

ORIGINAL ARTICLE

## Clinical comparison of four hair removal lasers and light sources

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### Abstract

**Background and objective:** There are few clinical studies directly comparing the efficacy of multiple hair removal systems in the same individual. This study evaluates the efficacy of four highly popular systems for laser hair removal. **Methods:** In this prospective comparison study, 10 subjects underwent treatment of unwanted hair on the back or thigh. Subjects were skin types I–III, aged 18–55 years. All were treated twice with (1) an intense pulsed light with a red filter; (2) an intense pulsed light with a yellow filter; (3) an 810 nm diode laser; and (4) a 755 nm alexandrite laser. Four treatment areas, using commonly accepted parameters for permanent hair reduction, as well as a control non-treated area were selected. Each treatment area was evaluated with a camera system specifically designed for hair counts at 1, 3, and 6 months after the second treatment by a blinded non-treating physician. Clinical results and adverse events were also noted. **Results:** Evaluation of photographs at 1, 3, and 6 months revealed a significant decrease in hair counts (~50%) and hair coverage (~55%). In the hairs that remained after two treatments, no statistical difference was noted in hair length or diameter. There was no statistical difference in efficacy between the four different light devices. Minimal transient adverse effects were noted from all systems. The cryogen spray-based alexandrite laser showed the highest pain scores. **Conclusion:** Although hair removal with commonly used systems is, as expected, highly effective, treatment with light-based devices can cause less pain, yet show efficacy similar to laser systems.

**Key words:** Hair Removal, Lasers, IPL

### Introduction

Hair removal with lasers and light-based devices is commonly performed in most dermatology practices. Lasers such as the alexandrite and 810 nm diode devices are generally considered to be equivalent in efficacy and safety (1,2). Intense pulsed light (IPL) devices have also been widely reported as effective for hair removal or reduction. Few studies have directly compared the long-term outcomes of lasers with IPL devices (3–5). This study was undertaken as a prospective clinical comparison of four hair removal devices. Information on hair counts, hair diameter, hair length, hair coverage and growth rate was collected through digital photography and computer analysis. Adverse events and patient perceptions were also recorded.

### Methods

The study period was from August 2004 to May 2005. Ten subjects were enrolled in the study. IRB approval was obtained prior to subject enrollment.

Informed consent from all patients was recorded. Inclusion criteria included age 18–65 years, Fitzpatrick skin types I–III and the presence of dark hair on the legs or back.

Exclusion criteria for the study were pregnancy, use of photosensitizing or anticoagulant medication, diabetes, history of keloid formation, recent oral retinoid use, active dermatosis within the treatment area or severe illness. Candidates with previous hair laser treatments within the treatment areas were excluded. The study subject profile is listed in Table I.

Four different light devices were utilized in this study. All devices were FDA-cleared for hair removal. Parameters for treatment were selected based on prior experience with each device and manufacturer's recommendations. Table II outlines all the devices and the utilized treatment settings.

This study entailed a prospective controlled and blinded protocol. Subjects were selected and test spots were performed only in those with Fitzpatrick skin type III. No adverse events were noted during the spot test phase. Treatment sites were then

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Table I. Patient profile.

Parameter	Number of patients
Total subjects	10
Female sex	8 (80%)
Non-Caucasian	4 (40%)
Fitzpatrick skin types	I or II (40%); III (30%)

selected by the investigator based on density, length, and diameter of hair on the legs or back. A brief description and history were recorded for each patient including age, sex, skin type, recent sun exposure, allergies, medications, history of major illnesses, and presence of a tan or other pigment changes at the treatment site.

Baseline photography was performed in all subjects. Skin was shaved and treated in  $5 \times 5$  cm squares with the four different light-based devices as depicted in Figure 1. The control square was

