Long-Pulsed 1064-nm Nd:YAG Laser-Assisted Hair Removal in All Skin Types

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BACKGROUND. **Although there are several different laser systems available for the reduction of unwanted hair, no single system has been shown to be superior in providing safe and effective hair removal in every skin type. The purpose of this study was to evaluate the safety and efficacy of a high-energy, long-pulsed, 1064-nm Nd:YAG laser with a contact cooling device for hair removal in skin phototypes I–VI.**

METHODS. **Thirty-six adult patients (skin phototypes I–VI) with dark terminal facial or nonfacial hair were treated with a long-pulsed Nd:YAG laser (1064 nm, 10-mm spot size, fluence of 30 to 60 J/cm^2). The selected pulse duration was dependent on the skin type of the patient: Skin types I/II, III/IV, and V/VI received 10, 20, and 30 ms, respectively. Three consecutive laser treatments were delivered to 36 skin sites at 4- to 6-week intervals. Hair counts and photographic evaluations of skin sites were obtained at baseline, immediately before each treatment session, and at 1, 3, and 6 months after the final laser treatment.**

RESULTS. **Peak hair reduction was observed 1 month after the series of laser treatments with a mean hair reduction ranging from 58% to 62% on facial sites and 66% to 69% on nonfacial sites. At 6 months after a series of three long-pulsed Nd:YAG laser treatments, a mean hair reduction of 41% to 46% on the face and 48% to 53% on the body was found depending on the skin phototype. Adverse reactions included mild to moderate treatment pain, short-term erythema, and rare occurrences of transient pigmentary alteration without scarring.**

CONCLUSION. **The long-pulsed 1064-nm Nd:YAG laser with contact cooling is a safe and effective method of hair reduction in patients of all skin types. Side effects were limited and transient.**

E. L. TANZI, MD AND T. S. ALSTER, MD HAVE INDICATED NO SIGNIFICANT INTEREST WITH COMMERCIAL SUPPORTERS.

SINCE ITS INTRODUCTION in 1995, laser-assisted hair removal has continued to grow in popularity. Rapid technologic advances in photoepilation by lasers and noncoherent light sources have made it difficult for even the most experienced laser surgeons to keep abreast of the latest developments. Based on the theory of selective photothermolysis,[1] lasers and intense pulsed light (IPL) sources with wavelengths in the red or near-infrared region (600 to 1200 nm) are most often used for hair removal because they effectively target melanin within the hair shaft, hair follicle epithelium, and heavily pigmented matrix.[2–4] Laser systems and IPL sources currently approved by the Food and Drug Administration for the reduction of hair include the long-pulsed ruby (694 nm), alexandrite (755 nm), diode (800 nm), and Nd:YAG (1064 nm) lasers and IPL (500 to 1200 nm) sources.

Although all of the aforementioned lasers and light sources meet the wavelength criteria for effecting selective follicular destruction, the treatment of darker skin phototypes has been particularly problematic because of the interference of epidermal melanin with laser absorption. To reduce epidermal energy absorption relative to follicular absorption, longer wavelength lasers such as the Nd:YAG have been shown to be best for patients with darker skin tones.[5–7] Additional advantages of the longer wavelength include reduced scatter and deeper penetration of the laser light. Although decreased absorption of the 1064-nm Nd:YAG wavelength by melanin-containing structures is an advantage in terms of epidermal heating and damage, it follows that the desired target (hair) also is less effectively heated. The use of high fluences and larger spot sizes can potentially compensate for the reduced melanin absorption capacity by taking advantage of reduced scatter of the laser energy as it passes through the epidermis.

The long-pulsed Nd:YAG laser has demonstrated safe and effective hair removal in patients with darker skin phototypes in a number of studies.[5–9] However, there are limited data regarding its long-term effectiveness in patients with paler skin phototypes (I–III). Furthermore, no study to date has been performed to evaluate laser-assisted hair removal in all skin phototypes by a single laser system. Therefore, the purpose of this study was to evaluate the safety and efficacy of

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Table 1. Laser Parameters

Skin Phototype	*Site*	*Number of Patients (n)*	*Pulse Duration (ms)*	*Fluence Range (J/cm^2)*	*Mean Fluence (J/cm^2)*
I/II	Facial	6	10	48–60	56
	Nonfacial	6	10	50–60	54
III/IV	Facial	6	20	38–50	46
	Nonfacial	6	20	45–55	50
V/VI	Facial	6	30	30–45	38
	Nonfacial	6	30	35–50	44

