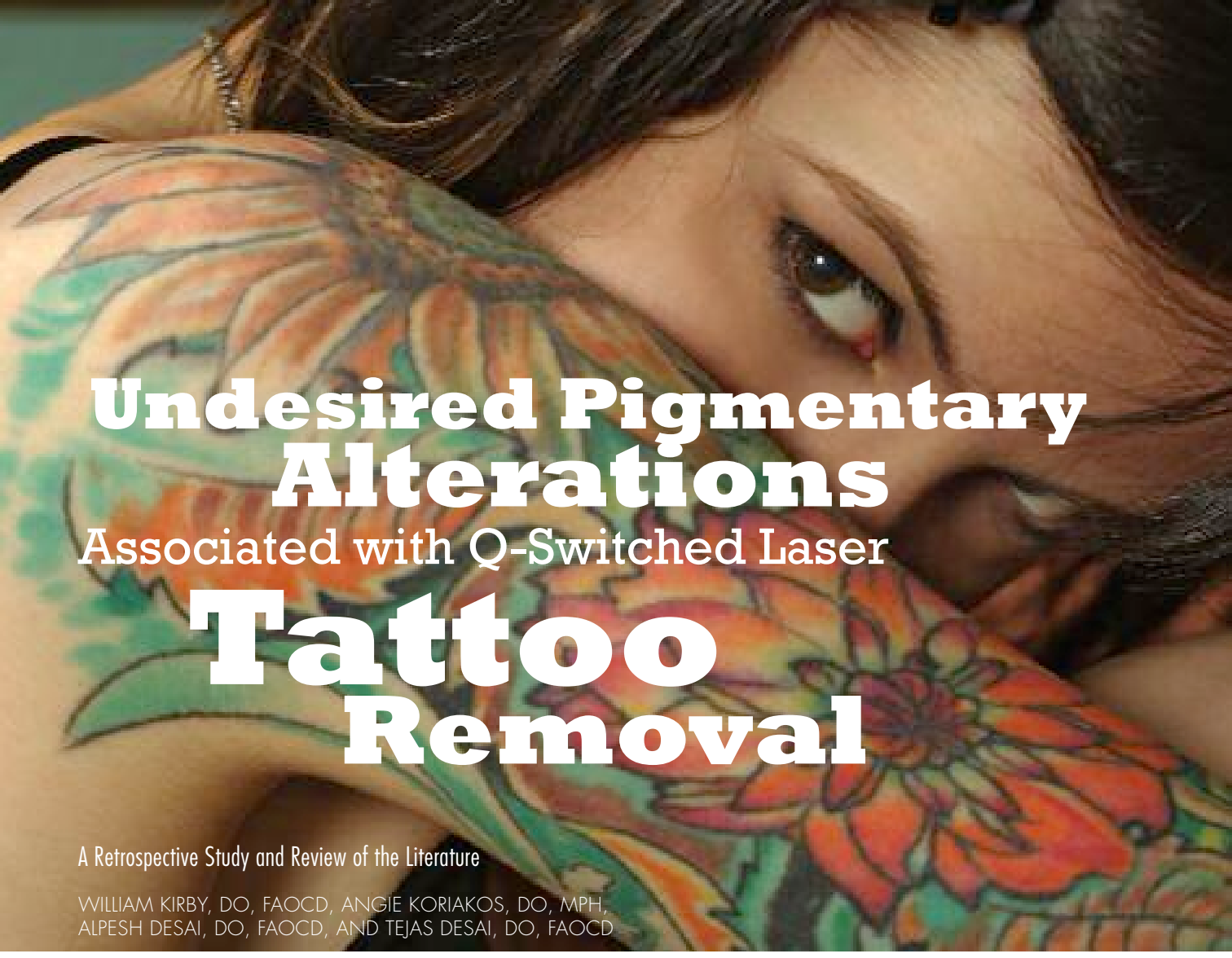

Undesired Pigmentary Alterations Associated with Q-Switched Laser Tattoo Removal

A Retrospective Study and Review of the Literature

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Tattoo ink treatment via Quality-switched (QS) lasers is widely considered the gold standard tattoo removal modality and is a relatively safe procedure, especially when compared to the continuous wave lasers and non-laser treatment methods used in the past. That being said, adverse side effects including undesired pigmentary alterations that occasionally occur with the use of the QS devices, while widely acknowledged among laser specialists, haven't been clearly quantified in the medical literature. This article addresses the undesired discoloration including hypopigmentation, hyperpigmentation and depigmentation that may accompany tattoo ink treated with QS lasers through a review of the literature and a discussion of a retrospective study.

