

Safe and Effective Long-Term Hair Reduction in Tanned Patients Using an 800 nm Diode Laser

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ABSTRACT: This study examined hair reduction in eleven tanned women and one tanned man (with Fitzpatrick Skin Types III to IV) using the 800 nm LightSheer™ Diode Laser System at our clinic in Jundiai, Brazil. The patients were treated with fluences ranging from 30 to 45 J/cm² at pulse durations of 30 and 100 ms and a pulse frequency of 0.5 Hz. Long-term hair reduction was achieved with all tested fluences and pulse durations, with hair regrowth ranging from 23% at one month post-treatment to 73% at the twelve-month follow-up period. Although the difference was not statistically significant, hair regrowth was slightly higher

in sites treated at 100 ms at all time periods. With a fluence of 30 J/cm² and a pulse duration of 30 ms, a single treatment site on each of three patients developed either hypopigmentation (1 site) or hyperpigmentation (2 sites). At 30 J/cm² and 100 ms, no pigmentary change or any other sign of epidermal injury was observed in any patient treated. This study suggests that the LightSheer Diode Laser System provides both safe and effective long-term reduction of unwanted hair in tanned patients with a fluence of 30 J/cm² and a pulse width of 100 ms.

INTRODUCTION

BOTH THE SCIENCE AND PRACTICE OF LASER HAIR reduction have made great advances over the past ten years. From the earliest Q-switched Nd:YAG lasers that required the concomitant use of a carbon suspension, through the development of the long-pulse ruby laser^{2,3,4}, the alexandrite laser⁵, and finally the solid-state diode laser^{6,7,8}, the pace of innovation in laser hair reduction systems has been truly remarkable. In addition to these technical achievements, an increasing body of clinical experience has given physicians insight into the most appropriate treatment parameters (e.g., fluence, pulse duration, and epidermal cooling) for specific hair and skin conditions⁶⁻¹³. Together, these advances have brought practitioners to the point where permanent reduction in unwanted hair can be provided safely to men and women with most skin types and hair colors.

The remaining challenge has been to extend the benefits of laser hair reduction to people with darker skin types (Fitzpatrick Skin Types IV, V, or VI) and to people with tanned skin. In the past, most practitioners did not recommend laser hair reduction for these patients because of the risk of epidermal damage caused by the absorption of laser energy in the heavily pigmented basal layer.

However, a number of new studies have shown that by using an 800 nm diode laser with modified treatment parameters, laser hair reduction can be safely and effectively used to treat patients with all Fitzpatrick Skin Types, including those with Skin Types IV, V, and VI.¹⁴⁻¹⁶

The key treatment parameters that have emerged from these studies are duration of the laser pulse and the method of cooling the epidermis before, during and after treatment.^{14,15} Because of differences in thermal relaxation time between the small melanin-containing structures (<5 ms) in the epidermis and the large pigmented hair shafts (>40 ms), the most effective pulse duration has been shown to be one that is long enough to allow the heat generated in the epidermis to dissipate before the temperature of the tissue reaches the damage threshold, but short enough to allow sufficient heat to build up in the hair follicle to destroy the regenerative structures.¹²

As importantly, active or parallel cooling of the skin has been shown to further reduce the risk of unwanted thermal damage. The key to effective cooling is to cool the skin prior to, during and after the laser pulse, in a manner that provides index matching at the skin surface. This is possible when using a chilled sapphire treatment tip.¹³

For tanned patients, practitioners have traditionally taken a conservative approach, recommending the use of bleaching creams or waiting until the tan fades before starting treatment. As the melanin in tanned skin is the same as melanin in dark skin, results from published studies of hair removal in patients with darker skin and our own experience led us to hypothesize that similar treatment parameters could be used to safely treat tanned skin. This study was designed to test this hypothesis and to identify treatment parameters that minimize the risk of epidermal injury while providing long-term hair reduction for tanned patients.

STUDY DESIGN

In this ongoing, prospective study, eleven tanned women and one tanned man (Fitzpatrick Skin Types III-IV) were treated with the LightSheer Diode Laser System (Lumenis, Inc.). All of the patients had sun exposure, during the week before treatment.