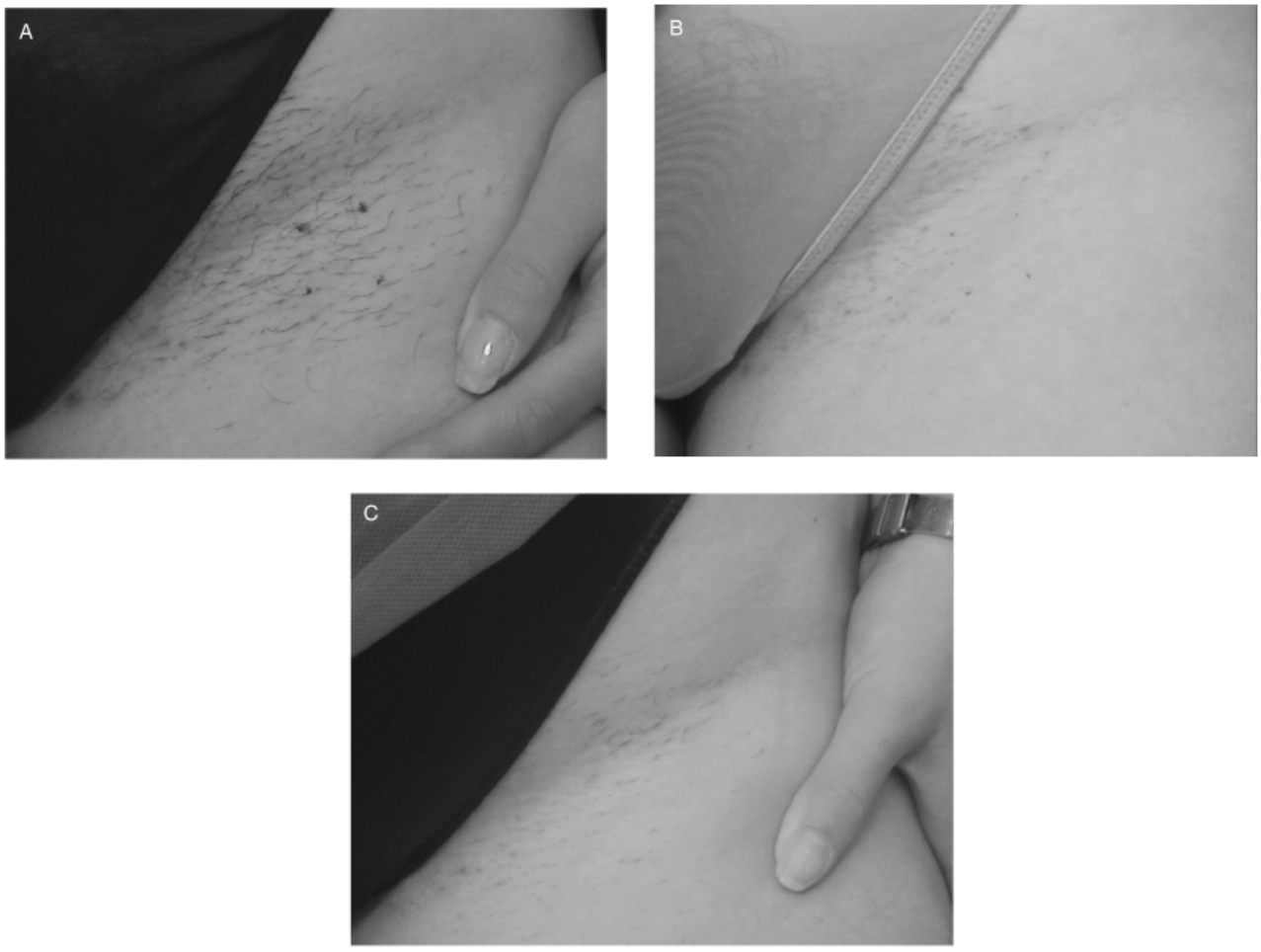

Figure 1. Patient with skin phototype I/II with excess inguinal hair at baseline (A). At 1 month after the third Nd:YAG laser treatment, an 81% hair reduction was observed (B). A 6-month follow-up revealed 63% hair reduction (C).

a high-energy, long-pulsed 1064-nm Nd:YAG laser for hair removal in skin phototypes I–VI.

