Journal of Cutaneous Laser Therapy 2000; 2: 183–190
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Original Research

800 nanometer diode laser hair removal in African American patients: a clinical and histologic study

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Received 6 December 2000
Accepted 12 February 2001

Keywords:
dark skin type – diode laser – hair removal – laser hair removal – pulse duration

BACKGROUND: **Although numerous lasers are available for laser assisted hair removal, their use in individuals with a dark skin type presents many challenges due to competition from epidermal melanin.**
OBJECTIVE: **Our aim was to evaluate two 800 nm diode lasers (Lightsheer®) with 30 msec and 100 msec pulse durations in the treatment of African American patients with skin types V and VI. Histologic studies, efficacy and side effects were examined in an effort to optimize laser hair removal procedures in this patient population.**
METHODS: **Facial, neck and axillary areas were treated using 800 nm diode lasers at 30 and 100 msec pulse durations with fluences between 15 J/cm² and 40 J/cm².**
RESULTS: **Both lasers could be used safely in skin type V and VI African American patients. Longer pulse durations enabled the delivery of higher fluences with minor and acceptable postoperative complication profiles.**
CONCLUSION: **The Lightsheer® diode laser (Coherent Medical, Santa Clara, CA, USA) operating at 30 msec and 100 msec can be safely used in hair removal procedures in African American patients.** *J Cutan Laser Ther* 2000; **2**: 183–190

Introduction

Over the past 5 years, a variety of lasers have been introduced for laser assisted hair removal. Initial studies using a Q-switched neodymium:YAG laser in conjunction with a carbon suspension failed to achieve any significant long-term hair reduction.[1,2] Early studies using a 1 msec normal mode ruby laser showed poor efficacy in hair reduction and significant postoperative pigment disturbances in tanned or dark skinned individuals.[3] More recently, long pulse ruby 694 nm[4,5] alexandrite 755 nm,[6] diode 800 nm[7,8] and neodymium:YAG 1064 nm[9] lasers have been introduced for laser hair removal. All of these systems show fair to good efficacy in long-term hair reduction, and are routinely used in individuals of a light skin type with dark hair.[10–16]

Examination of the melanin absorption curve shows significant energy absorption by melanin at wavelengths from 694 nm to 800 nm (Figure 1). This observation is confirmed clinically when these wavelengths are used in laser hair removal procedures. In fair (skin types I–III) patients with dark hair all wavelengths and various pulse durations show certain degrees of efficacy and lack significant postoperative side effects. As epidermal melanin increases in skin type IV–VI individuals, hair removal procedures become problematic with acute (blistering, crusting) and long-term (pigmentation) disturbances more common.[17] Laser assisted hair removal in

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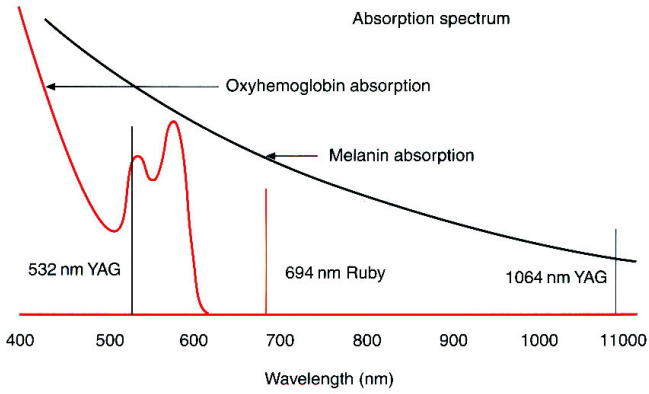


Figure 1
Melanin absorption curve. Note significant absorption by melanin at ruby 694 nm, alexandrite 755 nm and diode 800 nm wavelengths.

dark skinned individuals is clinically challenging, since a melanin-laden epidermis competes directly with the hair shaft, resulting in an increased incidence of postoperative side effects.

Pulse duration plays a significant role in laser hair removal in individuals with a dark skin type. For any given wavelength, increasing pulse duration allows the delivery of higher fluences in such individuals. Differences in the thermal relaxation times between small micron sized melanosomes and the large pigmented hair shaft can be exploited by using pulse durations greater than thermal relaxation time of microscopic melanosomes (<5 msec), but less than the thermal relaxation time of large pigmented hair shafts (>40 msec).

