

# Optimized Laser Hair Removal

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Unwanted hair is a common cosmetic complaint throughout society and around the world. A number of methods are available to address this condition, from temporary methods of control such as shaving and waxing, to permanent methods of hair reduction such as electrolysis and lasers.

Due to its permanence, and treatment efficiency compared to other methods<sup>1</sup>, laser hair removal has become one of the most popular cosmetic procedures. According to the American Society for Aesthetic Plastic Surgery, it accounted for 923,200 procedures in 2003, ranking second on the list of cosmetic applications behind Botox injections<sup>1</sup>. This procedure is growing at an annual

rate of 25% per year, surpassing chemical peels and micro-dermabrasion in popularity<sup>2,3</sup>. Laser hair removal is now estimated to generate nearly \$360 million in procedure fees annually<sup>1</sup>.

The reason for this exceptional growth is due to the nature of this procedure. Laser hair removal is a non-invasive procedure, allowing the treatment of large areas in a relatively short period of time. Much of this growth has been due to the development of lasers better suited for treatment of dark or tanned skin, expanding the available patient base and extending the treatment calendar in warmer climates. When performed by qualified operators and under appropriate supervision, the procedure is well tolerated, with no downtime<sup>1</sup> and reported low rate of side effects<sup>4,5,6</sup>. Treatment typically requires a course of 3-6 treatments at monthly intervals for cosmesis, a significant improvement compared to other methods. Since

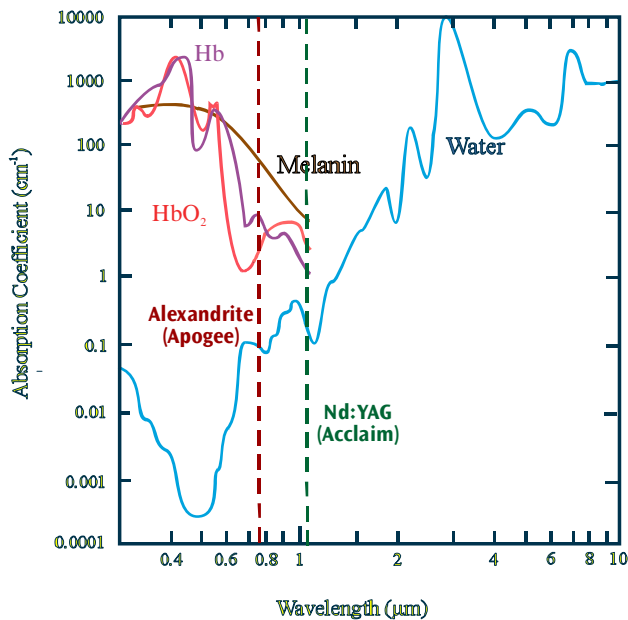


Figure 1: Major Chromophores of the Skin, Highlighting Alexandrite and Nd:YAG wavelengths

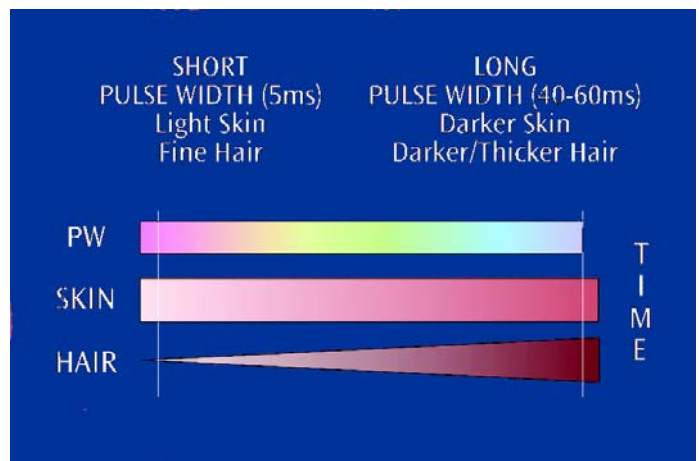


Figure 2: Appropriate Pulse Duration selection based on hair color and thickness



Figure 3: Female, Skin Type II subject, (top) before and (bottom) eight Months following 7 laser hair removal procedures

first being described in 1996<sup>7</sup>, laser hair removal has consistently proven its value in over 100 journal articles<sup>8</sup>.

## Laser Hair Removal Technology

Laser hair removal is achieved by applying the concept of selective photothermolysis<sup>9</sup>, by using a laser with a wavelength that is preferentially absorbed by the pigment in hair follicles, melanin [Figure 1]. Lasers are unique for this application, in that they produce monochromatic light, maximizing selectivity. Further they can deliver this light energy to the hair follicle in millisecond domain pulses with high peak power. This combination of selective wavelength delivered with high peak power, over an appropriate pulse duration which allows the energy to selectively target the hair follicle while minimizing the risk of damage to surrounding tissue.

Treatment efficiency is provided by high powered laser systems which deliver effective

treatment fluence (energy per unit area) in large spot sizes, and with high pulse repetition rates. This combination provides rapid treatment of large areas, including the legs and back. The addition of air cooling provides substantial improvement in patient comfort.

Both the hair, and the skin in which it resides contain melanin, requiring careful choice of laser parameters to optimize safety and efficacy for an individual's skin type. Thus, a laser wavelength well suited for fair skinned individuals may be a poor choice for those of dark skin types [Figure 2].