Methods

Thirty-six adult patients (22 to 58 years old, a mean age of 37; skin phototypes I–VI) with dark terminal facial or nonfacial hair who met the criteria for study inclusion were treated with a 1064-nm, long-pulsed Nd:YAG laser (Coolglide; Altus Medical Inc., Burlingame, CA). Exclusion criteria included any previous laser treatment to the study areas, regional electrolysis within 6 months of study entry, waxing, depilatory or bleach use within 1 month of study entry, hormonal or thyroid dysfunction, a history of keloid scarring, isotretinoin use within 6 months of study entry, photosensitivity, pregnancy, or tanning. Three consecutive treatments were delivered to 36 skin sites at 4- to 6-week intervals by a single operator (E.L.T.).

Table 2. Mean Percentage Hair Reduction*

Skin Phototype	*Site*	*1 Month*	*3 Months*	*6 Months*
I/II	Facial	58%	52%	41%
	Nonfacial	66%	61%	43%
III/IV	Facial	59%	55%	44%
	Nonfacial	69%	59%	48%
V/VI	Facial	62%	58%	46%
	Nonfacial	67%	63%	53%

*Percent hair reduction based on comparison with baseline terminal hair counts.

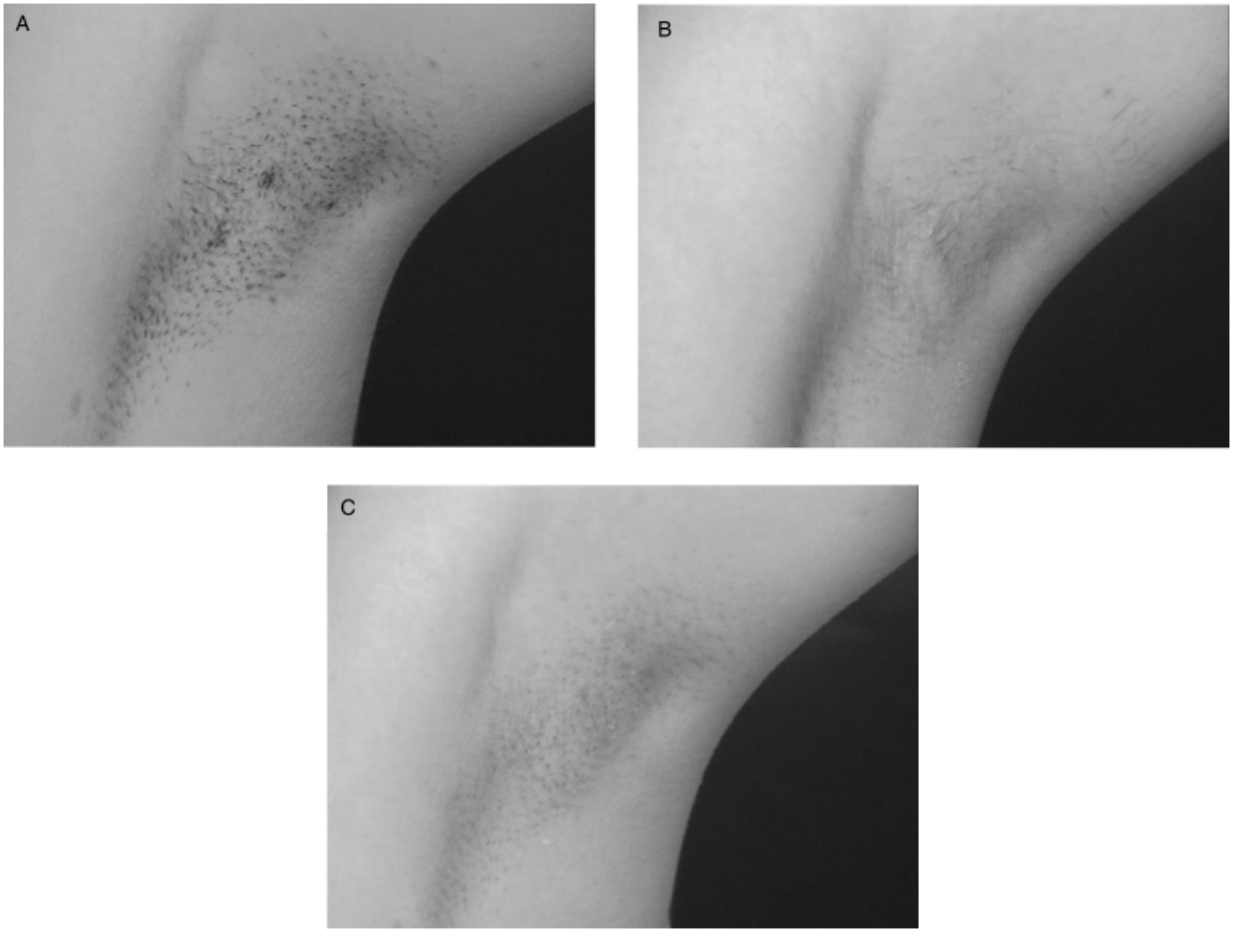

Figure 2. Patient with skin phototype III/IV with unwanted axillary hair at baseline (A). An 86% and 59% hair reduction was observed at 1 month (B) and 6 months (C) after the third Nd:YAG laser treatment, respectively.