Cutaneous cooling is another important factor in laser hair removal, especially in patients with a dark skin type. Contact cooling before, during and after pulse delivery is the most effective means of protecting the epidermis from an excessive temperature rise, and allows the use of higher and presumably more effective fluences, with fewer postoperative side effects.[18] The role of epidermal damage during laser hair removal is controversial however: except for the cosmetic 'downtime' associated with its occurrence, no long-term side effects are noted provided proper pulse durations are employed. Epidermal devitalization itself is rapidly repaired (Figure 2, A and B). If, however, melanosomes and their factories, the melanocytes in periglandular and perifollicular areas, are destroyed or significantly disabled during hair removal using short pulse duration lasers, prolonged postoperative hypopigmentation may develop (Figure 3). If longer pulse durations are used small structures (melanosomes) can survive and migrate along with regenerating epidermal cells, thus avoiding significant postoperative epidermal hypopigmentation. Fluence is the most important factor in laser hair removal and most clinicians attempt to deliver maximum fluence with the fewest postoperative side effects. The use of cutaneous cooling and longer pulse durations allows the delivery of higher fluences with improved clinical efficacy and safety.

Over the past 2 years we have had the opportunity to study the use of an 800 nm diode laser in hair removal procedures in skin type V and VI African American individuals. Our clinical and histological observations will be presented in order to provide reasonable guidelines for the use of 800 nm diode lasers in hair removal procedures in individuals of a dark skin type.

Clinical observations

At the present time, there are six recognized skin types and although clinical descriptions are clear, interpretation varies among physicians. Skin types I–IV are fairly easily recognized. Skin types V and VI are often mislabeled, with lightly pigmented African Americans often classified as skin type V or VI. In our practice, light-brown skinned African American patients are classified skin types IV–V, while dark skinned African Americans are classified as skin type V or VI. True skin type VI patients are not commonly seen and may better be classified as skin type VIb or VII (Figure 4). Confusion regarding skin type can lead to confusion among practitioners when treating these patients since skin type IV patients can be treated with significantly higher fluences than true skin type VI or darker skinned patients. We have treated over 40 skin type V and VI patients and have arrived at what seems to be a reasonable approach to laser hair removal in these individuals.

Coherent Medical (Santa Clara, CA, USA) provided the diode lasers (Lightsheer®) used in this study. Two different units were used. One unit was capable of delivering pulse durations between 10 msec and 30 msec at a maximum fluence of 60 J/cm^2. An extended pulse unit was capable of providing selective pulse durations up to 100 msec with fluences to 60 J/cm^2. The availability of

(A) (B)

Figure 2
Acute crusting noted 24 hours after diode laser treatment of a skin type IV Asian patient (A). Six days post treatment showing complete epidermal repair and lack of pigment disturbances (B).

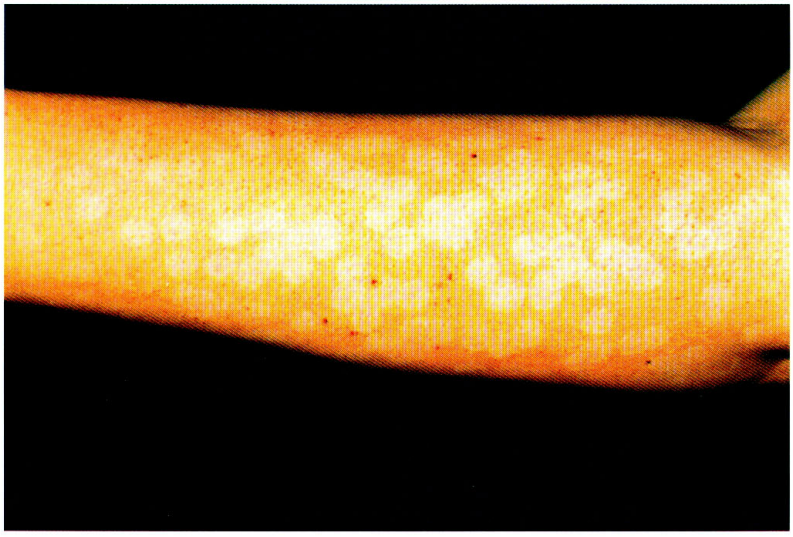
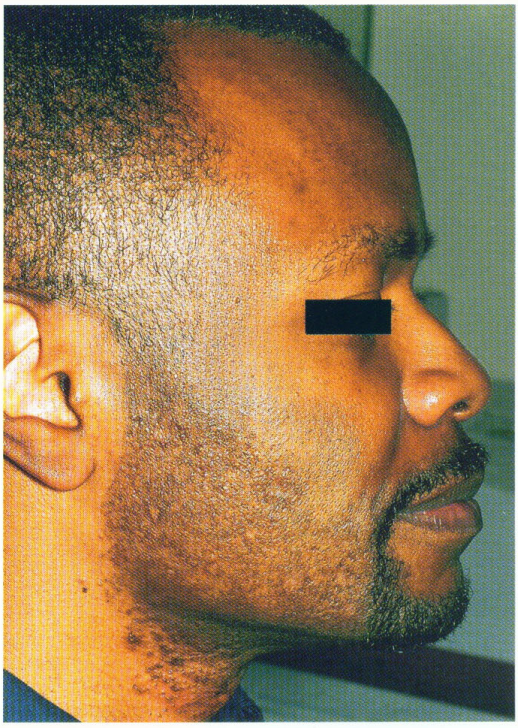


Figure 3
Hypopigmentation 6 months after 3 msec ruby laser hair removal treatment in a tanned patient. Note normal epidermis and significant hypopigmentation.

