

Intense Pulsed Light (IPL) in Aesthetic Photomedicine

By Matthew Redding

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In the last issue we looked at two of the most common applications for IPL in Aesthetic Practice:

- Permanent Hair Reduction &
- Resolution of superficial vascular lesions

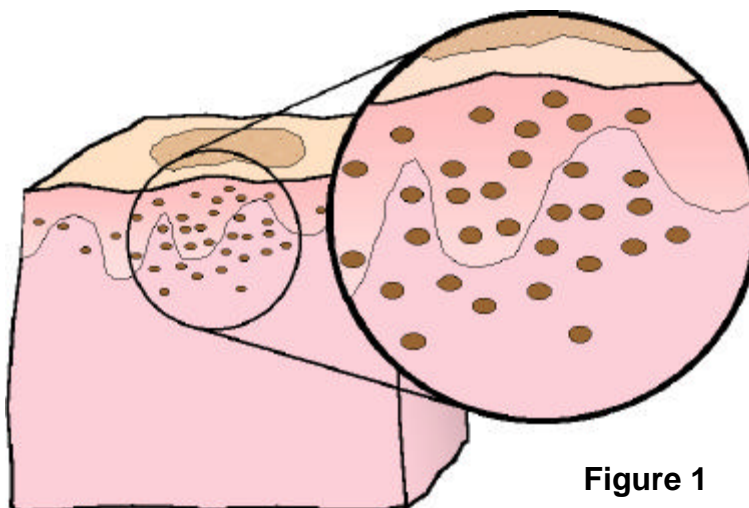
This article looks at three additional applications for IPL in Aesthetic Practice:

- Treatment of superficial pigmentation
- Skin Rejuvenation &
- Treatment of Inflammatory acne

IPL Treatment of Pigmented Lesions

What is a Pigmented Lesion?

Pigmented lesions are caused by abnormally excessive melanin content and present as an area of darker appearance on the skin.



There are many types of pigmented lesion and it is not within the scope of this article to discuss the aetiology or morphology of abnormal pigmentation. Needless to say that treatment of non benign, pre malignant or unidentified pigmented lesions is contra-indicated and accurate diagnosis is essential prior to any treatment.

Many people in their mid-thirties and older are now suffering from sun-damaged skin which can present itself in many forms: wrinkles and fine lines are often accompanied by dry and rough skin, mottled skin tone and areas of abnormal pigmentation. Lentigines, (also known as age or sun spots) and ephelides (freckles) are common, superficial pigmented lesions, and although benign, they can become an issue of

cosmetic concern. Lentigines may evolve slowly over years, or they may be eruptive and appear rather suddenly. Pigmentation may be homogeneous or variegated, with a colour ranging from brown to black. In the USA, solar lentigines are observed in as many as 90% of white people older than 60 years and in 20% of white individuals younger than 35 years.

IPL Treatment of Pigmented Lesions

Pigmented lesions have been treated successfully with lasers for a number of years and Q-Switched lasers are still the treatment of choice for deeper, dermal pigmented lesions (such as Naevus of Ota and Mongolian Spots), however, many of the pigmented lesions that cause cosmetic concern, such as lentigines, are present only in the epidermis.

Recently, intense pulsed light (IPL) treatment has proved highly successful in the treatment of superficial, epidermal pigmented lesions.

IPL systems operate on the principle of selective photothermolysis in which target chromophores (in this case melanin) are selectively damaged while protecting the surrounding healthy tissue. As discussed in previous articles, we utilise wavelengths that will be preferentially absorbed by the target (required to be destroyed) but NOT well absorbed by other chromophores in the skin and the irradiating pulse duration should match the thermal relaxation time of the target.

As can be seen from Figure 2, melanin shows broad band absorption over most wavelengths. Commonly wavelengths between 550nm and 1100nm are utilised for treatment of superficial pigmentation. This band of light excludes significant absorption in water which only creates generalised heating of the tissue, however it does encompass some wavelengths of light that are absorbed by haemoglobin and oxyhaemoglobin in blood. The reason for including these wavelengths is that shorter wavelengths do not penetrate as deeply as longer wavelengths thus optimising absorption in the superficial epidermal melanin.

