Vascular and pigmented lesions

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Patrick Bitter, Jr., MD, FAAD, describes his techniques for the treatment of vascular and pigmented lesions with broad spectrum light

Broad spectrum pulsed light devices, such as intense pulsed light (IPL) and broadband light (BBL) have been used to successfully treat a wide variety of vascular and benign pigmented lesions for nearly 20 years. IPL and BBL have become widely accepted as an effective treatment option, and in many cases even the treatment of choice, for conditions such as diffuse telangiectasias, rosacea, poikiloderma, and port wine hemangiomas. Benign pigmented lesions such as ephelides and lentigoes—freckling associated with photodamage and post-inflammatory hyperpigmentation—can all be treated successfully with broad spectrum light. Erythematous scars and inflammatory acne are also greatly improved with pulsed light therapy. Areas anywhere on the body are amenable to treatment with broad spectrum light.

There are now numerous pulsed light devices available on the market. While various parameters have been worked out for each type of device for the treatment of vascular and pigmented lesions, and for generalised photorejuvenation, the precise technique is generally never described in scientific publications. Technique is critical to achieving a successful outcome with any pulsed light device. To illustrate, one could follow precisely reported parameters for treating rosacea on the central face; however, two different operators using exactly the same parameters can achieve very different results in the same patient by simply doing a different number of pulses and passes. Where one practitioner may treat the cheek with twelve pulses, the other may treat the same patient's cheek with fifty pulses producing results that can be either a dramatic improvement or no result at all even though the parameters for both treatments are identical. The essential importance of technique in the use of IPL is nearly never explained in sufficient detail to allow a reader of a scientific paper to duplicate the results by simply attempting to follow the published parameters. This may be the primary explanation accounting for the different results seen in the numerous published clinical studies with IPL.

This article will discuss important considerations in treatment technique with pulsed light for vascular and pigmented lesions and general photorejuvenation.

There are a number of parameters the practitioner has to consider and choose from in treating pigmented and vascular lesions and for photorejuvenation with pulsed light devices. Generally these are the cut-off filter, the fluence, the pulse duration, and the temperature of the contact cooling. Each parameter has a particular effect on skin and target lesions. Understanding how each parameter can affect the treatment site is essential to choosing the optimal parameter for both vascular and pigmented targets for each different skin type.

Wavelength cut-off filters

The effect the different wavelength cut-off filters have on skin can be thought of in the following way: lower number cut-off filters (e.g. 515 nm and 560 nm filters) allow a spectrum of light from 515 nm and 560 nm to approximately 1200 nm, respectively, to be emitted through the crystal and pass into the skin. This spectrum of light includes the shorter wavelengths of light that are preferentially absorbed by melanin containing targets in the epidermis and superficial dermis. Consequently, these shorter wavelengths would have a greater effect on pigmentation. For lighter skin types I through III these lower number cut-off filters would be preferred for a greater treatment effect on undesirable areas of hyperpigmentation, such as lentigoes and melasma. For darker skin types IV and V, where there is an abundance of epidermal melanin and thus more to target, the lower wavelength cut-off filter may create too much heat and result in the undesirable effect of a superficial epidermal burn. Choosing a lower number cut-off filter (515 nm and 560 nm) is best and thus more aggressive and effective in treatment of

pigmented lesions in lighter skin types I through III while higher number cut-off filters (590 nm and 640 nm) are more conservative and thus safer for treating darker skin types IV and V.

Fluence

The effect changing the fluence has on target lesions and skin is more easily understood intuitively than the effect of the other parameters. The higher the fluence the greater the thermal effect on the target tissue and the lower the fluence the lesser effect on the target tissue. Therefore, higher fluences are used for a greater effect on larger vessels and lighter pigmented lesions. For a more limited and conservative effect and a safer treatment, particularly in darker skin types, a lower fluence is selected.

Changing the pulse duration also has an effect on the target lesions and skin. For the same fluence, a shorter pulse duration delivers the same amount of light energy over a shorter time producing a higher peak temperature in the epidermis. The same fluence delivered over a longer pulse duration (e.g. 15ms or greater) produces a lower peak temperature in the epidermis. Thus, shorter pulse durations (less than 15ms) are better at heating superficial pigmented lesions.

Longer pulse durations for the same fluence make a treatment more conservative thus protecting skin with more pigmentation as in skin type IV and V. Longer pulse durations also allow higher fluence to be delivered over a longer period of time without creating excessively high temperatures in the epidermis. Higher fluences are necessary when treating larger vessels and deeper structures such as hair follicles. Longer pulse durations are selected for higher fluences and in darker skin types for a safer treatment.

Temperature

The effect of changing the contact cooling temperature on target lesions and skin can be thought of in the following way. The lower the temperature of the crystal in contact with the skin, the cooler the starting temperature of the epidermis; the cooler the temperature of the epidermis, the lower the peak temperature for the same fluence and pulse duration; the lower the peak epidermal temperature with each pulse of broad spectrum light, the more conservative the effect and the safer the treatment. Conversely, the higher the starting temperature of the crystal in contact with the epidermis, the greater the peak temperature of the epidermis and the greater the epidermal effect. Higher contact crystal temperatures are desirable when lighter or more resistant pigmented lesions are being treated. Lower contact crystal temperatures are used when there is greater epidermal melanin as in skin types IV and V and when high fluences are used to treat vascular or deeper dermal targets and it is necessary to protect the epidermis from excessive heating.

