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# Using blend wavelengths in order to improve the safety and efficacy of laser hair removal

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## Abstract

**Background:** As the pursuit for a safe and effective device for laser hair removal continues, the use of simultaneous multiple wavelengths in a single device requires further exploration.

**Aim:** To evaluate the safety and efficacy of a novel multi-wavelength laser device for hair removal.

**Patients and methods:** This retrospective cohort study included adult participants of both sexes with Fitzpatrick skin types of III and IV. Hairy sites were treated by a multiple wavelength (810nm, 940nm, and 1064nm) laser device (Primelase, Coccoon medical, Barcelona, Spain). Laser parameters included: fluence of 14–20 J/cm$^2$, pulse duration of 7–30 ms, and spot size of 20*9 mm$^2$. Participants underwent up to 7 treatments at 6–8 weeks intervals and were followed for 6 months after the last treatment session. "Before" and "after" clinical photographs were acquired and were used to evaluate efficacy by 2 independent dermatologists. They employed the Global Aesthetic Improvement Scale (GAIS; scale of 0 [no improvement] to 4 [excellent improvement; Over 75% hair reduction]). Participants' satisfaction was rated on a scale of 1 (not satisfied) to 5 (very satisfied). Pain perception and adverse events were recorded as well.

**Results:** Eighteen participants (6 men, 12 women) were included with a total of 49 treatment sites. Mean hair reduction was 3.6 out of 4 in the GAIS. Participants' satisfaction rate was high (mean 4.5). Beside mild transient discomfort during the procedure, no adverse events were recorded.

**Conclusion:** The use of a multiple wavelengths' laser device is safe and effective for hair removal.

KEYWORDS
combined wavelengths, hair removal, laser epilation

## 1 | INTRODUCTION

Whereas thick lustrous scalp hair remains a desired quality, its appearance on other anatomic body locations is much less desirable. Thus, various methods have been and are still being employed for the removal of unwanted hair. One of the most popular modalities for that matter is laser epilation.[1] Based on the theory of selective photo-thermolysis,[2] a laser device produces light that is absorbed by pigmented melanin (which is mainly concentrated in the anagen hair shafts) and transferred downwards to the hair bulb. The light energy is converted to a thermal one, which diffusely damages the nearby follicle, without harming the surrounding cutaneous tissue.[3] A long-term hair reduction is accomplished by both miniaturization of hair follicles and their complete destruction.[4]

Numerous lasers and intense pulsed light devices have been employed over the years for hair removal.[5] These devices must be effective and safe, and should be suitable to treat different patients with different characteristics, including various skin colors, hair colors, hair types, and body locations.[6] Treating patients without taking into account their unique characteristics is bound to end up in substantial side effects comprising of burns, dyspigmentation, and scarring as well as with disappointing results.

In order to avoid these complications, laser devices using higher wavelengths, like the 810nm and the 1064nm, have been employed in recent years.[7,8] They not only allow deeper light penetration thus, targeting deeply located follicles, but also increase the safety of the procedure, especially in dark-skinned individuals, where abundant epidermal melanin might lead to excessive epidermal heating and burns.[9]

Two main forms of laser hair removal are currently acceptable: either by using a single high-energy pulse or by using a series of repetitive low-energy pulses.[10] Some members of our group took part in a recent publication reporting the use of the latter with a repetitive simultaneous triple-wavelengths (755nm, 810nm, and 1064nm) diode laser device for hair removal.[11] The simultaneous emission of multiple wavelengths allows targeting of multiple differently located chromophores within the hair follicle, thus increasing efficacy.

Herein, we present our experience with a novel diode laser device for hair removal. The device allows utilization of a single high-energy simultaneous triple-wavelength (810nm, 940nm, and 1064nm) pulse as well as using a single-wavelength high-energy pulse (either 755nm, 810 nm, or 1064nm).

## 2 | PATIENTS AND METHODS

This retrospective cohort study included adult participants of both sexes who were treated in our clinic between January 2019 and June 2020.

Prior to treatment all patients received a detailed and clear explanation regarding their expected procedure and signed an informed consent form.