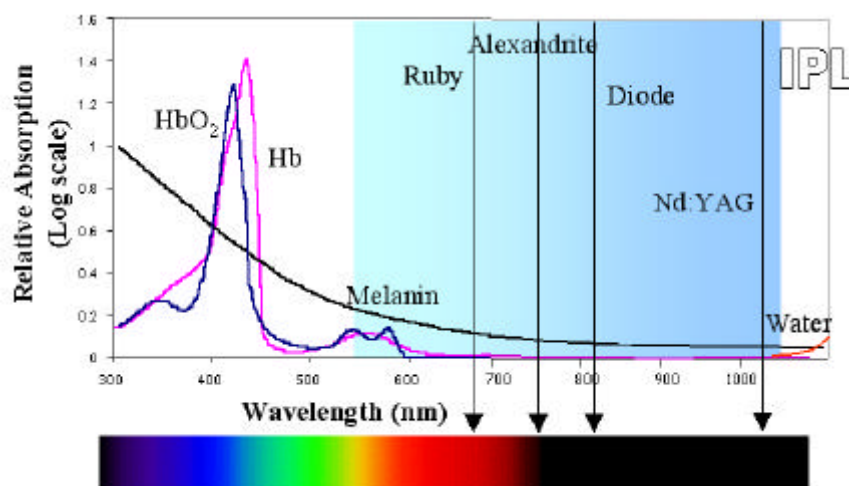


Figure 2

Generally light absorption in blood during pigmented lesion treatment is not of concern as significant absorption will only occur where there are vascular lesions and it is often desirable to treat these concurrently. If this is not the case then it is a simple matter to modify the technique to place light pressure on the skin with the IPL treatment handpiece during exposure. This pressure evacuates the blood vessels during the light pulse minimising any absorption in blood.

When light is pulsed into the skin it is predominantly absorbed in areas of high melanin concentration, as seen in pigmented lesions. The light absorbed by the pigmented area is converted to heat, destroying the excess melanocytes.

Immediately after treatment it is common to see erythema and a darkening of the lesions, it is important to counsel the patient to expect this darkening to alleviate any concern that their condition has worsened.

After treatment, the skin can be cooled and any erythema generally dies down within 30 minutes. Following treatment, the darkened lesions will crust, peeling off usually within one to three weeks leaving an area without excess pigmentation. It is thought that repeated sun exposure of the treated area will result in a recurrence of the original lesion. However, if sunscreen is used the lesions seem to rarely reappear and if they do they may be re-treated in the future. One or two treatments is generally sufficient for complete lesion clearance, although on occasion as many as 4 treatments may be required. The time left between treatments is typically 4 to 6 weeks. Figure 3 shows the result of one treatment of the right hand of a 52 year old male.

