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Effective Treatment of Traumatic Tattoos With a Q-Switched Nd:YAG Laser

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Background and Objective: **It is well known that the Q-switched Nd:Yag (QSNd:YAG) laser works well in the treatment of blue-black tattoos and benign pigmented lesions. It is less well known that this laser can also treat traumatic tattoos after accidents.**
Materials and Methods: **Twelve patients with traumatic tattoos were treated with a QSNd:YAG laser, 1064 nm.**
Results: **Gravel, mascara, high explosives, and older tattoos responded best with total clearance after 2–5 treatments. Hard materials such as asphalt, amalgam, and metal needed 6–11 treatments, and there was not always complete clearance. Transcient hypopigmentation but no scarring was seen.**
Conclusion: **QSNd:YAG laser treatment of traumatic tattoos is effective, atraumatic, and a good alternative to mechanical dermabrasion or other conventional therapies. Lasers Surg. Med. 22:103–108, 1998.** **© 1998 Wiley-Liss, Inc.**

Key words: explosion accident; laser; Nd:YAG; traffic accident; traumatic tattoo

INTRODUCTION

Over the past several years, we have been able to treat benign pigmented lesions and different kind of tattoos with Q-switched Alexandrite laser (QSAL) [1,2], Q-switched Ruby (QSRL) [3], and QS Nd:YAG laser [3,4]. It has been revolutionary in many ways, especially regarding cultural and traumatic tattoos.

Traumatic tattooing results from an abrasive or explosive accident. Foreign material is embedded into the skin and is very difficult to remove with conventional surgical methods unless an operating microscope is used at the time of the injury. Permanent tattooing may be a result, reminding the patient painfully of the accident. Previous treatment modalities, including surgical excision, dermabrasion, salabrasion, cryosurgery, CO_2 laser, or argon laser, might lead to a risk of scarring.

MATERIALS AND METHODS

Twelve patients with traumatic tattoos after accidents were treated with a QS Nd:YAG (neodynium: yttrium-aluminium-garnet) laser (Medlite, Continuum, Biomedical, Livermore, CA). The wavelength 1064 nm was used with a 3 mm spot, 10 ns pulse width, 10 Hz, 5–7 J/cm^2, and 6 weeks between treatments. Emla cream (lidocain) was used as a local anesthesia when the patients needed it. All patients had been surgically dermabraded in connection with the accidents, which were caused either by traffic, explosion, or a gunshot. A considerable amount of persistant blue-black pigmentation in dermis was noted.

RESULTS

Injuries from gravel, mascara, and high explosives responded best to treatment, probably because of their more soft nature, and they needed 2–6 treatments. Harder materials such as asphalt, amalgam, and metallic paint from a car (Fig. 1) needed 6–11 treatments, and it was not

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Fig. 1. Metallic paint from a car accident before and after nine laser treatments.

TABLE 1. Protocol Over Treatments and Results

Material	Location	Tx	Clearance
Abrasive			
gravel	arm	2	complete
	cheek	2	complete
	leg	2	complete
mascara	eyelid	3	complete
metal	cheek	9	complete
	chin	8	complete
asphalt	temple	6	complete
	nose	5	incomplete
	upper lip	5	incomplete
Explosive			
hand grenade	face	4	complete
gunpowder	eyelids	7	incomplete
amalgam	gingiva	11	incomplete

always possible to receive a full clearance of the foreign material (Table 1). Older accidents responded faster with less treatments in comparison with the younger ones (Fig. 2). The immune system probably had time to break down and phagocytose some of the foreign material. Transcient hypopigmentation was seen in two of our patients, but after a year both of them were repigmented. There was no persistant scarring.

DISCUSSION

Dramatic improvement was shown after the treatments, and there was no further scarring. This has been shown before with the other QSAL [5] and the QSRL [6,7], but not to my knowledge with the QSNd:YAG laser. Q-switched lasers store the energy in the laser before it is released so that the high peak power outputs with a nanosecond pulse duration. This has limited the nonspecific thermal damage and subsequent scarring in the skin. The patients were relieved overall after completing the treatments and many felt that they now could go on with their lives instead of brooding about their accidents.

The mechanism behind the effect is not fully understood, but there are several possible mechanisms, e.g., rapid shock waves produce a reduction in pigment particle size and fragmentation of pigment containing cells. Pigment is released and after an inflammatory response, there is phagocytosis of the tattoo pigment. The shock wave is caused by the high temperature (>1,000°C) that occurs and the thermal expansion afterward. This heat from the absorbed light energy creates a chemical alteration in the pigment granule structure and alters the optical properties of the tattoo.

