Received: 10 July 2019 | Accepted: 15 August 2019
DOI: 10.1111/dth.13069

THERAPEUTIC HOTLINE: SHORT PAPER

DERMATOLOGIC THERAPY WILEY

Combined pulsed dye laser and Q-switched Nd:YAG laser intraumatic facial tattoo removal: A case series

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Abstract

Traumatic tattoos can be treated with several methods, including mechanical and chemical devices. However, they are rarely used due to the high risk of permanent side effects such as scarring and depigmentation. Recently, laser devices, especially the Q-switched (QS) laser and the pulsed dye laser (PDL), applied in combination, have achieved complete clearance of the lesions without any risk of side effects. Herein, we reported three cases of traumatic facial tattoos successfully treated with combined PDL and QS Nd:YAG laser.

KEYWORDS
pulsed dye laser, Q-switched lasers, traumatic tattoo

1 | INTRODUCTION

Traumatic tattoos are caused by materials like gravel, asphalt, dirt, dust, pencil lead, metal, gunpowder, and firework debris, which accumulate under the skin due to explosive forces, abrasion, or accidental injuries. The color of traumatic tattoos can vary from black, gray, blue to brown depending on the material and its depth; in most cases, the carbon component causes a blue–black color.

The first-aid treatment should include the immediate and complete removal of the foreign pigmented materials before re-epithelization; if this procedure is not carried out, the particles remain in the skin, triggering inflammatory and granulomatous changes. Second, traumatic tattoos can be removed with mechanical or chemical methods, including the salt abrasion technique, dermabrasion, cryosurgery, and surgical excision. Although all these methods may be effective, they are rarely used due to the high risk of permanent side effects such as scarring and depigmentation (Kent & Graber, 2012; Kuperman-Beade, Levine, & Ashinoff, 2001).

Recently, nonablative lasers tattoo removal have been investigated in numerous randomized and controlled studies and, to date, these devices are considered the gold standard for safe and effective tattoo removal (Luebberding & Alexiades-Armenakas, 2014).

Herein, we report three cases of traumatic facial tattoos successfully treated with combined pulsed dye laser (PDL) and Q-switched (QS) laser, resulting in a complete disappearance of the lesions without any side effects.

2 | CASE 1

A 28-year-old man came to our dermatological clinic with a blue-gray scarred tattoo on the left side of his face, in the periocular area, due to asphalt abrasion. The traumatic tattoo was the result of a motorcycle accident 10 years earlier (Figure 1a). Other physicians had attempted to remove the tattoo without success, with consequent psychological stress for the patient. A test was performed on a small area for evaluating the periocular skin reaction. The lesion was initially treated with one session of PDL (Synchro VasQ, DEKA, Calenzano, Italy) with the following parameters 6.5 J/cm^2, spot 12 mm, 0.5 ms, and subsequently with two sessions of QS Nd:YAG laser (Synchro QS4, DEKA, Calenzano, Italy) 6 J/cm^2, spot 4 mm, 2 Hz. Any discomfort was reduced with air cooling, and the postoperative wound was medicated with a combination of *fusidic acid/betamethasone valerate* cream to reduce redness. Three months after the last laser session, the lesion had almost completely

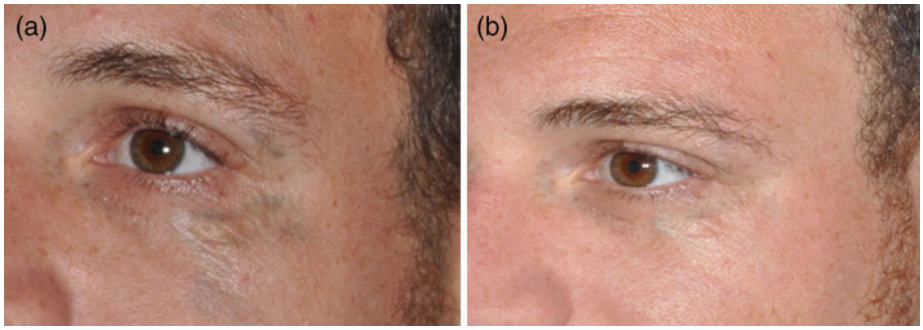

FIGURE 1 (a) A blue-gray traumatic tattoo on the left side of the face, in the periocular area, due to asphalt abrasion. (b) The same patient 3 months after the last laser session. The lesion has almost completely disappeared, with a remarkable lightening of the tattoo and an improvement in the skin texture