(A)



(B)

(C)

Figure 4
Range of pigmentation noted in African American patients. From light to dark brown colors. All could be considered skin type VI patients.

these two units enabled us to use a wide variety of fluence and pulse duration combinations. The availability of contact cooling also permitted the use of higher fluences with fewer side effects.

Results

Results of clinical studies showed that the 800 nm diode laser at 30 msec could be safely used in skin type V and VI individuals. Fluences used at 30 msec ranged from 15–25 J/cm^2 in skin type V individuals and 15–20 J/cm^2 in skin type VI individuals. At these fluences few postoperative complications were noted and most often were seen as mild crusting and transient hyperpigmentation (Figure 5). The use of 100 msec pulse durations allowed approximately 30% higher fluences to be used: 20–35 J/cm^2 in skin type V and 20–30 J/cm^2 in skin type VI individuals (Table 1). These fluences were able to achieve significant short-term hair reduction in patients with an acceptable incidence of postoperative side effects (Figure 6, A and B; Figure 7, A and B). The availability of 100 msec pulse durations provided a means of delivering higher laser fluences with mild postoperative side effects and good efficacy in most patients. Long-term follow up studies after multiple treatments are in progress to determine long-term efficacy.

Histologic observations

Histologic studies in vivo and in vitro showed that the Lightsheer® diode laser operating at 30 msec and 100 msec pulse durations could safely (from a histologic perspective) treat patients with skin types V and VI. Biopsies obtained immediately post laser treatment at low fluences showed mild epidermal damage and occasional subepidermal separation at the dermal epidermal junction (Figure 8). Higher fluences, however, showed full thickness epidermal damage and residual thermal damage in the dermis (Figure 9). Longer 100 msec pulse durations showed less epidermal damage when compared to similar fluences at 30 msec.

Discussion

In our practice almost all African American women presented with facial and/or neck hair with or without pseudofolliculitis barbae (PFB). Men universally consulted us for treatment of 'beard bumps'. Most patients noted a significant reduction in PFB activity after a single treatment and were pleased with these results regardless of our overall hair reduction success. Most dark skin type men and women noted reduction in PFB symptoms within 2–4 weeks after initial laser treatment. We currently use the Lightsheer® diode laser to treat skin types V and VI African American patients using the fluences outlined in Table 1.

We routinely do test patches and observe results at one week in order to maximize treatment parameters. In most instances we treat at 5 J/cm^2 below the maximum tolerated dose in order to provide a margin of safety during extensive procedures in deeply pigmented individuals. Longer pulse durations and contact cooling, along with reduced fluences, can provide significant long-term hair reduction with acceptable postoperative side effects and lack of long-term complications.

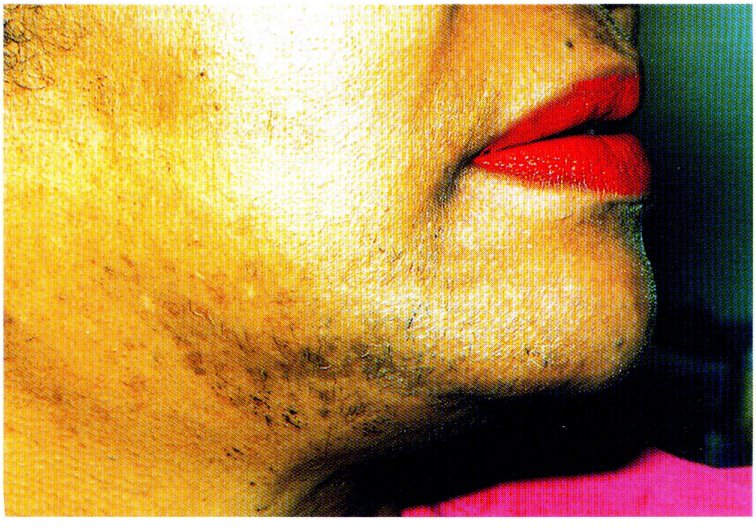
The availability of 100 msec pulse durations in the Lightsheer® diode laser has enabled us to expand our hair removal practice to include patients of all skin types. Long-term studies are currently in progress to determine

Figure 5
Transient hyperpigmentation which may be noted in response to diode hair removal procedures in dark skin type patients.