The LightSheer Diode Laser System used in the study was capable of producing variable pulse durations (30-100 ms) and a range of fluences (15-60 J/cm²). The patients were treated with fluences that varied between 30, 35, and 40 J/cm² and pulse durations of 30 and 100 ms. Epidermal cooling was provided by applying the ChillTip™ sapphire lens (Lumenis, Inc.) to the treatment site for approximately one-half second before, during and after each laser pulse. For this study, patients received a single treatment with the LightSheer.

Hair counts were calculated from two test sites on the posterior thigh of each patient. Anatomical markers (e.g., knee, prominent moles, etc.) were identified on each patient to ensure exact alignment at follow-up visits, and a standard grid anchored to these markers was used to indicate the treatment sites. Digital photographs of the grid and the anatomical markers were then taken to be used for alignment at follow-up. Before the initial treatment and at each follow-up visit, digital photographs were taken of each test site from a fixed distance, and it was these photos that were used for the hair counts. Before treatment, the test sites were shaved and the skin was cleaned with isopropanol.

At baseline and at each follow-up visit, the number of terminal hairs at each test site was counted from the digital photographs by a single investigator to ensure consistency. Hair regrowth was defined as the percentage of terminal hairs remaining after treatment compared with the number at baseline. The investigator also examined the test site and recorded any adverse skin response, including hypopigmentation, hyperpigmentation, erythema, edema, crusting, blistering, or textural changes.

RESULTS

Long-term hair reduction was achieved at all tested pulse durations. Table 1 shows the patient-by-patient breakdown of hair counts after a single treatment at 30 J/cm². Even with a single treatment with this lowest applied fluence, average hair regrowth with the 100 ms pulse duration ranged from 23% at one month post-treatment to 73% at twelve months. Similarly, with the 30 ms pulse duration hair regrowth ranged from 24% at one month to 66% at twelve months (Table 2, Figure 1).

Hair regrowth was affected by pulse duration. Although the differences did not reach statistical significance because of the limited sample size, hair reduction on sites treated with a 100 ms pulse duration had slightly higher hair regrowth values at 3, 6, and 12 months post-treatment than sites treated with a 30 ms pulse duration (Table 2, Figure 1).

In terms of safety, both fluence and pulse duration played a role. Test sites treated at 35 and 40 J/cm² in six patients showed epidermal injury at one week post-treatment, including blistering, hyperpigmentation, and hypopigmentation. In general, epidermal injury was more severe with the 30 ms pulse duration, but at these higher fluences, epidermal injury often occurred at both 30 and 100 ms (Figures 2 and 3).

Test sites treated with 30 J/cm² generally had little or no epidermal damage. Exceptions included sites treated with 30 J/cm² fluence at 30 ms on two patients that exhibited transient hyperpigmentation at the one-month follow-up that resolved by the three-month follow-up date. In addition, one patient treated with 30 J/cm² in 30 ms developed hypopigmentation at one site at the one-month follow-up that resolved by the sixth month.

Table 1. Hair Counts After a Single Treatment with 30 J/cm²

Patient #	Pulse Duration	Base-line	Hair counts			
			1 m	3 m	6 m	12 m
1	30 ms	70	38	40	68	60
	100 ms	89	39	78	72	72
2	30 ms	49	6	20	19	25
	100 ms	36	8	3	24	22
3	30 ms	77	52	20	59	67
	100 ms	73	40	21	57	57
4	30 ms	60	11	35	35	40
	100 ms	35	3	24	41	47
5	30 ms	60	13	46	35	45
	100 ms	70	29	64	52	59
6	30 ms	32	10	23	37	37
	100 ms	26	5	19	29	32
7	30 ms	53	9	36	30	36
	100 ms	59	14	24	32	24
8	30 ms	25	6	18	11	11
	100 ms	23	4	16	14	12
9	30 ms	61	9	42	42	44
	100 ms	43	4	44	48	43
10	30 ms	31	4	36	15	10
	100 ms	26	1	22	14	5
11	30 ms	70	5	27	29	30
	100 ms	60	10	30	33	31
12	30 ms	29	3	11	14	15
	100 ms	32	4	15	18	17

