fem care Ltd is the intense pulsed light system used in this study. The IFL i 200 system is a broadband non coherent light source using i pulse™ technology. It works on the principle of selective photothermolysis.

## **Specification of the system are as follows :**

- 1) Wavelength : 530 – 1200 nm
- 2) Energy : Upto 20 J / cm<sup>2</sup>
- 3) Pulse duration : Computer controlled pulse  
Single pulse 12ms – 50 ms  
Triple pulse 5 – 20 ms on time, 7 – 30 ms of time  
(multiple pulse pattern configuration)
- 4) Spot size : 33mm x 27mm
- 5) Maximum pulse energy : 178 J (delivered to tissue)
- 6) Energy profile to tissue : Homogenous over treatment area
- 7) Repetition rate : 0.25 Hz average
- 8) Electrical : Dependent on model :
  - 230 V, 50Hz @ 5A
  - 110 V, 60 Hz @ 10A
- 9) Cooling : Self contained fan cooled
- 10) Environmental : 10°C (68F) to 30°C (86F)  
non condensing humidities below 75% RH

- 11) Dimensions : 480mm High x 200 mm wide x 550 mm deep  
(18.9 in x 7.9 in x 21.6 in)
- 12) Weight : 25 Kg (55 lbs)

# IFL Treatment Programmes

PROG.	SPECIFICATION		USAGE		
			HAIR	PIGMENTED BLEMISHES	VASCULAR BLEMISHES
1	Single Pulse 10msec 2-9 J/cm <sup>2</sup>				
2	Single Pulse 15msec 3-12 J/cm <sup>2</sup>				
3	Single Pulse 20msec 4-15 J/cm <sup>2</sup>				
4	Single Pulse 25msec 5-17 J/cm <sup>2</sup>				
5	Single Pulse 30msec 6-19 J/cm <sup>2</sup>				
6	Single Pulse 35msec 6-19.5 J/cm <sup>2</sup>				
7	Single Pulse 40msec 7-20 J/cm <sup>2</sup>				
8	Single Pulse 45msec 7-20 J/cm <sup>2</sup>				
9	Single Pulse 50msec 8-20 J/cm <sup>2</sup>				
10	Multiple Pulse 14msec ON : 7msec OFF 7-20 J/cm <sup>2</sup>				
11	Multiple Pulse 15msec ON : 10msec OFF 7-20 J/cm <sup>2</sup>				
12	Multiple Pulse 10msec ON : 15msec OFF 6-18.5 J/cm <sup>2</sup>				
13	Multiple Pulse 5msec ON : 30msec OFF 3-12 J/cm <sup>2</sup> Multiple Pulse				
14	Multiple Pulse 15msec ON : 20msec OFF 7-20 J/cm <sup>2</sup>				
15	Multiple Pulse 10msec ON : 20msec OFF 6-18.5 J/cm <sup>2</sup>				
16	Multiple Pulse 20msec ON : 25msec OFF 8-20 J/cm <sup>2</sup>				

USAGE		
HAIR	PIGMENTED BLEMISHES	VASCULAR BLEMISHES
Reserved for future applications		
Light Skin - Types 1 to 3 Asian Skin Type	Light Skin - Types 1 to 3	Light Skin - Types 1 to 3
Dark Skin - Types 4A-5	Dark Skin - Types 3 to 5	Dark Skin - Types 3 to 5
Reserved for future applications		
Reserved for future applications		
Dark Skin - Types 4A-5	Dark Skin - Types 4-5	Dark Skin - Types 4-5
Reserved for future applications		