Two laser wavelengths have become the standards for laser hair removal; Alexandrite, such as the Apogee 5500 and Nd:YAG, such as the Acclaim 7000, both by Cynosure, Inc. Each has been designed to optimize treatment for a different patient population. The combination, of the two wavelengths embodied by the Apogee Elite, provides optimal hair removal across the patient population.

## Alexandrite

The alexandrite laser has an emission wavelength of 755-nm. This was among the earliest wavelengths employed for laser hair removal because it provides an excellent wavelength for treatment of lighter skin types [Figure 3]. With over eight years of clinical experience, the alexandrite laser remains the standard for hair removal in lighter skin types (types I-IV).

While well absorbed by melanin, the 755-nm wavelength has sufficient depth of penetration to effectively treat deep hair follicles. To maximize the selectivity of the Alexandrite laser, it is important to match the pulse duration of the laser to the size of the hair<sup>7</sup>. The capability to select treatment pulse durations greater than 3-msec provides users of Apogee Alexandrite lasers the ability to customize treatment parameters based on skin type and hair geometry. The addition of cold air cooling in conjunction with laser treatment provides greater patient comfort.

Treatment with the Alexandrite laser is typically conducted using the largest available spot size that provides a *clinically relevant* fluence at the highest possible pulse rate, allowing deeper penetration of energy into the tissue. When

conducted in association with air cooling, treatment of skin types I to II are typically between 20 and 30 j/cm<sup>2</sup> fluence, with a pulse duration of 20-msec. For treatment of thinner and/or lighter hair, the pulse duration may be reduced to as short as 5-msec, with an appropriate reduction in fluence. In type III to IV skin, treatment is typically conducted at 18-25 j/cm<sup>2</sup> with a pulse duration of 40-msec.

In skin types I-IV, the alexandrite laser has proven the most effective, with long-term efficacy of approximately 80% hair reduction following five treatments<sup>10</sup>. Even a single treatment results in significant long-term hair reduction<sup>11</sup>. In direct comparison, the alexandrite has been shown superior to other wavelengths<sup>12</sup>.

While the Alexandrite has been used for treatment of darker skin types (IV-VI)<sup>13</sup> and tanned patients, there is an increased rate of side effects, owing to increased melanin concentration in the skin. The ability to adjust pulse duration to suit skin type, as well as the addition of air cooling provide some additional benefit, however a more elegant solution is the choice of a wavelength better suited to dark skin types<sup>14</sup>

In addition to hair removal, the Alexandrite laser has proven useful in the treatment of benign pigmented lesions<sup>15</sup> and symptoms of photo-aging such as wrinkles.

## Nd:YAG

The Nd:YAG laser has an emission wavelength of 1064-nm. Due to reduced absorption of this wavelength by melanin, the Nd:YAG is better optimized for the treatment of darker skin types (IV-VI) and those with tanned skin [Figure 4]. Since its introduction in 1999<sup>16</sup> the long-pulsed Nd:YAG laser has become the standard of care for treatment of darker skinned patients (types IV-VI) and those with tans<sup>17</sup>

Treatment with the Nd:YAG laser again, uses the largest spot size with a *clinically relevant* fluence. When conducted in association with air cooling, treatment of skin types I to II are typically around 50 j/cm<sup>2</sup> fluence, with a pulse duration of 10 to 20-msec. For treatment of tanned skin in light-skinned patients, fluence is typically reduced by 5 j/cm<sup>2</sup> to compensate for greater skin



Figure 4: Female, Skin Type V subject, (top) before, and (bottom) nine Months following 7 laser hair removal procedures

pigment. In type IV to VI skin, treatment is conducted at 25 to 40 j/cm<sup>2</sup> and with pulse duration of 20 to 40-msec. Lower fluence and longer pulse durations are employed for darker skin types.

The Nd:YAG laser has proven effective with long-term efficacy of approximately 53-71% hair reduction following multiple treatment sessions<sup>18,19</sup>. Due to the reduction in melanin absorption Nd:YAG is of choice for the treatment of darker skin types for general hair removal, as well as conditions such as Pseudofolliculitis barbae, or "beard bumps"<sup>20,21</sup>.

A single treatment results in significant long-term hair reduction in tanned patients while maintaining a low rate of side effects<sup>15</sup>. This utility in the treatment of tanned skin provides more confidence when treating patients during the summer months, and in warmer climates.



The high-powered, long-pulse Nd:YAG laser is also employed for the treatment of facial<sup>22</sup> and leg telangiectasia and for the treatment of components of photo-aging including age spots and wrinkles<sup>23</sup>.

## Discussion

Both Nd:YAG and Alexandrite lasers have proven valuable to the general practice of laser hair removal. There is significant overlap between the two wavelengths; however the right choice of laser and method leads to optimal laser hair removal.

Light skin types benefit from the application of the Alexandrite laser, darker skin types and those with tan from the Nd:YAG laser. In a practice with a homogeneous patient population, one wavelength provides an excellent base from which to grow a hair removal practice.

The versatility of these devices, which allow the treatment of vascular lesions and components of photo-aging expand potential applications beyond hair removal and enhance utility in the busy cosmetic practice.

In many cases, the ability to treat a wide range of skin types under a wide range of conditions is paramount. These can include multicultural patient populations, seasonal tans, large volume centers that wish to expand their client base into underserved populations. The Apogee Elite, by Cynosure, Inc. incorporates high power Alexandrite and Nd:YAG lasers into a single, compact system, providing a convenient platform for the delivery of optimal hair removal for the broadest range of patients.

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