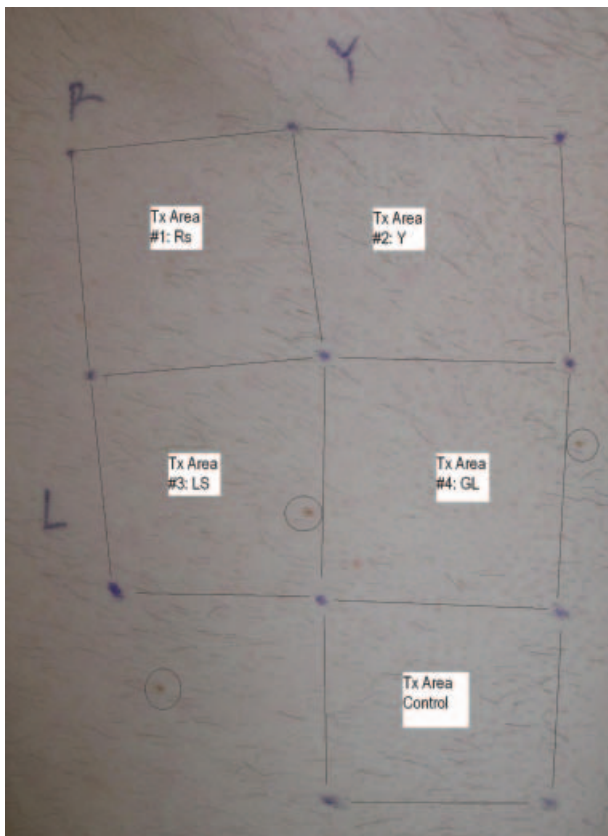


Figure 1. Example of treatment configuration.

Table II. Light devices and lasers.

Model	Company name/brand	Wavelength	Spot size	Cooling	Fluence	Pulse width
IPL I	Palomar/Starlux Rs	650–1200 nm	12 × 28 mm	Contact	65 J/cm <sup>2</sup>	100 ms
IPL II	Palomar/Starlux Y	525–1200 nm	16 × 46 mm	Contact	35 J/cm <sup>2</sup>	100 ms
Diode laser	Lumenis/LightSheer	810 nm	9 × 9 mm	Contact	28 J/cm <sup>2</sup>	Auto (14 ms)
Alexandrite laser	Candela/GentleLase	755 nm	18 mm (diameter)	Cryogen spray	18 J/cm <sup>2</sup>	3 ms (preset) DCD 30/30

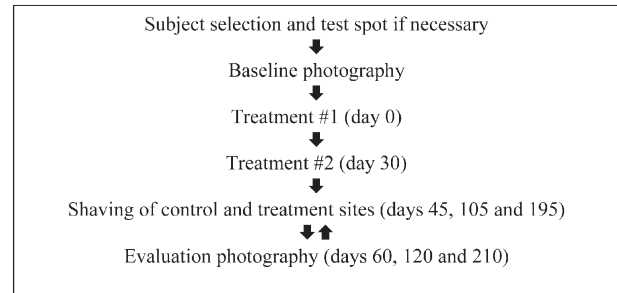


Figure 2. Study protocol.

shaved but not treated. Areas not being treated with a particular laser were covered with an opaque plastic plate to prevent inadvertent laser exposure. A template of the treatment areas was recorded on a plastic transparency. The locations of at least three skin markings were also recorded. (Three or more nevi were used to track the precise locations of treatment areas.) Shaving and treatment were repeated at day 30. Slight overlap with all light devices was performed during treatment to ensure complete coverage. Only two treatments were performed. No topical anesthesia was applied. Pain scores were recorded for all subjects.

During the post-treatment evaluation phase of the study, control and treatment squares were shaved 14 days prior to photography, which was conducted at days 60, 120 and 210. Figure 2 summarizes the study protocol.

Photography was conducted with two different cameras. Non-polarized images were recorded with a Nikon 4300 digital camera in  $5 \times 5$  cm fields with a metal spacer adjusted at 20 cm. Polarized images were recorded on a Nikon 5000 with a metal spacer adjusted at 25 cm. A plate of clear glass was affixed to the end of the spacer, thus blanching the skin. An example image from each photographic system is shown in Figure 3.