Immediately before each treatment, hairs longer than 1 mm were shaved close to the skin using a safety razor. Topical anesthetic cream (Ela-max 5%; Ferndale Laboratories Inc., Ferndale, MI) was applied 20 to 30 minutes before each procedure. An integrated contact chill tip was used to protect the epidermis during laser irradiation. The selected pulse duration was dependent on the skin type of the patient; skin types I/II, III/IV, and V/VI received 10, 20, and 30 ms, respectively. Longer pulse durations were selected for increased epidermal protection in patients with darker skin phototypes. Adjacent, nonoverlapping 10-mm spots were placed over the treatment areas with fluences ranging from 30 to 60 J/cm^2 based on the skin phototype. Fluence was increased by 10% at each treatment visit if no side effects were noted from the previous session (Table 1).

Sequential digital photographs using identical lighting, patient positioning, and camera equipment were obtained of all treatment sites at baseline, before each treatment session, and at 1, 3, and 6 months after the final laser treatment. Two separate hair counts using a

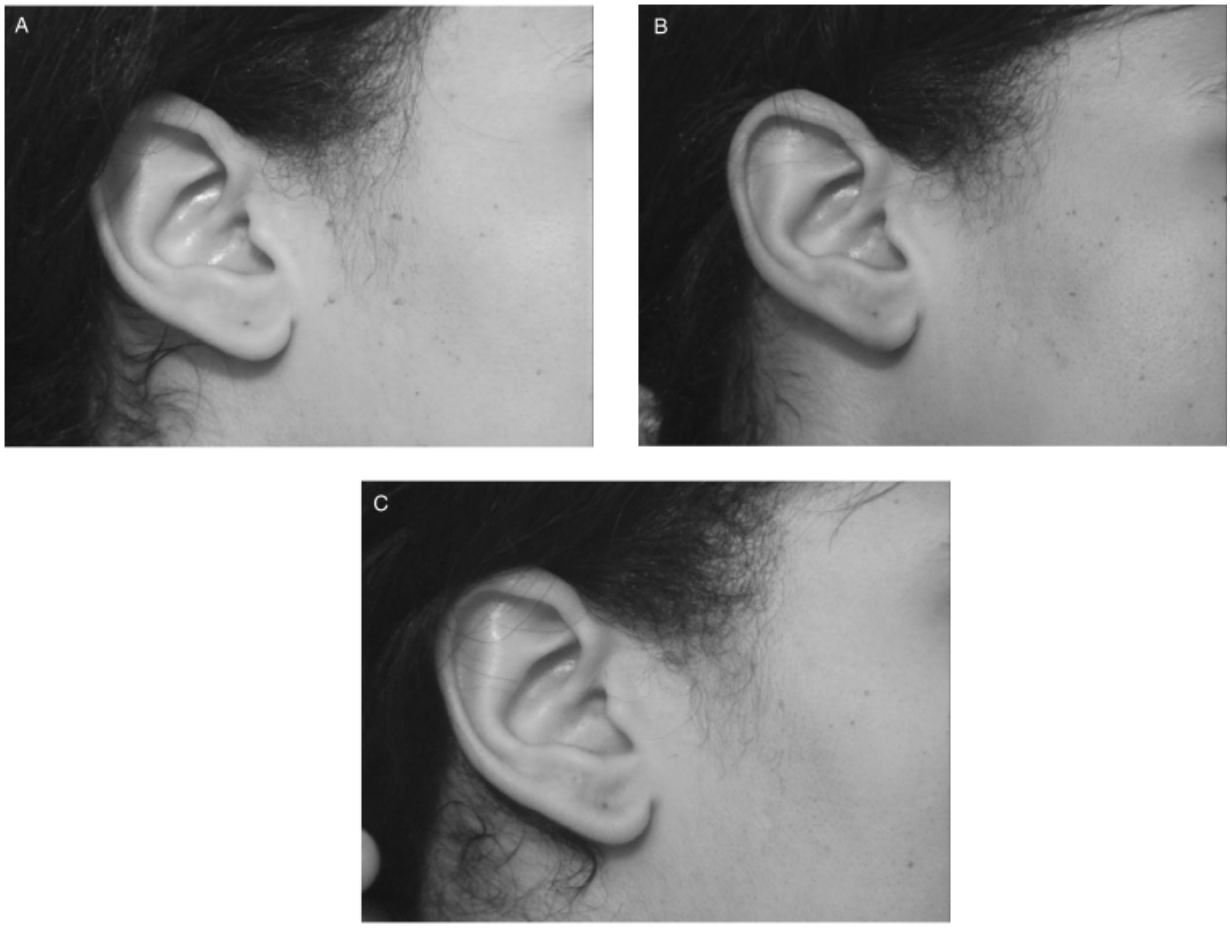

Figure 3. Patient (SPT V/VI) with hypertrichosis before treatment (A) and 1 month after three consecutive monthly Nd:YAG laser treatments (B) showing a 77% hair reduction. At 6 months after treatment, a 56% hair reduction was seen (C).

×10 illuminated magnifier were performed within a well-defined 3-cm^2 region. Matching sites for hair counts were identified at each visit by digital photography software with image overlay capability, permitting near identical marking of skin areas. Percentage of hair reduction was defined as the average number of terminal hairs present 1, 3, and 6 months after treatment compared with the average number of terminal hairs at baseline. Subjective patient reports and adverse effects were also recorded at each follow-up visit.

Results

The peak hair reduction occurred 1 month after the series of laser treatments, with a mean hair reduction ranging from 58% to 62% on facial sites and 66% to 69% on nonfacial sites (Table 2). At 6 months after a series of three long-pulsed Nd:YAG laser treatments, a mean hair reduction of 41% to 46% on the face and 48% to 53% on the body was found depending on skin phototype (Figures 1–3). Nonfacial areas were slightly more responsive than facial areas in each skin phototype.

Adverse effects (calculated from all 108 treatment sessions) were limited to mild to moderate treatment pain in 100% of treatment sites, short-term erythema in 95% (103 of 108), perifollicular edema in 89% (96 of 108), and transient hyperpigmentation in 1% (1 of 108, duration of 4.5 weeks). Fibrosis and scarring were not seen in any treatment site as a result of laser irradiation.