Spot size

Another parameter that is a factor relevant to the effectiveness of a treatment is the spot size of the crystal in contact with the treatment area. Some devices, such as Sciton's BBL™ (Palo Alto, CA), allow the operator to change the spot size through the use of treatment applicators that fit over the crystal, reducing the size of the treated area and allowing a more focused treatment. A smaller spot size permits the operator to use higher fluences that are focused on specific vascular and pigmented target areas producing the thermal effect necessary to clear the lesion yet containing the thermal effect within the target zone, while sparing non-target areas. Smaller spot adaptors or applicators also permit the treatment of harder to reach areas such as the medial canthus, nasal tip, and infrabrow skin.

Each pulsed light device has different parameters that have been worked out to treat pigmented and vascular lesions. While there is no one optimal parameter for every type of vascular or pigmented lesion, in general, vascular lesions respond most effectively to higher fluences, pulse durations of 10 to 20ms, and cut-off filters that are 560nm. The 515nm cut-off filters can be used for smaller and more superficial vessels, while the 590nm cut-off filter is used for skin type IV patients. As a general guideline, the larger the vessel the higher the fluence and the longer the pulse duration. Contact cooling is another factor that enters into consideration for treatment of both vascular and pigmented lesions. First, contact cooling provides protection of the epidermis, especially when a higher fluence is used or a lower numbered cut-off filter (515nm or 560nm) is selected. Second, a slightly higher contact temperature may be more effective at clearing superficial and smaller vessels as well as generalised erythema (e.g. raising the contact cooling temperature from 15°C to 20°C).

Benign pigmented lesions respond very well to pulsed light treatments with complete to nearly complete clearance expected in one or two treatments. In general, the lower wave length cut-off filters, such as 515nm filter for skin types I through III and 560nm filter for skin type IV patients are most effective for all types of benign pigmented lesions, such as ephelides, solar lentigoes, and thin pigmented seborrheic keratosis. Shorter pulse durations (5 and 10ms) are more effective for pigmented lesions than longer pulse durations. Additionally, higher contact cooling temperatures, such as 20–25°C are more effective at heating collections of epidermal melanin resulting in clearance of the pigmented lesion.

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While proper choice of parameters is essential to effectively treat pigmented and vascular lesions, treatment technique is equally important. Interestingly, most published papers on pulsed light treatments do not detail treatment technique. Either the authors assume that all pulsed light practitioners employ the same technique (i.e. a single pulse or a single pass over target lesions) or there is no consistent technique used from patient to patient. From nearly thirty thousand pulsed light treatments performed by this author, it is clear that how the treatment is performed is key to the final result. Given the same parameters, there can be markedly different results depending on exactly how the treatment is done. When reading scientific papers on pulsed light treatments, readers should always inquire and expect to be informed of exactly what technique the author used.

Treatments with pulsed light are essentially carried out with the practitioner's choice of parameters, applicator spot size, total number of pulses, number of passes, amount of overlap between pulses, and number of pulses over a given target. The other variables that influence the end result is whether a cooling device is used during treatment and the total number of treatments.

The author's preferred technique for pigmented and vascular lesions is to perform pulsed light treatments using a two-step process. The first step is to perform one or two passes over the entire cosmetic unit with milder more conservative parameters. The second step is to select a more aggressive parameter using a smaller spot size and focusing these pulses over the vascular or pigmented target. The purpose behind this two-step technique is that the first two passes over the entire cosmetic unit serve to first

improve the appearance of skin in the entire cosmetic unit and second, prime the vascular or pigmented lesion to be more sensitive to the more aggressive parameter used in the second step. By treating the entire cosmetic unit there is a blending of areas of lesser target with a more pleasing overall result for the patient. Also, by treating the entire cosmetic unit there is much less likelihood of a contrast between the treated and untreated skin. Contrast between treated skin and untreated areas may produce an obvious pattern in the shape of the crystal. This has been referred to as 'tiger striping' and has been a common and undesirable side-effect of pulsed light treatments. Tiger striping is a result of partial treatment of an area when more aggressive parameters are used. The use of higher fluence parameters and lower wavelength cut off filters has been the most commonly employed technique in the past with pulsed light treatments. This technique has had the common and undesirable side effect of tiger striping. Tiger striping never occurs with the two-step treatment process described in this article.

For the purposes of clarity it is important to distinguish between multiple pulses or passes and stacking of pulses. Stacking a pulse is when serial pulses are given over the same target area without pausing between pulses. The effect of stacking pulses is to create increasing epidermal and dermal heat with each subsequent pulse. Stacking of pulses creates a high likelihood of an epidermal or dermal burn and subsequent wound. Multiple pulses are pulses delivered with a pause between pulses. The pause may be the time to treat the entire cosmetic unit with a first pass before going back over the area a second time, or it may be just enough time to examine the target before the next pulse is delivered. This momentary pause of a few seconds to a minute is sufficient to allow cooling of the treatment site enough so as to avoid the thermal burns that may occur by stacking pulses. This author recommends against stacking pulses with pulsed light treatments.

Lastly, it is essential to record precisely the parameters and technique employed with each treatment. Each treatment record should record, as a minimum, not only the pulsed light device used and choice of filter, fluence, pulse duration spot size and contact cooling, but also the number of pulses and passes over a given area. Reporting the parameters but not reporting the technique is analogous to reporting the concentration of botulinum toxin used, but not reporting the amount and exact location of each injection. Without this information the reader would not really know how the treatment was performed and would be unlikely to duplicate the results. By carefully recording parameters and technique, the practitioner learns what is effective, as well as what is too aggressive or too conservative a treatment for each patient. Others can learn from experienced practitioners who record and report the details of both parameters and technique advancing our knowledge of pulsed light and how to treat a wide variety of conditions in patients with all skin types safely and effectively.