

**ONLINE FIRST**  
**Successful and Rapid Treatment of Blue and Green Tattoo Pigment With a Novel Picosecond Laser**

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**Background:** While the understanding and technology of laser tattoo removal has advanced much over the last 4 decades, treatment and results remain far from perfect. With commonly available devices, treatment courses are often painful and prolonged with mixed results. We describe the successful and rapid treatment of 12 tattoos containing blue and/or green pigment with a novel, picosecond, 755-nm alexandrite laser.

**Observations:** All previously untreated multicolored tattoos as well as tattoo recalcitrance to treatment demonstrated at least 75% clearance of blue and green pig-

ment after 1 or 2 treatments with a novel, picosecond, 755-nm alexandrite laser. More than two-thirds of these tattoos approached closer to 100% clearance.

**Conclusions:** While additional laser studies are needed, we believe that this new technology is more effective in targeting blue and green pigment, resulting in rapid clearance with less collateral injury to surrounding skin tissue.

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**W**HILE ADVANCES in the understanding, theory, and technology of laser- and related energy devices over the last 40 years, the field has also been witness to the evolution of laser removal.<sup>1</sup> Tattoo removal has profited from the days of nonselective ablation with the carbon dioxide and argon-ion continuous wave lasers to the present selective photothermolysis with quality-switched (QS) lasers.<sup>2-4</sup> Active efforts such as cooling and depigmentation have been greatly reduced because water is no longer the target chromophore.

**REVIEW OF CASES**

We describe a series of 12 patients with 12 tattoos containing blue and/or green pigment that were either previously untreated and multicolored or recalcitrant to previous treatment. Recalcitrant tattoos were defined as those with clinically apparent pigment after at least 10 previous treatments. One patient had 1 untreated multicolored tattoo, and 1 patient had 2 multicolored tattoos. The average age of the patients was 31.7 years (range, 23-56 years). Dispersed sites types of these tattoos ranged from the face to the torso and were located on the upper back or shoulder, followed by the leg or thigh, abdomen, and arm. Additional colors included black, white, yellow, red, orange, and purple. The average age of the untreated tattoos was 6.7 years (range, 2-20 years). The 1 patient's 2 multicolored tattoos were of 13 and 15 years' duration (Table).

Of the 10 multicolored tattoos, 3 consisted of green pigment only, 6 had blue and green pigment, and 1 tattoo was described by the patient as having "variegated" pigment. This particular patient

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Treatment of blue and green tattoo pigment with novel picosecond laser. See page 820.

Age, y	Sex	Site	Tattoo	Color(s)	Tattoo Status	Observations
138	F	10	1	Star	Blue, green, yellow, black, white	Partial recalcitrant
138	F	10	20	Star	Blue, green, yellow, black, white	Recalcitrant
143	F	10	1, 2	Star	Blue, green, orange, black, red, purple	Recalcitrant
143	F	10	10	Star	Blue, green, black, red, purple	No comment
143	F	10	10	Star	Blue, green, yellow, red, purple	No comment
143	F	10	2	Star	Blue, green, yellow, red, purple	No comment
143	F	10	1	Star	Blue, green, black, red, purple	No comment
143	F	10	2, 3	Star	Blue, green, black, yellow, red, purple	No comment
143	F	10	10	Star	Blue, green, black, yellow, red, purple	No comment
143	F	10	10	Star	Blue, green, black, yellow, red, purple	No comment
143	F	10	10	Star	Blue, green, black, yellow, red, purple	No comment



Figure 1. Previously untreated multicolored tattoo including green and blue pigment. A, Pre-treatment appearance. B, Appearance after 1 treatment.

Further acknowledged that the current tattoo was created on top of a pre-existing tattoo of multiple colors including yellow. Of the 2 multicolored tattoos, 1 was initially described as initially appearing "variegated" while the other had remaining visible green pigment.

After informed consent was obtained, all patients underwent 3-dimensional photography, and the tattoos were anesthetized with local injection of lidocaine or application of topical compounded 2% tetracaine and 1% lidocaine eutectic. Picosecond systems were properly placed on the patients, and appropriate goggles were worn by the treating physician and all staff members present.

All treatments were performed with a novel, 755-nm alexandrite laser, with variable pulse duration of 190 to 800 picoseconds and repetition rate of 3 to 10 Hz (pulse width 1.5 to 1.8 mm, with fluence ranging from 2.0 to 2.80 J/cm<sup>2</sup>). Treatment para-

eters were guided by patient skin type and achievement of clinical end point, namely epidermal whitening during the initial test spot. The procedure was well tolerated with minimal subsequent discomfort, and patients reported an average pain score of 1.08 on a 10-point scale (11 indicating no pain, 10, worst pain). One patient required follow-up, and the remainder noted no more than the formation of crust. Post-inflammatory hyperpigmentation was observed in a minority of patients, but no additional follow-up visits, no scarring or residual pigmentation alteration was noted.

Patients returned for follow-up, on average, 6 months after their initial treatment. In this trial, we found that 11 of the 12 treated tattoos had achieved greater than 75% clearance of the blue and/or green pigment after only 1 treatment, with greater than two-thirds of these approaching closer to 100% clearance. The results, a green-only tattoo, required 2 treatments to achieve a

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Figure 2. Previously untreated multicolored tattoo including green pigment. A, Pre-treatment appearance. B, Appearance after 1 treatment.