Table 2. Percent Hair Regrowth After a Single Treatment with 30 J/cm²

Pulse Width	1 Month	3 Months	6 Months	12 Months
30 ms	24.3%	61.0%	62.7%	66.0%
100 ms	22.8%	62.7%	76.7%	73.2%

Table 3: Epidermal Injury by Fluence and Pulse Duration Immediately Post-Treatment on Tanned Patients*

	30 J/cm ²	35, 40 J/cm ²
30 ms	<ul style="list-style-type: none"> • Erythema, slight crusting • Hyperpigmentation, hypopigmentation in a few cases 	<ul style="list-style-type: none"> • Erythema, edema • Blistering • Hyperpigmentation, hypopigmentation
100 ms	No Injury	<ul style="list-style-type: none"> • Erythema, edema • Erythema Crusting • Erythema Pigmentary changes

*All adverse effects transient.

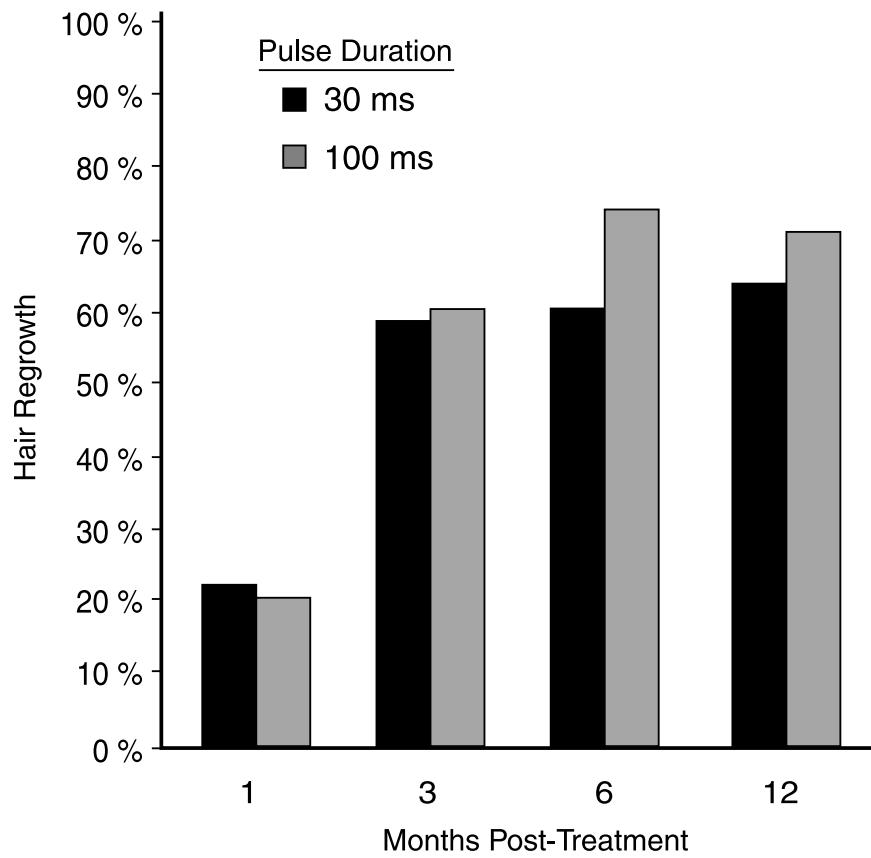


Figure 1. Percent Hair Regrowth After a Single Treatment with 30 J/cm².

