



# Analytical Report

## Intense Pulsed Light Systems

### AN INDEPENDENT ANALYSIS

By David Cauger, Contributing Editor

Intense pulsed light devices (IPLs) have flooded the aesthetic market in recent years. The cost of these devices ranges from \$15,000 to \$150,000. Since their introduction into the aesthetic marketplace over a decade ago, there have been many improvements and "secondary" technologies designed to enhance clinical outcomes and reduce side effects.

In this article I will provide an unbiased assessment of how these devices function in basic terms. I hope this overview is understandable and intuitive. Its primary objective is to inform the reader of the nature of these devices and the various strengths and limitations they have. The secondary objective is to inform the reader of significant technological improvements and the consequential results in efficacy and patient safety.

In my article "Intense Pulse Light Devices" in the September-October 2003 issue of ATnT, I quoted IPL devices as the "jack of all trades and master of two." These two applications are benign epidermal lentigenes (age spots) and telangectasias of the face. The classical case is Fitzpatrick types I-II

with broken capillaries on the cheek and nose and multiple age spots on the face and hands. In these cases the IPL is now the preferred device. IPLs also can address a variety of benign pigmented and vascular abnormalities

that are best left to the trained dermatologist or vascular surgeon. The hair removal capabilities have improved due to a myriad of technological advances. There are countless small studies that make many dubious claims. Large scale independent studies are required to determine the true accuracy of these claims.

Intense pulsed light devices are very close to what they are named: A very intense flash of light. This is very much like the flash cubes of old cameras. Basically, they

consist of a fairly high voltage power supply scheme that provides the energy to the flash lamps. They also have electronic controls and user interfaces. Many manufacturers no longer use changeable filters within handpieces but rather have disposable handpieces with fixed “spectral signatures.” What they are filtering is typically a spectral range of 400nm – 1200nm. They may block out light from the lower end of the spectra or the higher end. After

these handpieces burn out, the owner purchases a new handpiece. There

are so many different IPL models, it would not be practical to comment on each one. I hope to provide you with enough information to ask the right questions so that you may make an informed decision. This article will not contain “before and after” photos, only simple and honest facts.

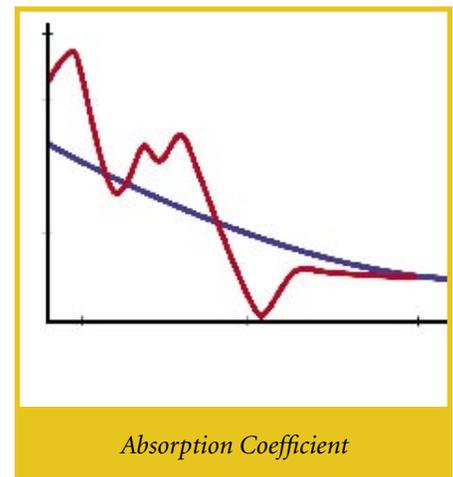
I am not convinced that a 500 watt IPL can outperform a 20,000 watt Alexandrite laser in hair removal as much as I know a Hyundai cannot outperform a BMW. Remember, 100 watts equals 100 joules over a period of 1 second. This is very important to

*“IPL devices deliver low powers of each wavelength in their spectrum. As a result we see many patients who have failed laser hair removal from IPL and have significant re-growth causing them to seek laser hair removal. Many providers who use IPL devices typically market them as lasers despite the fact that they are not, by definition, lasers. Consumers are becoming more aware of these differences and are asking wavelength specific questions during consultations as they understand what they should look for as they shop.”*

—Jay M. Kulkin, MD MBA FACOG, Women’s Institute For Health PC

understand.

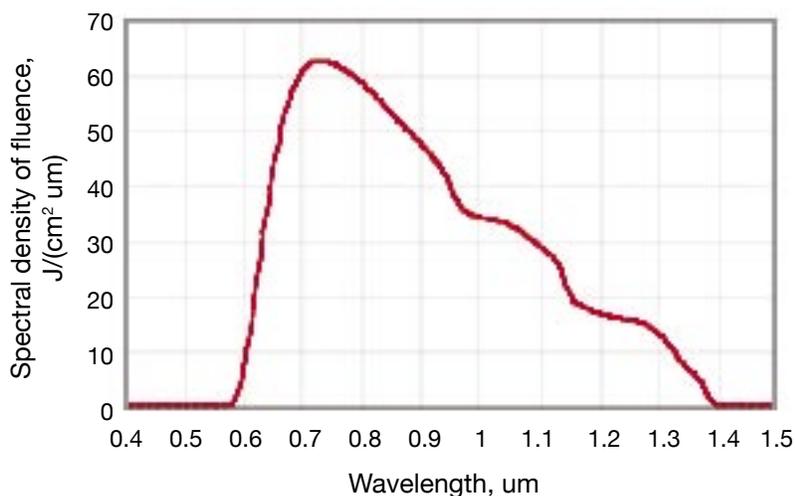
When the salesperson states “we can get 200 joules from our units” what does this mean? As stated, joules are a function of watts over a period of 1 second. More importantly, like a water pressure through a pipe, the discriminating M.D. should ask how much “volumetric flow rate” can your device achieve in 20 milliseconds using a standard 10mm or 12mm “pipe?” This is the concept of joules per centimeter squared ( $J/cm^2$ ). This is 80% of what you need to know to make an informed decision. In combining the concept of watts, time, and square area, you have the basics



of what is referred to as fluence.