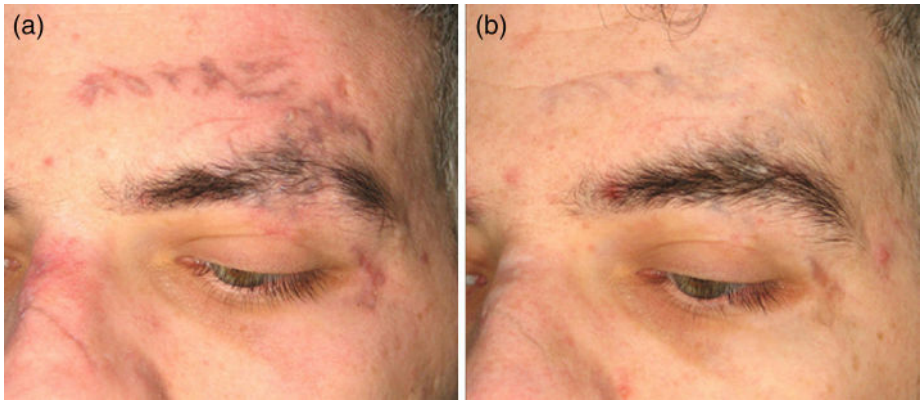

FIGURE 2 (a) A typical large scarred gray tattoo, spread over the left side of the forehead, left eyebrow and temporal area. (b) Two months after the last laser session, there was impressive significant reduction in the pigment content as well as excellent improvement of the red scar tissue

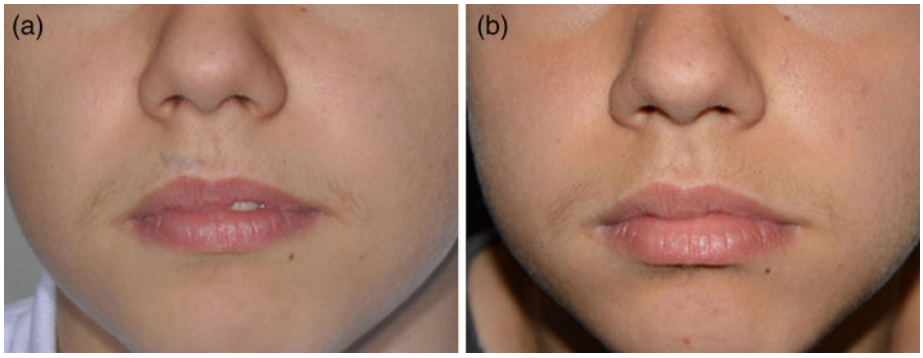

FIGURE 3 (a) A dark gray-black tattoo near the upper lip, due to the pencil insertion during a game. (b) Complete disappearance of the pencil tattoo

disappeared, with remarkable fading of the tattoo and skin texture improvement (Figure 1b).

3 | CASE 2

A 39-year-old man had a large scarred gray tattoo spread over the left side of his forehead, left eyebrow, and temporal area, the result of a car accident occurred a year earlier with relevant asphalt injury.

The skin was erythematous with a rough texture; the implanted materials had induced inflammatory changes (Figure 2a). The lesion was initially treated with two sessions of PDL (Synchro VasQ, DEKA, Calenzano, Italy) 7 J/cm^2, spot 12 mm, 0.5 ms, and subsequently with two sessions of QS Nd:YAG laser (Synchro QS4, DEKA, Calenzano, Italy) 6.5 J/cm^2, 4 mm, 2 Hz. Any discomfort was reduced with air cooling, and the postoperative wound was medicated with a combination of *fusidic acid/betamethasone valerate* cream. Two months after the last laser session, there was a significant reduction in pigment content, as well as excellent improvement of the red scar tissue (Figure 2b).

