Evaluation of a New 400 ms Extended Pulse LightSheer™ Diode System for Safe and Effective Laser Hair Removal

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INTRODUCTION

SUCCESSFUL LASER HAIR REMOVAL relies on the principle of selective photothermolysis. The preferential absorption of light energy by melanin pigment in the hair follicle occurs when appropriate wavelengths, fluences and pulse durations are chosen. In laser hair removal systems, pulse durations are typically equal to or shorter than the thermal relaxation time (TRT) of terminal hair follicles. The required pulse duration for permanent reduction of medium to coarse hairs must be longer than the TRT of the hair shaft in order to permit thermal diffusion and damage to the regenerative structures of the follicle.

The challenge with laser hair reduction in dark skin individuals is to target the hair follicle while protecting the melanin-rich epidermis. This involves two techniques, the selection of extended pulse durations and the use of aggressive contact cooling. Selective photothermolysis predicts that heat diffuses more slowly from thick, coarse hairs, than from smaller structures, such as the melanin containing epidermis. Coupled with contact cooling, longer pulse durations confine thermal damage to the follicle while allowing heat to diffuse from the epidermis. Under these circumstances, the skin does not reach its damage threshold and is protected from thermal injury. Continuous contact cooling, before, during and after the pulse, lowers the epidermal temperature prior to the pulse and later, extracts heat away from the skin. This combination of skin cooling techniques and extended pulse durations permits the safe use of higher, more efficacious fluences for the treatment of dark-skinned individuals.

METHODS

A modified 800 nm pulsed diode LightSheer™ laser system with a 9x9-mm chilled (4° C) sapphire tip was used during this study. A 400 ms extended pulse duration setting was available in addition to the standard, shorter pulse width options. The device is capable of generating treatment fluences up to 100 J/cm^2. Twenty dark-skinned subjects (phototypes IV – VI) were enrolled in a 100 ms and 400 ms comparative investigation. Test spots were first administered on the backs of all subjects to determine the maximum tolerated dose (MTD) at each of the two pulse durations. Each of these two settings was then used to perform side-by-side laser treatments. Adverse reactions were noted and hair reduction was evaluated.

RESULTS AND CONCLUSIONS

Table 1 shows the 400 ms test spot safety data for the enrolled subjects. Side effects were typical of laser hair reduction therapy and generally consisted of burning/stinging pain, peri-follicular edema and erythema, and rarely, purpura and the Nikolsky sign. At high fluences, one subject exhibited epidermal hypopigmentation that remained evident at one-month post-exposure. Otherwise, delayed changes in pigmentation, scarring or textural change were not observed using the 400 ms pulse duration. As with shorter pulse durations, the MTD at 400 ms is inversely correlated with skin type. For skin phototype IV and V subjects, the MTD at the 400 ms pulse duration was approximately three times the MTD at 100 ms. Phototype VI individuals tolerated nearly twice the fluence at 400 ms as with the 100 ms pulse duration. Using the acceptably tolerated treatment doses for the 100 and 400 ms pulse durations, no patients complained of any discomfort during hair reduction treatment or post-operatively.

Six weeks after the first treatment, hair reduction was roughly 20% for each of the first seven of the enrolled subjects at the MTD for the 400 ms pulse duration. Because laser hair reduction is fluence dependent, extended pulse LightSheer diode systems that incorporate contact cooling

are particularly advantageous to dark-skinned individuals. Since approximately two or three times the fluence of extended pulse 800 nm laser light can be safely applied on dark skin without risk of adverse reactions, fewer treatments will likely be required to achieve complete and permanent hair reduction. Furthermore, at the selected fluences, there is no greater risk of pigmentary anomalies compared to shorter pulse widths for lighter skin types.

The addition of the 400 ms pulse width expands the already established safety and efficacy of the LightSheer in even the darkest skin types by requiring fewer treatments for long-term hair reduction. The integrated parallel cooling provides tremendous patient comfort and epidermal protection, even when compared to longer wavelengths. Clinical trials are ongoing in order to further assess the long-term hair reduction in dark-skinned subjects following a course of three treatments separated at six-week intervals.

Table 1: Adverse Reactions Following 400 ms LightSheer Test Spots

Skin Type	Fluence (J/cm^2)	Patients with Adverse Reactions/ Total Patients
IV	80	0/5
IV	90	4/5
IV	100	5/5
V	60	0/10
V	70	2/10
V	80	8/10
V	90	10/10
VI	40	0/5
VI	50	3/5
VI	60	5/5

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