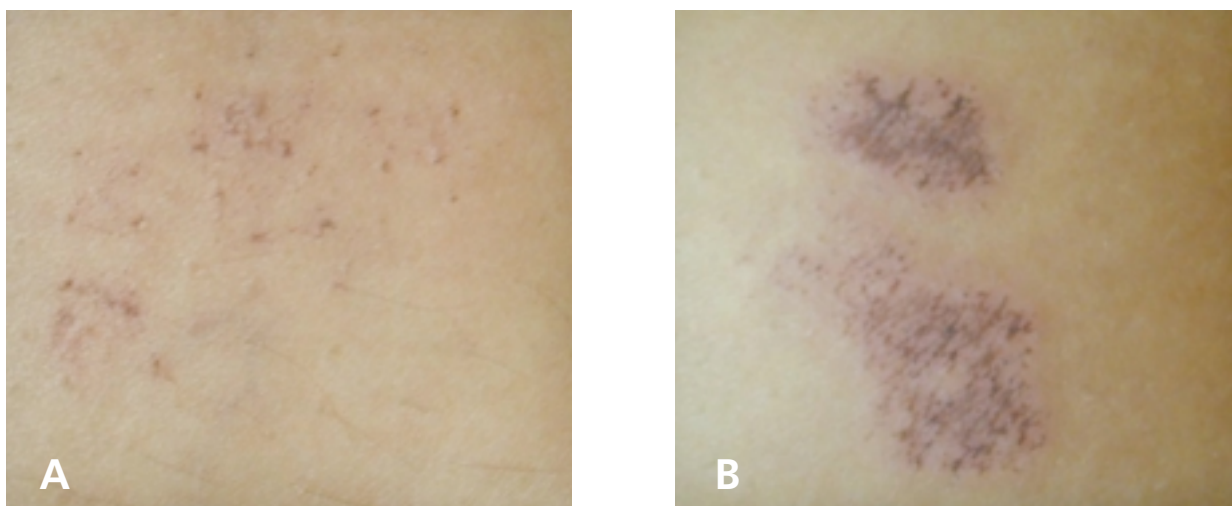


Figure 2. Digital photographs of test sites on the posterior thigh of a woman treated with 40 J/cm² in 100 ms (photo A) and 30 ms (photo B). With a 100 ms pulse duration, slight crusting is visible with several small (<1mm) lesions. With a 30 ms pulse duration, the epidermal injury is more severe, with contiguous areas of damage (>1cm) showing blistering.