I hope the “water flow” analogy was clear. I say this because IPLs add a “third dimension” to this concept. Don’t worry, I will attempt to make this clear through a graph that is intended to add to your understanding of the nature of these devices.

## Spectral Energy Signature Concept



### THE BASICS

Specific wavelengths of light have a natural “attraction” to colors that are of importance in aesthetics. This is the foundation of the *Selective Theory of Photothermolysis*, Anderson, R.R., Parrish, J.A. To simplify this groundbreaking work, imagine a black car in a parking lot surrounded by white cars on a sunny day. The white cars reflect light while the black car absorbs light. This will make the surface of the black car hotter in comparison to the surrounding white cars. This is analogous to a black hair surrounded by lighter skin. The same concept

applies to the other aesthetic targets of blood and water. This attraction of various wavelengths of light to the aesthetic targets of melanin, blood, and water is illustrated above. It is important also to understand that skin and the targets mentioned have different time frames in which they heat up and cool down. This concept is known as Thermal Relaxation Time (TRT). It is important to fully understand TRT because this defines both the filters and duration of time of the pulse (pulse width) you will select according to the patient skin type and what you are treating.

The above chart represents the

attraction or coefficients of the aesthetic targets. Melanin has a rather simple curve. Notice that it is attracted more efficiently at lower wavelengths. It appears to have little difference from the 755nm to the 1064nm range, but this is highly deceiving. Higher fluences with longer pulse durations can compensate for the relative lack of attraction when using longer wavelengths. Unfortunately, if the target is melanin, the light source will also be attracted by the melanin of skin.

In the case of light based hair reduction, it is the contrast between the hair color and the skin color that makes all of the difference. A light skinned patient with dark hair can be treated successfully with most IPL systems. The lesser the contrast, the harder and more complicated the treatments become. Some advanced IPL systems may treat darker skin types with various degrees of long-term success. These systems have higher fluences and contact sapphire cooling. These systems include: StarLux, Palomar

Medical Technologies, Burlington, MA, Quantum HR, Lumenis, Santa Clara, CA, ProWave 770 Cutera, Inc. Brisbane, CA. This form of epidermal cooling allows for high fluences to be used without burning the surrounding skin tissue. All IPLs have filters that usually begin

around 500nm. However, do not let small clinical studies provided by a salesperson convince you the IPL is ideal for hair removal, especially for darker or tanned skins. For darker skin types the high-powered Nd:YAG laser is the proven device. These patient types are more problematic, require more treatments and skilled clinicians to achieve an acceptable outcome.

Intense pulse light systems are perhaps the most difficult aesthetic devices to quantify because they do not output a single wavelength. IPL systems output a varying range of wavelengths with varying average power along any given range of wavelengths, such as 50 nanometers. The chart at the left illustrates this important concept.

In the example at the left, notice

that about 50% of the energy is located between 700nm and 1000nm. This light is not “coherent,” which means it has a tendency to scatter and not be absorbed by the target.

### WHAT IPL IS BEST FOR MY PRACTICE?

The scope of comparison of IPLs could easily comprise a 200-page book. It is best to understand what are the predominate skin types of your patients, the scope of your intended treatments, and what you currently now own for devices, if any. For example, if your practice is in Wisconsin where 90% of your patients may be types I-III, and you wish to perform only hair removal and the treatment of “sunsports,” it may be wise to look at companies with established track records that have IPLs for under \$40,000. On the other hand, if your practice is in South Florida, and you currently do not have any light based devices, it may be wise to seriously consider a higher end device along with a high power Nd:YAG laser.

If your intent is to include leg veins, it would be in your best interest

to learn sclerotherapy and investigate the Nd:YAG laser. Hair reduction is still the number one requested service in aesthetics followed by that catch-all term “facial rejuvenation.” Please refer to my Er:YAG article for a more comprehensive understanding of this subject.

All the credible clinical evidence relating to successful light based hair reduction correlates with fluence. The higher the fluence one can apply safely during the growth phase of the hair, the greater the likelihood of follicular destruction. Follicular stem cells do not have a chromophore. Therefore, their destruction is assumed to be based on the thermal diffusion of heat from the melanin targets of shaft and root sheaths. When insufficient energy is used, treated anagen hairs may return in several months. The hair may recover completely or be thinner than it was prior to treatment.