A non-treating physician trained in hair counting in a blinded fashion performed all hair measurements. All hair counts are reported as mean hairs per square centimeter. Hair diameter is reported as mean hair diameter ( $\mu\text{m}$ ) for all hairs in the photograph. Hair length is reported as mean hair length (mm) for all hairs in the photograph. Hair coverage was calculated by computer analysis of the polarized photographs. The ratio of hair coverage

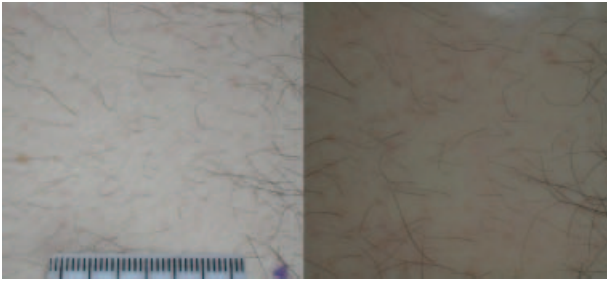


Figure 3. Photographic samples showing a non-polarized image (left) and the same area under polarization (right).

represents the total number of dark pixels to the total number of pale pixels. For example, a low ratio may be calculated if there are few thick hairs or many thin hairs. Statistical significance was evaluated with Student's *t*-test.

**Results**

All four light and laser devices resulted in long-term hair reduction. Hair counts within the treatment areas and control area prior to any shaving or laser application showed similar numbers of hairs. The hair count was statistically reduced at day 210 with all four light devices by almost 50% from initial values (Figure 4). There was no statistical difference between the different light-based devices in the

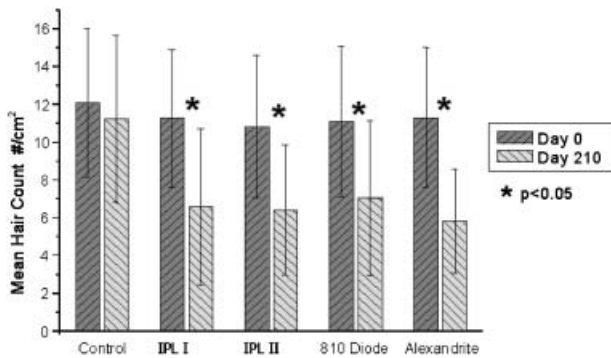


Figure 4. Hair count at days 0 and 210.

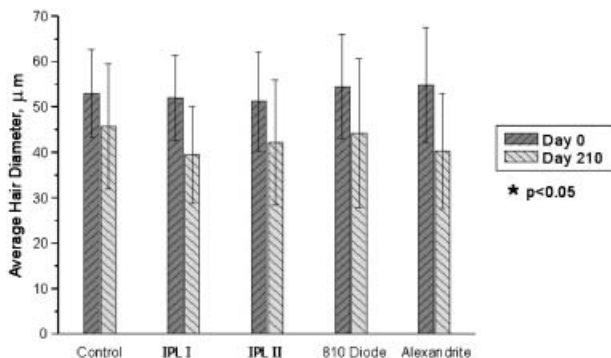


Figure 5. Hair diameter at days 0 and 210.

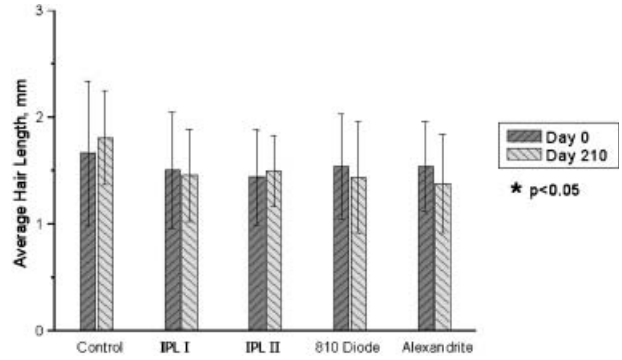


Figure 6. Hair length at days 0 and 210.

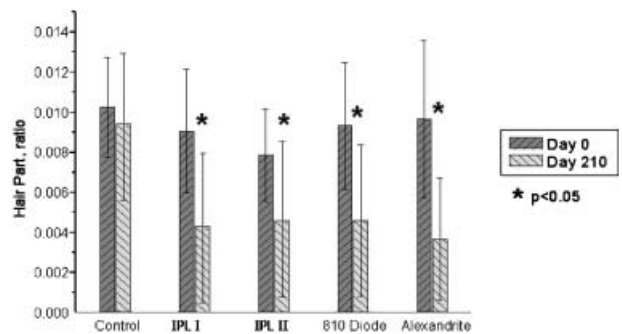


Figure 7. Hair coverage (hair part) at days 0 and 210. Hair part ratio represents the number of dark pixels divided by the number of pale pixels on a digital image via computer analysis.

amount of hair count reduction. Hair measurements at days 60 and 120 were similar (not shown).