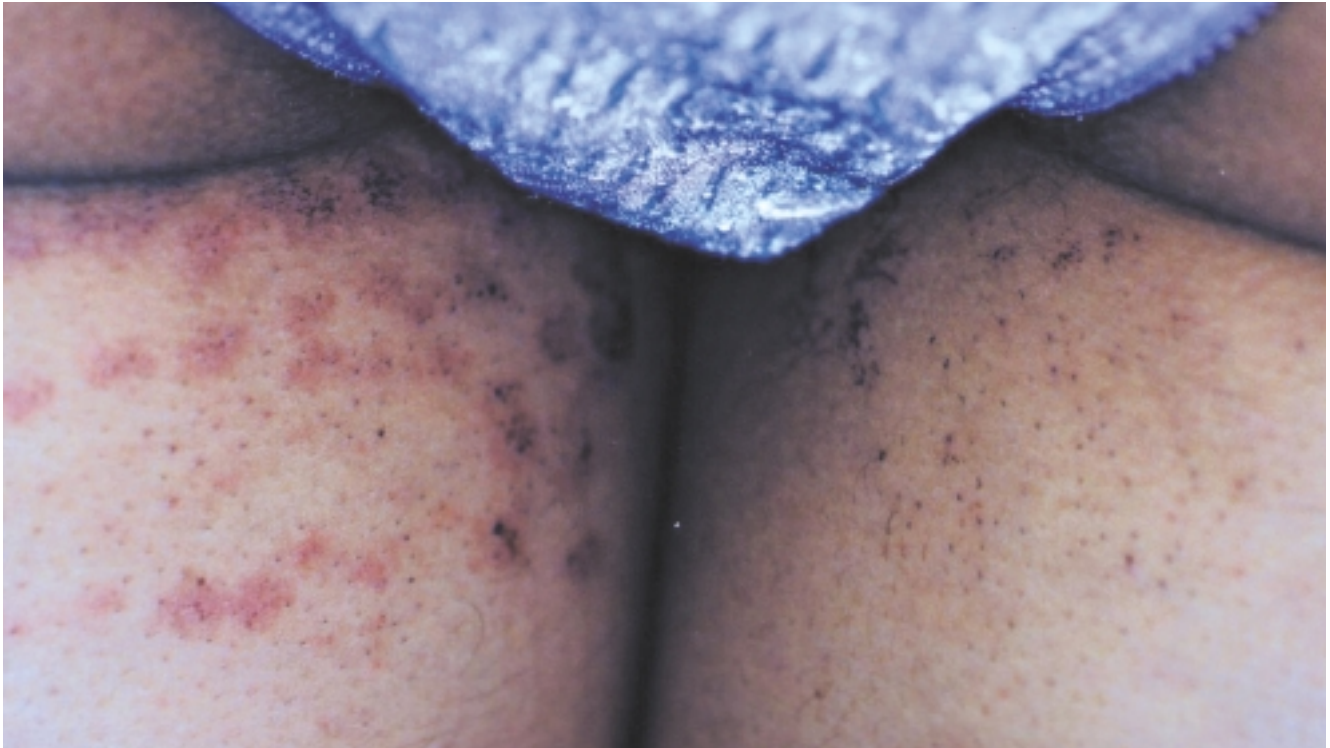


Figure 3. Digital photograph taken at 3 days post-treatment of test sites on the buttocks of a woman treated with 40 J/cm². The left side was treated at a pulse duration of 30 ms and the right side was treated with a pulse duration of 100 ms. The epidermal injury (erythema, edema, blistering) is more pronounced with the 30 ms pulse duration with contiguous areas >1 cm in diameter affected.



Figure 4. Digital photograph taken at 2 days post-treatment of the bikini line of a patient treated with a fluence of 30 J/cm² at a pulse duration of 100 ms. No epidermal injury was observed.

At sites treated with a fluence of 30 J/cm² and a pulse duration of 100 ms, no epidermal injury was observed at any of the test sites on any patient. Figure 4 shows a typical result using these treatment parameters. The patient's bikini line was treated two days before this photograph was taken. Although she had a clearly discernible tan at treatment, no epidermal injury occurred.

DISCUSSION

This study has shown that the LightSheer Diode Laser System with contact cooling, long pulse durations, and moderate fluences can be used to provide safe and effective removal of unwanted hair in tanned patients. As importantly, treatment provides not only a short-term benefit but also a long-term reduction in hair regrowth. Follow-up is continuing to better quantify the permanence of this effect.

Both the efficacy and risk of epidermal injury when using the LightSheer on tanned patients was correlated in this study with fluence and pulse duration (Table 3). Higher fluences and shorter pulse durations were associated with an increased risk of epidermal injury and should not be used on tanned patients.

Treatment with 30 J/cm² in 100 ms caused no epidermal injury at any of the test sites on any of the patients in the study. We recommend that practitioners treating tanned patients for the first time start with such conservative parameters and use higher fluences only after they have proven safe in limited skin testing, taking into consideration the body area being treated, the amount of skin pigmentation, and the hair density in each area.

The immediate skin response after treatment will appear different when using a 100 ms pulse duration. When using this long pulse duration, there is less reaction on the skin compared to shorter pulse durations. Especially when trying a 100 ms pulse duration for the first time, it is important to be conservative with the choice of fluences to avoid over-treating the site.

When providing laser hair reduction to tanned patients, as with other patients, it is also important to remind them that they may see what appears to be hair re-growth shortly after treatment. In actuality, hairs extruding from the skin within a few days after treatment are the remnants of the hair shaft falling out of the follicle. Our experience has been that this phenomenon is more

common when using a 100 ms pulse duration, perhaps because less of the hair shaft is vaporized than when using shorter pulse durations. In any case, patients should be advised to expect to see these remnants.

Although this study was not designed specifically to evaluate which hair types are best suited to treatment, our experience has shown that it is difficult to get effective hair reduction in patients with fine hair and tanned skin. Again, patients should be counseled so that they have reasonable expectations of the improvement they are likely to see.

Laser hair reduction represents a significant advance in the treatment of unwanted hair. It is effective, fast, convenient, and safe. Until recently, tanned patients were unable to take advantage of this procedure without having to use bleaching creams or waiting until the tan faded. As the results of this study became clear to us, we began offering the procedure to tanned patients in our Jundiai clinic, and the patients have reported uniformly high levels of satisfaction.

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