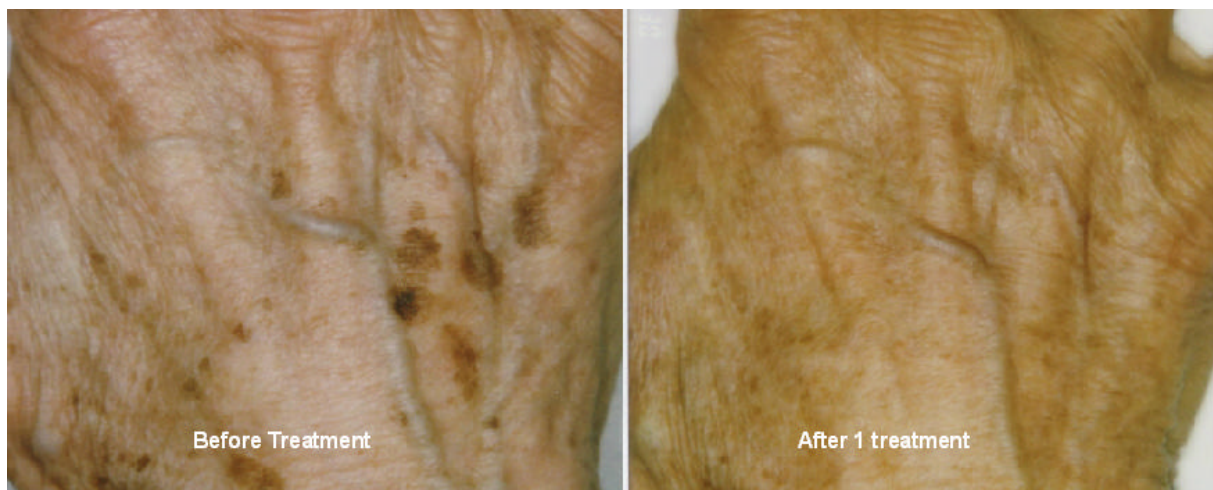


Figure 3

Skin Rejuvenation

As discussed previously many people suffer from the symptoms of sun-damaged and ageing skin. This can present itself in many forms: wrinkles and fine lines are often accompanied by dry and rough skin, mottled skin tone and areas of abnormal pigmentation. Lentigines, (also known as age or sun spots) and ephelides (freckles) are common. Superficial pigmented lesions, although benign, can become an issue of cosmetic concern. Vascular irregularities such as telangiectasias and rosacea can also contribute to overall skin tone irregularities and up until recently, treatment options have been limited.

Alongside abnormal pigmentation and irregular skin tone, sun-damage often causes changes in the texture of the skin. Skin can become rough and dry, with fine lines occurring around the eyes and mouth. Appearance is also affected by genetic factors, disease processes and the overall loss of cutaneous elasticity associated with age.

Numerous treatments have been developed to improve the appearance and health of photo-aged skin. To date the most effective methods for improving photo-damaged skin have been invasive. The major disadvantage of invasive treatments is the requisite recovery period and patient downtime following procedures such as laser skin resurfacing. Ablative laser skin resurfacing has, to date, been carried out using CO₂ and Er:YAG lasers, with the common associated postoperative complications such as bleeding and infections. Other treatments have involved using various topical agents and the techniques of dermabrasion and epidermabrasion. Recent published work indicates that IPL systems can be used to stimulate collagen growth in the dermis without damaging the epidermis. Hence, the photo-aging symptoms discussed above, can be treated utilising non-ablative intense pulsed light (IPL).

Principles of Skin Rejuvenation

The process of Photorejuvenation is usually a two stage process utilising two different handpieces. One commonly covers the wavelength range from 550 to 1100nm, which targets absorption peaks in haemoglobin and oxy-haemoglobin. Melanin also shows broad band absorption over these wavelengths, and the shorter wavelength light from the system will be predominantly absorbed in areas of high vascularity and superficial melanin concentration. The light absorbed by these areas is converted to heat, destroying excess melanocytes and blood vessel

Treatment of these vascular and superficial pigmented lesions of the skin utilising broadband Intense Pulsed Light from 550nm to 1100nm have been discussed in detail in this and previous articles in this series. This initial course usually comprises 1-3 treatments with the 550 to 1100nm handpiece and is designed to remove any skin tone irregularities such as areas of excess pigmentation or thread veins.

The second phase of treatment is aimed at improving the texture of the skin. It is thought that the success of Photorejuvenation treatments is based on light being absorbed by micro capillaries within the epidermis and dermis. The small size of these structures, and associated short thermal relaxation time, means thermal damage is avoided. Significant heat diffusion does take place and causes mild, reversible inflammatory thermal damage within the skin. The skin acts to repair this by increasing the rate of production of collagen, resulting in an improved appearance. Clinical effectiveness depends on the skin's ability to produce collagen and hence older people are, generally, less responsive to Photorejuvenation treatments. IPL output wavelength band of 650-1100nm targets the weak absorption bands in haemoglobin around 700-800nm whilst avoiding the strong haemoglobin absorption below 590nm (see Figure 2). These longer wavelengths gently heat the dermis, causing fibroblast activity which stimulates growth of collagen which lies in the deeper layers of the skin.