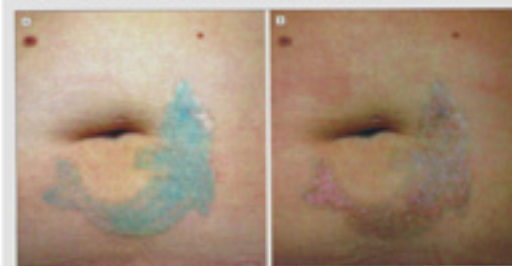


Figure 3. Previously treated but recalcitrant tattoo including "variegated" pigment. A, Pre-treatment appearance. B, Appearance after 1 treatment.

meter rate of clearance. Both tattoos recalcitrant to treatment achieved greater than 75% clearance of the green and "variegated" pigment after 1 or 2 treatments (Figures 1, 2, and 3). Of the additional colors noted within the treated tar-

gets, purple consistently demonstrated greater than 75% clearance, but the remainder of the colors showed 25% clearance or less after 1 or 2 treatments (Figures 1, 2, and 3).

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**COMMENTARY**

During initial consultation for tattoo removal, patients are regularly advised that removal will likely take many, often painful sessions, with subsequent blistering, crusting, healing, and crusting. Furthermore, just as there are many colors individuals can choose from when selecting the design of their tattoo, so too are there many elements and chemical compounds used in the creation of these colors, especially red and green. Because of this, while a particular laser and selected parameters may successfully remove one tattoo of a certain color, they may not work as effectively on another tattoo of the same color.

The age of the tattoo is also important to consider when discussing treatment course and expectations. Older tattoos are generally treated more successfully. It is of paramount importance that the physician have proper training in selection of which laser and parameters are most appropriate for the tattoo to be treated. This is often determined based on the laser's wavelength, certain wavelengths have been proven more effective at removing particular colors.<sup>5,6,7</sup>

The QS lasers regularly used in the removal of tattoos are the ruby (694-nm), neodymium:yttrium, aluminum, garnet (Nd:YAG) (1064-nm and 1319-nm), and alexandrite (755 nm). To date, few blue and green lasers are specifically built for the QS ruby and Nd:YAG lasers have been shown to be more effective for dark blue pigments.<sup>8-11</sup> While some researchers have shown the QS alexandrite laser to be the most effective of the 3 for green pigments,<sup>12-14</sup> we would not agree with these findings. Instead, it has been our experience that the QS ruby laser is more effective in the removal of both of these color dyes. However, even with these lasers, success often comes only after a prolonged series of sometimes very painful treatments with an extended recovery time. In our experience, where clearance of green and blue pigments achieved, it takes an average of 8 to 10, but possibly as many as 20 treatments.

In this regard, we present our findings of extremely rapid and successful treatment of 12 green and/or blue tattoos with a novel, picosecond, 755-nm alexandrite laser. All tattoos, those previously untreated as well as those with recalcitrant pigment after at least 10 treatments, had between 75% and 100% clearance after only 1 or 2 treatments. We believe this new technology is far more effective in targeting blue and green pigment, with rapid clearance and improved recovery time owing to less collateral injury to surrounding tissue.

- responsibility for the integrity of the data and the accuracy of the data analysis, final review and design, manuscript preparation, acquisition of data, Bauer, Bello, Smith, Weiss, Kavan, Bragman, Bernstein, and Geronemus. Analysis and interpretation of data, Bauer, Bello, Kavan, and Geronemus. Drafting of the manuscript, Bauer and Geronemus. Critical revision of the manuscript for important intellectual content, Bauer, Bello, Kavan, Weiss, Kavan, Hale, Bragman, Bernstein, and Geronemus. Statistical analysis, Bauer and Bello. Obtained funding, Geronemus. Administrative, technical, and material support, Geronemus. Study supervision, Smith, Weiss, Kavan, Hale, Bragman, Bernstein, and Geronemus.
- Financial Disclosures:** The treatment device for this research was loaned to us from Cytonance. Dr Geronemus has served as an investigator for Cytonance, Solta, Incision, Palomar, Candela, Lumen, Welther, and UOxal. Dr Bragman has served as an investigator for SynGene and Solta, and Dr Weiss has served as an investigator for Solta. Dr Geronemus has received honoraria from Solta, Incision, Solta, Candela, Oxyon, Cytonance, and InMode. Dr Weiss has served as a consultant for Solta, Incision, and Dr Hale has served as a consultant for Solta, Incision, and Candela. Dr Geronemus owns stock or options in Solta.
- REFERENCES**
1. Geronemus RA, Smith R, Hale R, Bello K, Kavan J, Bragman L. Laser tattoo removal: a comprehensive review of the literature. *JAMA Dermatol.* 2009;145(12):1601-1608.
  2. Bello K, Hale R. Subcutaneous tissue destruction. *Ann Plast Surg.* 2009;62(5):515-518.
  3. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  4. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  5. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  6. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  7. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  8. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  9. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  10. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  11. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  12. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  13. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.
  14. Anderson RR, Witt DJ. Laser tattoo removal: a review. *Semin Dermatol.* 2009;28(2):103-110.

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