4 | CASE 3

A 10-year old boy had a dark gray-black tattoo located on the skin above the upper lip, appeared 4 years earlier after a pencil trauma (Figure 3a). The lesion was managed with one session of PDL (Synchro VasQ, DEKA, Calenzano, Italy) 6.5 J/cm^2, spot 12 mm, 0.5 ms, and subsequently with one session of QS Nd:YAG laser (Synchro QS4, DEKA, Calenzano, Italy) 6.5 J/cm^2, 4 mm, 2 Hz. The postoperative wound was medicated with a combination of *fusidic acid/betamethasone valerate* cream. We only checked the result 2 years after the last laser session, as the patient had moved to another country, and noted the total disappearance of the pigmentation (Figure 3b).

5 | DISCUSSION

The gold standard of tattoo removal is laser therapy. The targeted destruction of tattoo ink particles and foreign materials embedded in the dermis is based on selective photothermolysis: the laser wavelength and pulse duration should match the targets as much as possible in order to achieve selective effects. Based on this theory, the QS lasers are the most appropriate systems for targeting the very small ink particles and foreign materials. QS lasers (Ruby, Alexandrite and Nd:YAG) emit high-powered pulses with a very short duration of nanoseconds. The fast thermal expansion of the targets causes their fragmentation and consequent production of acoustic waves that propagate into the surrounding structures; the photomechanical and photoacoustic effects contribute to the laser mechanism of tattoo removal. The tattoo particles are removed by phagocyte cells and eliminated through the lymphatic and transepidermal passage (Bäumler, 2017; Luebberding & Alexiades-Armenakas, 2014; Naga & Alster, 2017; Seitz, Grunewald, Wagner, Simon, & Paasch, 2014). Among the QS lasers, we prefer to use the QS Nd:YAG at 1064 nm, as the laser energy is well absorbed by the blue-black pigment of traumatic tattoos, and at the same time a long wavelength (1,064 nm) acts on the deeper dermal layers, avoiding melanin absorption in the epidermis; the risk of depigmentation and blistering is greatly reduced, sparing the superficial melanocytes. The QS Nd:YAG is also appropriate for treating traumatic tattoos in patients with darker skin. A preliminary test is recommended before treating traumatic tattoos by penetrating 1 cm^2 into the lesional area, in order to evaluate the immediate post-Nd:YAG laser effect that entails a rapid whitening of the skin with a few petechiae. The same test can detect any risk of burning, especially when the foreign material is gunpowder.

In our patients, the first laser session was performed by PDL, and only afterward the QS Nd:YAG laser was applied. The PDL is the optimal treatment for reducing erythema and telangiectasia associated with scars (Antony & Harland, 2003; Gorouhi, Davari, Kashani, & Firooz, 2007; Martins, Trindade, & Leite, 2008). Traumatic tattoos may negatively alter a person's appearance due not only to the acquired pigmentation but also to the vascular and inflammatory marks and scarring caused by the depositing of foreign pigmented particles. The PDL is able to selectively target the dilated blood vessels, diffuse erythema, and inflammation without any damage to the surrounding tissues; moreover, this laser softens, smoothes and flattens any scars by acting on the collagenesis with a realignment and reformation of the collagen fibers.

A traumatic tattoo is a sort of puzzle consisting of several different pieces and therefore an approach based on the use of two selective and complementary laser systems seems to be very promising. This treatment offers numerous benefits in terms of aesthetic enhancement of traumatic tattoos without any significant side effects.

6 | CONCLUSIONS

The PDL is the optimal treatment for reducing scar bulk and symptoms. It also decreases erythema and telangiectasia associated with scars, normalizes the skin surface texture, and improves the scar pliability. The QS Nd:YAG laser is highly effective for traumatic tattoo removal, resulting in complete clearance in the majority of cases. In our three cases, we demonstrate the efficacy of a combined treatment. A preliminary test is necessary as well as a strict follow-up in order to avoid any side effects.

CONFLICT OF INTEREST

None of the authors has any potential financial conflict of interest related to this manuscript.

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How to cite this article: Bonan P, Bassi A, Bruscino N, et al. Combined pulsed dye laser and Q-switched Nd:YAG laser intraumatic facial tattoo removal: A case series. *Dermatologic Therapy*. 2019;32:e13069. https://doi.org/10.1111/dth.13069