Immediately after treatment, there is a whitish surface that disappears after a few minutes. This transcient whitish surface corresponds to gas intradermally. The skin is a little red and swollen for a few days, and after a few weeks, the results are evident. Probably it is more difficult to fragment harder tattoos than softer ones, and harder tattoos would need higher energy levels so it can fragment more easily. The deeper the tattoo, the higher energy is needed, probably due to the scattering of the beam. Also, the age of the traumatic tattoo could be important for the result. The older tattoo tends to require fewer treatments than younger ones. The reason might be that the ink particles are moving deeper in the dermis [8] as well as moving out of the dermis, presumably by action of mobile phagocytic cells. It is a well-known fact that a decorative old tattoo fades over the years and grossly black hard lymph nodes can be found close to a tattoo that has been previously dermabraded. These lymph nodes are full of pigment from the tattoo [9]. Also, the amount of ink and the depth of ink have a great influence over the number of treatments needed.

There is no crust or wound afterward, but there is a risk of transcient hypopigmentation that might last as much as a year. This risk is higher energy is used and the treated skin is type IV. It is important to inform the patient about this risk and about the risk of scarring, even if it is minimal. We have not had any scarring in this study, but theoretically there must be a risk if too high energy is used, especially multiple times over high risk areas, e.g., deltoideus areas. Use as low energy as possible to see a threshold response. Photodocumentation before is a must, and if there is problem with interpretation, a reflectance spectrophotometer can be used.

The treatment results also can be followed histologically (Fig. 3). Biopsies have demonstrated little if any fibrosis in superficial dermis, but even with clinical clearing of the tattoo, ink has remained in dermis after QSRL [10].

The QSAL and the QSRL also probably work well in treating traumatic tattoos. A comparative study of the QSRL and QSND showed no significant differences in lightening the tattoos at similar fluences [11]. However, the QSRL induced more hypopigmentation and a higher incidence of textural changes [12]. This results (except the textural changes) were confirmed recently in a prospective paired comparison study [13].

The longer wavelength allows for greater

Fig. 2. Military explosion accident before and after three treatments.

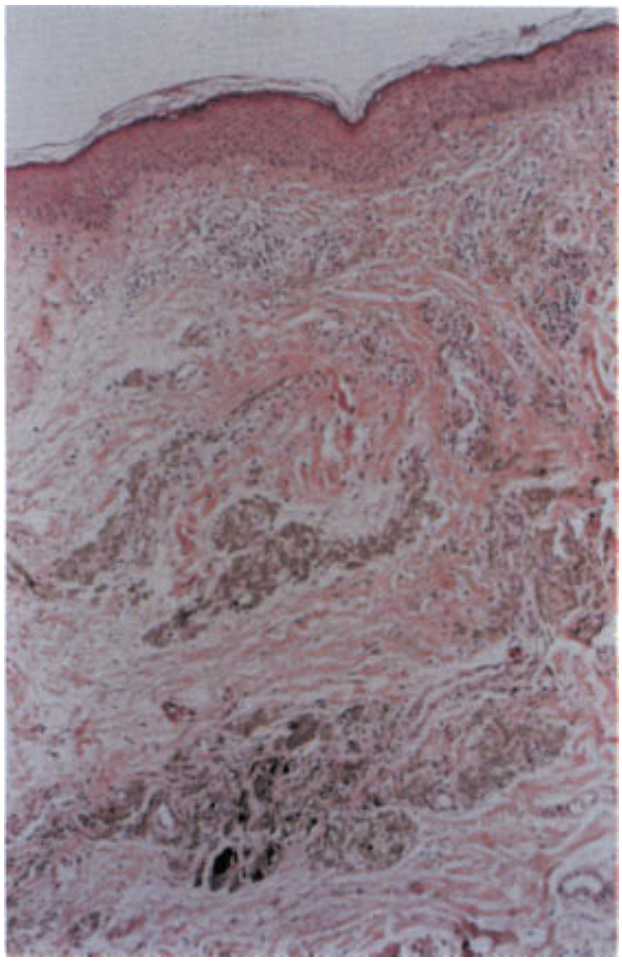

Fig. 3. Gun powder on the eyelid in upper middle reticular corium and a little less in the phagocytes in the papillary corium after three laser treatments.

dermal penetration. Perhaps there could be an advantage at times with the deeper penetration and lesser interaction with melanin that Nd:YAG laser has with its longer wavelength 1064 nm.

The lack of hyperthrophic or atrophic scarring and the absence of textural changes after QSRL and QSNd:YAG laser have been confirmed histopathologically by the lack of alteration in either collagen bundles or elastic fibers [14]. This has been shown after the treatment of tattoos [4].

CONCLUSION

Q-switched Nd:YAG laser treatments of traumatic tattoos are effective, atraumatic, and in some cases a better alternative than conventional therapies. Harder and probably younger tattoos need more treatments with higher fluence.

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