Discussion

There are numerous lasers and light-based sources now available for the removal of unwanted hair. Although rapid technologic advances in this burgeoning field have been highly rewarding, no single system has been shown to provide safe and effective hair removal in all skin phototypes. Previous reports have shown effective hair removal with the long-pulsed Nd:YAG laser in patients with darker skin phototypes

(IV–VI),[5,6,8,9] but reports demonstrating its use for patients with lighter skin phototypes have been limited by either a single treatment session or highly variable follow-up evaluation.[5,7,10,11]

The findings reported in this study demonstrate that the long-pulsed Nd:YAG laser can be used safely for laser-assisted hair removal in patients with all skin types. Statistically significant differences in responses between skin types could not be ascertained because of the low number of patients in each group studied. The mean hair reductions reported herein, however, are slightly lower than published data following a series of treatments using other popular hair removal lasers, particularly in patients with lighter skin tones. This is not unexpected given the relative reduced absorption by melanin at the 1064-nm wavelength as compared with shorter wavelength laser systems. Up to 75% hair reduction has been demonstrated after a series of long-pulsed 694-nm ruby laser treatments.[12] Other studies[13–17] have shown approximately 71% to 85% hair reduction after a series of long-pulsed 755-nm alexandrite laser treatments in patients with skin phototypes I–IV. After 800-nm diode laser treatments, 74% to 84% hair reduction has been reported in skin phototypes I–IV.[17,18] To enhance clinical results, it is anticipated that additional treatments with the Nd:YAG laser would lead to further hair reduction, as has been shown by Lorenz et al.,[19] who reported 71.5% hair reduction in patients with skin phototypes I–IV after five treatments with a long-pulsed Nd:YAG laser.

Conclusion

The results of this study support the safe and effective use of a long-pulsed 1064-nm Nd:YAG laser for hair removal in patients with all skin phototypes. For patients with lighter skin tones, additional treatments may be necessary to achieve the results that have been reported with the use of shorter wavelength laser systems. As this study was not a direct comparison between laser systems, further investigation is warranted to define optimum treatment parameters for each skin phototype.

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