Participants were included if they were treated by the Primelase device (Coccoon medical, Barcelona, Spain) using simultaneous multiple wavelengths and have returned to follow-up 5–6 months after the last treatment session.

Exclusion criteria comprised of previous treatment with a laser, IPL, or electrolysis for hair removal.

### 2.1 | Study device

This FDA-approved high-power (4800 watt) diode laser uses square-shaped spots. The device allows using either a "static" (single high-energy pulse) or a "dynamic" (a series of repetitive low-energy pulses) mode. Only the former was evaluated in the current study. Additionally, the operator can choose the "Blend" mode utilizing simultaneous emission of 3 wavelengths (810nm, 940nm, and 1064nm) or a single-wavelength mode (755nm, 810nm, or 1064nm).

### 2.2 | Treatment

Prior to each treatment, treatment sites were disinfected, shaved, and applied with cool ultrasound gel. Protective goggles were applied. All treatments were carried out by a single technician in our clinic. Laser parameters included fluence of 14-20J/cm2, pulse duration of 7-30ms, pulse repetition rate of 2-3Hz and spot size of 20*9mm$^2$. Epidermal cooling was performed in each and every session using an integrated sapphire tip. Patients underwent 4 sessions with the "Blend" mode followed by 1–3 sessions with a single-wavelength (755nm) mode at 6–8 weeks intervals determined by clinical efficacy.

A follow-up visit took place 5–6 months following the last treatment session.

### 2.3 | Outcome measures

Hair reduction compared to baseline at 5–6 months follow-up was the primary efficacy endpoint. Hair reduction at each treatment site was assessed using the standardized Global Aesthetic Improvement Scale (GAIS; 0 = no improvement, 1 = poor improvement; hair reduction by less than 25%, 2 = average improvement; hair reduction by 26–50%, 3 = good improvement; hair reduction by 51–75%, 4 = excellent improvement; hair reduction by over 75%). GAIS scale was rated by two independent board-certified dermatologists using "before" and "after" high resolution digital photographs. Patients' satisfaction was assessed at the follow-up visit (Graded on a scale of 1 [not satisfied] to 5 [very satisfied]). Patient's satisfaction score was recorded separately for each treatment site. Pain perception was recorded for each treatment site in each treatment session. A visual analogue scale (VAS; a scale of 1 [not painful] up to 10 [extremely painful]) was used for that matter. Safety assessment was performed during each treatment and follow-up visits. Any treatment-related adverse events were recorded.

### 2.4 | Statistical Analysis

Values are presented as mean (± standard deviation) or number (percentage). Categorical variables were compared using chi-squared test and continuous variables were evaluated using independent samples t test. All statistical tests were two-sided and P-value <0.05 was considered statistically significant. SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) was used for all analyses.

## 3 | RESULTS

A total of 18 participants (12 women, 6 men) with a mean age of 27.8 (+/- 3.3) were included in this study. Participants had Fitzpatrick skin types of III–IV. A total of 49 sites, bearing moderate-to-high density dark terminal hair were treated. These included the back, abdomen, chest, and shoulders among men, and the lower extremities, axillae, and groins among women. Participants completed 5–7 sessions (mean 5.4 [+/- 0.76]) at 6–8 weeks intervals determined by clinical efficacy, and returned to follow-up 5–6 months after the last treatment session. Spot size was the 20*9mm$^2$. During the initial treatments (sessions 1–4) the "Blend" mode was used, in order to maximize light penetration and to induce damage in deeply located hair follicles. In later treatments, a single wavelength was utilized (755nm) in order to effectively harm remaining fine hair units.

Participants' mean satisfaction score at the last follow-up visit was 4.5 (± 0.62) out of 5. A reduction of over 75% in hair density compared to baseline was observed in 61% of the treatment sites. Mean GAIS was 3.6 (± 0.61) out of 4. Inter-observer agreement of GAIS score was 85.7%. There was no statistically significant correlation between neither the treatment site nor the Fitzpatrick skin types and the mean GAIS. Mean VAS pain score recorded after each treatment session was 4.5. There was no statistically significant difference in VAS pain scores between the "blend" mode and the single-wavelength mode. Aside from pain, no additional side effects were recorded, including paradoxical hypertrichosis.