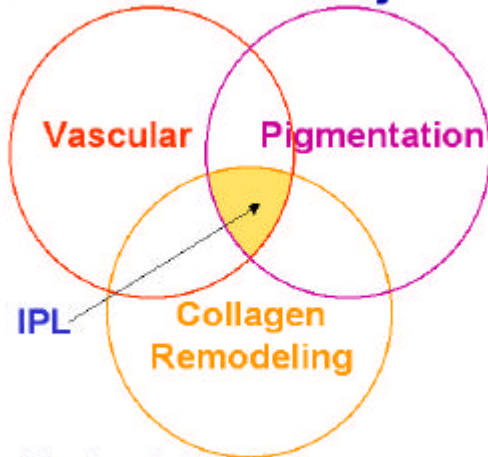
Alongside improvements in skin tone, Combination Facial Therapy will improve both the firmness and overall texture of the skin. This method combines the use of a mild facial peel (maximum of 40% Glycolic) with photo-therapy using a handpiece which emits light over a wavelength range of 650 to 1100nm. It has been observed that greater success has been seen with second phase IPL treatments when used in conjunction with mild chemical peels which remove the outer dead layers of skin allowing more effective penetration of light. Also the peel leaves the face feeling fresh which has a short term benefit for the patient while the phototherapy shows improvement in the medium to longer term.

IPL treatments, combined with traditional chemical peels, open up a whole new area of cosmetic treatments and combination therapies for further development. They are now being used extensively to remove periocular and perilabial wrinkles.

Treatments are usually spaced 2-3 weeks apart and a course of 6 treatments is common to achieve optimum results in the highest number of patients.

It can be seen that there are three facets to non ablative Photorejuvenation, these are 1) treatment of vascular lesions, 2) treatment of superficial pigmentation and 3) stimulation of collagen production. In the past three different lasers could have been used to achieve these results, but now with the development of IPL protocols a single system can produce good results in most patients. (Figure 4)

3 Factors of Photo Rejuvenation



The best effects are seen as a combination of all these...

Figure 4

Photo Treatment of Inflammatory Acne

Acne is a disorder of the skin's sebaceous glands that can affect up to 80% of the population aged 14-30. Follicles, often called pores, sometimes get blocked. When this happens sebum, which is the oil produced by the sebaceous glands in the skin cannot drain to the surface and bacteria begins to grow. Both whiteheads and blackheads start out as a "microcomedone" as illustrated in Figure 5

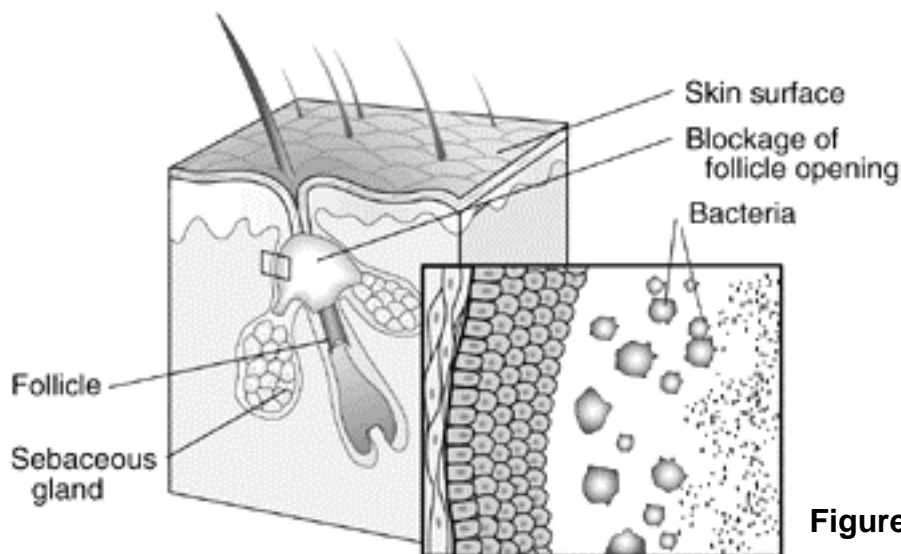


Figure 5

Although commonly considered to be a adolescence problem, 25% of the people affected by acne in their teens will go on to develop permanent scars. The effects on personal appearance caused by acne and the resultant scarring can cause significant psychological, social and occupational problems if left untreated. Current treatments show limited success for most people and involve long term use of antibiotics, or isotretinoin administration, with its associated side-effects.