TATTOO REMOVAL DEVICES

Currently, three different QS devices available to treat both amateur and professional tattoos include: the neodymium:yttrium-aluminum-garnet (QS Nd:YAG; 532 nm and 1,064 nm), the alexandrite (QS Alex; 755 nm) and the ruby laser (QSRL; 694 nm).[1] Although all three can offer excellent resolution of tattoo ink, they can also cause skin discoloration. These pigmentary changes are usually transient, but may be permanent.[2]

PIGMENTARY PROBLEMS WITH QS LASER TREATMENT

Hypopigmentation (Figures 1 and 2)

Hypopigmentation is more common when the wavelength of the laser is well absorbed by melanocytes. At 1064 nm, the QS Nd:YAG laser has the longest and most deeply penetrating wavelength, with the least risk of pigmentary alteration. Thus the QS Nd:YAG (1,064 nm) is the safest choice for laser tattoo removal in darker skin types.[3] At 532nm, the QS Nd:YAG laser may cause a short-lived hypopigmentation in any skin type due to the minimal depth of penetration of this wavelength, therefore preserving follicular melanocytes.[1] Kilmer and Anderson noted that QS Nd:YAG (532) "treats red ink effectively, but also leads to temporary hypopigmentation."[4] Fitzpatrick and Goldman noted in a study of 17 patients with amateur and professional tattoos treated with a QS Alex that "transient hypopigmentation occurred in approximately 50%."[5] In two separate studies with the QS Alex, Alster[6,7] found no permanent hypopigmentation when amateur, professional, and traumatic tattoos were treated. In a study treating 162 tattoos, both amateur and professional, with the QSRL, the authors noted that "transient hypopigmentation occurred in many patients."[8] Another study of 57 blue-black tattoos treated with the QSRL showed that "persistent confetti-like hypopigmentation was fre-

Figure 1. Black tattoo on left chest prior to treatment.

Figure 2. The same tattoo showing significant ink reduction and minimal transient hypopigmentation after three treatments with a QS Nd:YAG (1064nm).

quent."[9] In a comparison study of QS Alex, Nd:YAG (1064-nm), and QSRL lasers in the treatment of blue-black tattoos, hypopigmentation occurred most frequently with the QSRL laser followed by the QS Alex, with no hypopigmentation seen after QS Nd:YAG (1,064 nm) treatment. In another comparison of the QS Nd:YAG and QSRL in treating blue-black tattoos, the QSRL had the highest incidence of long-lasting hypopigmentation, while the Nd:YAG had no incidence of hypopigmentation.[10] When Levine and Geronemus compared the QS ruby laser and the QS Nd:YAG, they also noted that "hypopigmentation was found more commonly with the Q-switched ruby laser."[11]

Hyperpigmentation (See Figures 3 and 4)

For the most part, there is a direct correlation between a patient's Fitzpatrick skin type and the incidence of hyperpigmentation, with darker skin types being more likely to experience hyperpigmentation. Although use of the QS Nd:YAG laser is preferable in darker skin types, temporary hyperpigmentation is still common.[2] Kuperman-Beade, Levine, and others noted that "hyperpigmentation and textural changes are infrequent adverse effects of the Q-switched Nd:YAG laser."[12] In a study of 36 tattoos treated with the QS Nd:YAG, the incidence of hyperpgmentation was noted to be 5.6%.[13] A frequent cause of transient hyperpigmentation that patients incorrectly attribute to QS laser use is post-inflammatory hyperpigmentation due to irritant contact dermatitis from the use of ice packs and adhesive tape as well as allergic contact dermatitis to over-the-counter post-treatment topical antibacterial preparations.

Depigmentation

The side effect of depigmentation occurs more rarely than that of hypopigmentation after QS laser therapy.[11] Kilmer and Anderson noted that the QSRL "is frequently associated with transient pigmentary changes, including rare depigmentation."[4]

PATIENTS AND METHODS

A study examining pigmentary changes after tattoo removal included 34 women and 16 men with Fitzpatrick skin type I to VI from 21 to 63 years of age, with an average of 35.39 years. The tattoos chosen were black — either amateur or professional — and were located on different areas of the body. All study participants had successfully completed laser tattoo removal treatment with a QS Nd:YAG device and had received between three and 13 treatments (average of 8.43) at intervals of at least 6 weeks. At a follow-up appointment 6 to 8 weeks after the final treatment with the QS device, patients were assessed and examined for hyperpigmentation, hypopigmentation or depigmentation. Any noted pigmentary changes were classified as mild, moderate, or severe (based on subjective observations).