Hair diameter was slightly, but not statistically significantly decreased (Figure 5). Hair length was essentially unchanged throughout the study (Figure 6). The total number of hairs was statistically decreased. Hairs that still grew after the pre-photographic shaving were normal in diameter and length.

Hair coverage, or hair part, is a parameter that evaluates the combined diameter, length and number of hairs via computer analysis (Figure 7). A low ratio suggests thinner, fewer or shorter hairs. A high ratio suggests thicker, numerous and longer hairs. There was a statistically significant change after two treatments with all four devices. There was no statistical difference between the four devices.

Although similar in efficacy, the four devices varied in their pain intensity, as reported by the

Table III. Patient-reported pain scores (0=none).

Device	Mean pain score (0–10)	SD
IPL I	3.4	1.3
IPL II	2.1	1.0
810 nm diode laser	2.3	0.8
755 nm alexandrite laser	4.1	1.8

SD=standard deviation.

Table IV. Immediate and delayed responses (physician evaluation; number of patients).

Device	Immediate erythema	Perifollicular edema	Blisters	Crusts	Hypopigmentation	Hyperpigmentation
IPL I	10 (100%)	0	0	0	1 (10%) <sup>a</sup>	0
IPL II	10 (100%)	0	0	0	0	0
810 nm diode laser	10 (100%)	7 (70%)	0	0	0	0
755 nm alexandrite laser	10 (100%)	10 (100%)	0	1 (10%) <sup>b</sup>	0	0

<sup>a</sup>One patient with type III skin had a small area of hypopigmentation with complete resolution at day 210.

<sup>b</sup>One patient with type III skin had a single spot of transient crusting with complete resolution at day 210.

study subjects (Table III). Both the IPL II (35 J/cm<sup>2</sup>) and the 810 nm diode laser (28 J/cm<sup>2</sup>) caused minimal pain during the treatment session on a scale of 0 to 10. In general, the devices utilizing contact cooling appeared to cause less discomfort.

The treating physician evaluated immediate and delayed responses. The most relevant events are described in Table IV. All patients were noted to have erythema but only those treated with the lasers showed perifollicular edema. No patients had blisters or any permanent side effects.

## Discussion

The lasers and light devices used in this prospective blinded and controlled study showed similar long-term efficacy. An attempt was made to use clinically effective and similar treatment settings with the two lasers. The large number of available IPL devices makes choosing appropriate parameters somewhat more difficult. Less experience is published with the IPL devices, especially the Starlux Rs device. A significant reduction in hair number after two treatments was expected and confirmed by the computer analysis that showed decreased hair coverage at the end of the study as compared to the control area. Interestingly, hairs that did grow after the two

treatment sessions were not thinner or shorter. Without the use of topical anesthetics, patient preference might be based on pain level during the treatment session. The alexandrite laser was the only laser in the study with a cryogen spray. Increased pain perception may be explained by this difference in hardware. This study confirms our general clinical experience that lasers and light devices have similar outcomes in patients with skin types I–III.

## References

1. Liew SH. Laser hair removal: Guidelines for management. *Am J Clin Dermatol.* 2002;3:107–15.
2. Lask G, Eckhouse S, Slatkine M, Waldman A, Kreindel M, Gottfried V. The role of laser and intense light sources in photo-epilation: A comparative evaluation. *J Cutan Laser Ther.* 1999;1:3–13.
3. Marayiannis KB, Vlachos SP, Savva MP, Kontoes PP. Efficacy of long- and short pulse alexandrite lasers compared with an intense pulsed light source for epilation: A study on 532 sites in 389 patients. *J Cosmet Laser Ther.* 2003;5:140–5.
4. Bedewi AF. Hair removal with intense pulsed light. *Lasers Med Sci.* 2004;19:48–51. Epub 2004 Jul 1.
5. Eremia S, Li C, Umar SH. A side-by-side comparative study of 1064 nm Nd:YAG, 810 nm diode and 755 nm alexandrite lasers for treatment of 0.3–3 mm leg veins. *Dermatol Surg.* 2002;28:224–30.