Skin type	30 msec	100 msec
IV	20–30 J/cm^2	35–45 J/cm^2
V	15–25 J/cm^2	20–35 J/cm^2
VI	15–20 J/cm^2	20–30 J/cm^2

Table 1
Fluence and pulse duration parameters in relation to skin type in African American patients.

(A)



(B)

Figure 6
Skin type VI African American patient before (A) and 5 months after (B) three diode laser treatments (face).

the degree of permanent hair reduction achievable in patients of dark skin type. Regardless of the degree of hair reduction, however, the dramatic improvement in PFB or 'beard bumps' resulting from this treatment makes this procedure a worthwhile option for patients with a dark skin type who have excess hair and its associated complications.

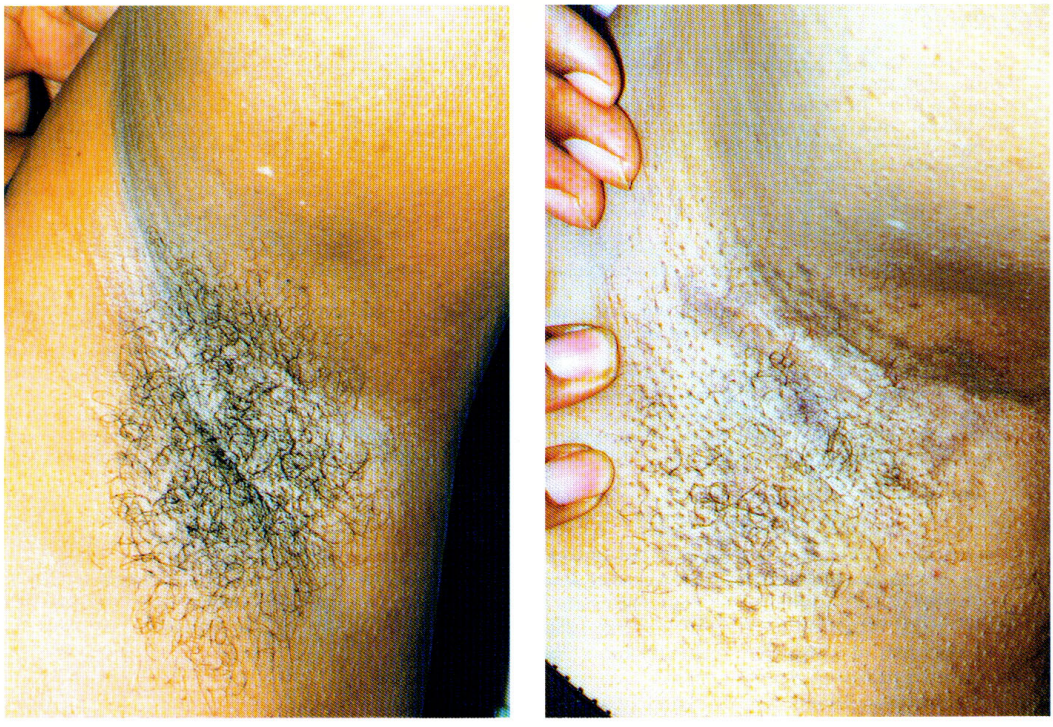


Figure 7
Skin type VI African American patient before (A) and 6 months after (B) three diode laser treatments (axilla).

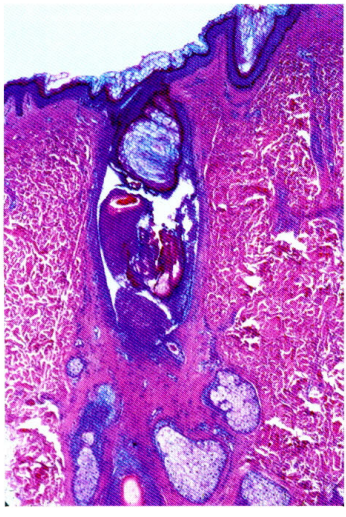


Figure 8
Diode laser treatment biopsy of skin type VI patient treated at 100 msec and 30 J/cm^2. Epidermis is spared and hair follicle is coagulated.

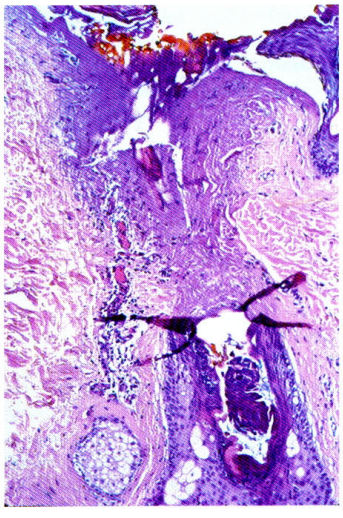


Figure 9
Skin biopsy immediately post-treatment showing epidermal damage and coagulation of hair follicle in skin type VI patient treated at 30 msec and 30 J/cm^2.

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