Table 1 summarizes the main results in this study.

**TABLE 1** Treatment outcome at last follow-up visit.

| Patient's number | Mean satisfaction | Mean GAIS (per patient) | Mean VAS (per patient) |
|---|---|---|---|
| 1 | 4 | 3 | 2 |
| 2 | 4 | 4 | 3 |
| 3 | 5 | 4 | 5 |
| 4 | 5 | 4 | 4 |
| 5 | 5 | 4 | 5 |
| 6 | 3 | 2 | 7 |
| 7 | 4 | 4 | 6 |
| 8 | 5 | 4 | 3 |
| 9 | 5 | 3 | 4 |
| 10 | 5 | 4 | 5 |
| 11 | 4 | 4 | 5 |
| 12 | 5 | 4 | 6 |
| 13 | 4 | 3 | 4 |
| 14 | 5 | 4 | 5 |
| 15 | 5 | 4 | 4 |
| 16 | 4 | 3 | 4 |
| 17 | 5 | 4 | 4 |
| 18 | 4 | 3 | 5 |
| Average (SD) | 4.5 (0.62) | 3.6(0.61) | 4.5(1.2) |

Abbreviations: GAIS, global aesthetic improvement scale; SD, standard deviationVAS, visual analogue scale.

## 4 | DISCUSSION

This retrospective cohort assessed the safety and efficacy of a high-power novel laser hair removal device, which delivers a single high-energy simultaneous triple-wavelength pulse. The cohort included participants of both sexes with Fitzpatrick's skin type III-IV. Treatment was highly beneficial and well tolerated. Participants were highly satisfied with their outcomes, corresponding to the minor side effects and objective improvement following the treatment.

Numerous previous studies have demonstrated the applicability of various single-wavelength lasers for hair reduction,[12-14] yet data regarding the use of multiple wavelengths laser devices is scarce. A recent publication, which some members of our group took part in, demonstrated the use of simultaneous wavelengths of 755nm, 810nm, and 1064nm, using repetitive low-energy pulses with encouraging results.[11] In that study, however, only men were included. The current study evaluated treatment in both sexes using single high-energy pulses rather than repetitive low-energy ones.

The current study demonstrates the use of the "Blend" mode of the device, which emits a single high-energy simultaneous triple-wavelength pulse (810nm, 940nm, and 1064nm) which was used during the initial treatment sessions in order to maximize photoabsorption in differently distributed chromophores throughout the hair shaft. In the later treatments, a single wavelength was utilized (755nm) in order to effectively destruct fine superficial miniatured remaining hairs.

The advantage of using a high-power device, as in this study, is the uniform delivery of energy even at short pulse durations. Thus, a single high-energy pulse is used efficiently and treatment is performed rapidly. Further advantages of the current device lay within the long wavelengths used in the "blend" mode enabling deep penetration into the dermis, with minimal risk of epidermal damage, as the absorption curve for melanin declines as the wavelength increases.[15] This is especially important among patients with higher Fitzpatrick's' skin type. Indeed, as opposed to previous studies on single-wavelength devices, such as Nd:YAG, that reported high rates of post-inflammatory hyperpigmentation and erythema among darker-skinned individuals,[16-18] no dyspigmentation, burns or paradoxical hypertrichosis occurred in the current study, despite the inclusion of patients with Fitzpatrick's IV skin type.[19]

The limitations of this study include its retrospective nature and the lack of a control group.

Further studies, comparatively evaluating different combinations of laser wavelengths, repetitive low fluence pulses vs. single high fluence pulse, and wavelength combinations vs. a single-wavelength device are warranted.

## 5 | CONCLUSION

The current study demonstrates the benefits of a safe and effective novel hair removal modality using a simultaneous tripe-wavelength laser device of 810 nm, 940 nm, and 1064 nm wavelengths.

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None.

### CONFLICT OF INTEREST

All of the authors have no conflicts of interest to disclose.

### ETHICAL APPROVAL

The study was approved by the ethics committee of Rabin Medical Center (RMC-0610–19).

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author [LM] upon reasonable request.

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