Managing patient expectations is important. Patients returning for their 15th hair removal treatment are likely to become impatient. They most likely will express their dissatisfaction

among friends and become a source of “negative referral.” This is absolutely the worst situation, besides litigation, and in many cases it is fatal to the practice.

The best referral is a referral from a satisfied patient and the surest way to build a successful aesthetic practice. People expect results. It is their nature. When their expectations are not met, they become angry. Non-surgical medical aesthetics is a service business. The sooner M.D.s realize this, the better their aesthetic component will be. Therefore, choosing the right devices is a critical decision.

### DEVICE CONSIDERATION: WHAT YOU SHOULD ASK THE SALESPERSON

- 1. Epidermal Cooling:** Sapphire contact is the best, but other cooling strategies work well. If you have a large patient base of darker skin types, I would recommend a device that has sapphire cooling.
- 2. Watts:** How many watts is the device? This ultimately dictates the fluence range.
- 3. Power Output Control:** This means

that energy from the light source is regulated so unwanted “spikes” in energy that may burn a patient are substantially reduced. Ask the salesperson if their design is a PFN type or how they regulate power output.

- 4. Pulse structure:** Is the pulse a single event or “true pulse,” especially with longer pulse durations, or is it made up of “sub-pulses?”
- 5. Spectral energy distribution with their filters or handpieces:** Ask the salesperson to bring these. All companies have them, and there is no reason why you should not be able to view these.
- 6. Consumable costs:** This translates into how much it will cost you every time you fire a shot on each handpiece. Some handpieces are larger and can cover a larger area, and this makes a difference. Use a fixed area as a reference to compare – such as a 10 x 10 inch square surface. Get it in writing.
- 7. User interface:** Most user interfaces are relatively easy. The higher end models have touch screen graphical

user interfaces. It is relatively minor, but if you intend to delegate, it may be a factor.

- 8. Training:** Who will be training and what are their credentials? How long will the training be? This is very important.
- 9. Local references.**
- 10. Company background.**

### COMBINATION TECHNOLOGIES

Several manufacturers combine technologies to supposedly increase efficacies while reducing potential side effects. These include the use of IPLs in conjunction with the following: radio frequency, traditional filament heat sources, pneumatic negative pressure (sucking the skin into the handpiece). In these cases ask the salesperson what part of the total fluences these technologies provide. Also ask what the fluences would be if the secondary technology were turned off. In the case of pneumatic technology, this is designed to reduce pain by creating pressure. This follows the “Nerve Gate Theory” where signal pathways to the brain that convey the sensation

third generation of IPLs, and there are more choices than ever before. Use your critical thinking skills and choose wisely. For basic information on IPLs, please refer to the product listing in Laser & Light section on page 55. 

## TREATMENT

## COMMENTS

Superficial telangectasias of the face	Excellent results with most patients. Recommend sunscreen.
Benign solar lentigos and freckles, all body parts	Excellent results with most patients. Endpoint is a graying or darkening of the lesion. Recommend sunscreen.
Leg telangectasias	Poor results – Sclerotherapy and the high powered Nd:YAG are the better modalities.
Collagen synthesis	Very moderate to poor response. Highly patient dependent. Please check for devices that superficially are designed for this purpose.
Hair removal	Good results with proper patient selection. Moderate to poor results with darker skin types.
Acne	Moderate success and temporary. Use with 5-ALA may enhance the clinical outcome.
Benign vascular lesions	Port wine stains, hemangiomas and others. Excellent to poor results depending on the case. Dermatologist and vascular surgeons only.
Other benign pigmented lesions	Wide range – café-au-lait macules, congenital nevi, post-inflammatory hyperpigmentation, melasma and others. Excellent to poor results depending on the case. Dermatologists only.

## REFERENCES

Lee, P.K. *Lasers in Aesthetic Surgery*, pp 207–222, 2001 Thieme Medical Publishers, Inc.

Raulin, C., Greve, B., Grema, H. IPL technology: A review. *Lasers in Surgery and Medicine* 32:78-87 (2003)

of pressure cannot fully convey the sensation of heat from the IPL.

The following is a list of indications and comments. This is based on feedback from clinicians I have spoken with over the last 7 years. None had any financial motivation to exaggerate or understate their clinical experiences. Pigmented lesions and vascular lesions comprise a wide range of classes. Most of these lesions are not recommended to be treated except under the direct supervision of a dermatologist or vascular surgeon.

## CONCLUDING REMARKS

Intense pulse light systems require significant training because of their wide range of wavelengths, pulse durations, pulse signatures, and varying fluences as they relate to the aforementioned. These are highly diverse devices, and most developed aesthetic practices that use light based devices own at least one. Less developed aesthetic practices may rely too heavily on their use leading, in some cases, to reduced efficacies and complications. We are in our



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