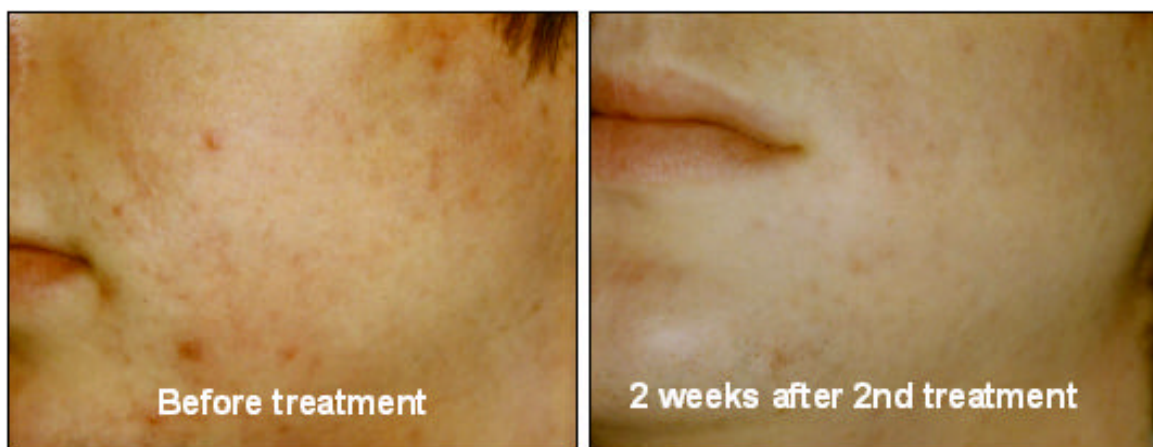
It has been shown that the major cause of inflammatory acne, *Propionibacterium Acnes* can be destroyed by the application of light. There are two mechanisms through which this is believed to occur, photochemical and thermal:

Blue light (wavelength ~400nm) is most efficient at destroying the bacteria, as the porphyrines produced by the bacteria are highly **photosensitive** to these wavelengths. However, at these short wavelengths, skin penetration depths are very small and it is difficult for light to penetrate the skin sufficiently to target bacteria in deep blocked pores.

Recent studies seem to indicate that yellow light (~585nm), which has a greater skin penetration depth than blue light, is more effective *in vivo* at targeting the bacteria that causes acne.

Infrared wavelengths (greater than ~750nm) have also been shown to combat acne. These long wavelengths can penetrate the skin to cause heating of the overactive sebaceous glands. It is thought that reversible **thermal damage** to sebaceous glands can result in long term remission from acne due to the decrease in sebum production. Broadband light sources such as IPL systems can offer shorter wavelengths for optimum surface bacterial destruction, whilst also getting to the deep-seated bacteria existing in pustules and papules and damaging the sebaceous glands themselves.

Treatments are commonly spaced 2-3 weeks apart.



Acne Treatment: Wavelengths 550nm - 1050nm Fluence 16J/cm²

Figure 6



Clinical research is currently being undertaken to determine the optimum protocol, or if in fact a combination of both blue light and broadband treatments is most efficacious. Clearly as treatments advance and new protocols are developed it is important to be confident your treatment platform has the capacity and flexibility to incorporate new hardware and software and that the manufacturer has a commitment to develop such advancements.

The next article will look at the patient consultation, practical aspects of IPL treatment and running an IPL clinic.

Matthew Redding
Director
LightLogic (a Medical Technologies Company)
+61 8 9340 3555
matthew@lightlogic.com.au

Matthew is a qualified Medical Radiographer and has worked extensively within healthcare and engineering environments in clinical, education and senior management roles. He also holds a Bachelor of Business degree with a major in management and a minor in applied science. He is a director of Medical Technologies, a company with over 14 years experience with medical lasers and manages their LightLogic Division. He has studied laser and IPL physics and physiology in the UK.