RESULTS

The total rate of undesired pigmentary alteration from treatment with the QS Nd:YAG (1064nm) was 30% for all patients. Among them, there was mild hyperpigmentation in 16%, moderate hyperpigmentation in 4%, and severe hyperpigmentation in 2%; there was mild hypopigmentation in 4%, moderate hypopigmentation 2%, and severe hypopigmentation in 2%. There were no cases of depigmentation.

STUDY LIMITATIONS

This study involved procedures performed at a single clinic with a single QS device; a study with a larger patient population, multiple clinic sites and multiple QS

Figure 3. Black tattoo on the left buttock.

Figure 4. The same tattoo showing ink reduction and transient hyperpigmentation after five treatments with a QS Nd:YAG (1064nm).

units would obviously provide more accurate information. Since patients were assessed 6 to 8 weeks after their last treatment, and since many undesired pigmentary alterations are transient, assessing patients with a longer time interval after their last treatment would likely have decreased the percentage of patients experiencing this unwanted side effect. As noted above, because the QS Nd:YAG (1064nm) has a lower rate of pigmentary alterations when compared to the QS Nd:YAg (532nm), the QSRL (694 nm) and QS Alex (755), a study consisting of colored tattoos and incorporating other QS devices would likely have increased the percentage of patients who experience pigmentary alterations. Lastly, a study devoted to a single Fitzpatrick skin type, or compartmentalized based on specific skin types, would likely have revealed more specific results.

TREATING POST-TREATMENT PIGMENTARY ALTERATIONS

Because most cases of pigmentary alterations associated with QS laser treatment are temporary, simple "watchful waiting" and patient reassurance is usually sufficient. However, for the patients who request treatment options for the discoloration they are experiencing, we offer the following approaches.

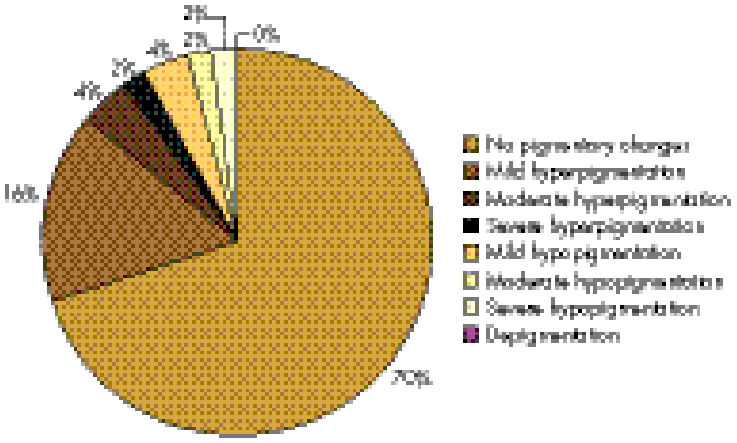

Figure 5. Chart illustrating the incidence of pigmentary alteration associated with QS laser treatment of tattoo in a retrospective study performed by the authors.

First, post inflammatory hyperpigmentation secondary to contact dermatitis should be ruled out; when this is determined to be the cause, the patient should be re-educated and sun avoidance measures taken.

For patients with true hyperpigmentation secondary to QS laser treatments, the application of topical hydroquinones and sunscreens to the affected area has shown to be helpful. Conversely, patients with hypopigmentation may apply hydroquinone and sunscreen to the normal surrounding skin while avoiding the hypopigmented or depigmented area. This will make the condition less noticeable as the return of pigmentation takes place. Additionally, as laser tattoo removal treatments are traditionally preformed approximately 6 weeks apart, patients with pigmentary alterations should be scheduled at longer treatment intervals.

CONCLUSION

In summary, although a safe procedure, the treatment of tattoo ink with quality-switched lasers may be associated with adverse side effects including undesired pigmentary alterations. Prior to beginning treatment with a Q-switched laser, patients seeking the eradication of tattoo ink should be informed that that temporary, and possibly permanent, pigmentary changes may occur. ■

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