Successful Elimination of Traumatic Tattoos by the Q-Switched Alexandrite (755-nm) Laser

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Traumatic tattoos are very difficult to eradicate because of the resultant deep penetration of foreign body particles. Previous treatments, such as surgical excision and dermabrasion, commonly resulted in incomplete removal or significant scarring or both. Three patients with traumatic tattoos were treated with the Q-switched alexandrite laser (755 nm), with complete lesional resolution observed after one to four treatments. No adverse sequelae, such as scarring or pigmentary alteration, were noted in the laser-irradiated skin.

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Mechanical penetration of the skin by such foreign body particles as metal, glass, dirt, sand, and carbon-containing material can lead to a traumatic tattoo [1, 2]. A combination of epithelium abrasion and impregnation of the skin by pigmented particles occurs as a result of trauma involving friction with road surfaces. Depending on the extent of injury, the foreign substances can become so deeply embedded in the skin that their removal is rendered extremely difficult.

Previous treatments, including surgical excision, dermabrasion, salabrasion, cryosurgery, and electrosurgery, were best delivered as soon as possible after the injury (before skin re-epithelialization) to obtain the most satisfactory results [2–12]. Often even these treatments were ineffective in eliminating the deeper tattoo particles and led to significant scarring. A variety of lasers have been used to treat traumatic tattoos, with the best results obtained after ruby laser treatment [13–15]. The Q-switched alexandrite laser has been shown to remove effectively tattoo pigment contained in amateur and professional tattoos [16–18]; however, its use in the treatment of nondecorative, traumatic tattoos has not been previously evaluated.

Patient Reports

Three patients with traumatic tattoos were treated with the Q-switched alexandrite laser (Candela Laser Corp, Wayland, MA), with a 755-nm wavelength, a 100-nsec pulse duration, and a 3-mm spot size, until complete clearing of their tattoos had been achieved. The tattoos were treated with adjacent, nonoverlapping laser pulses. No anesthesia was used. Individual energy thresholds were determined by an immediate whitening response within the laser-irradiated areas.

Patient 1

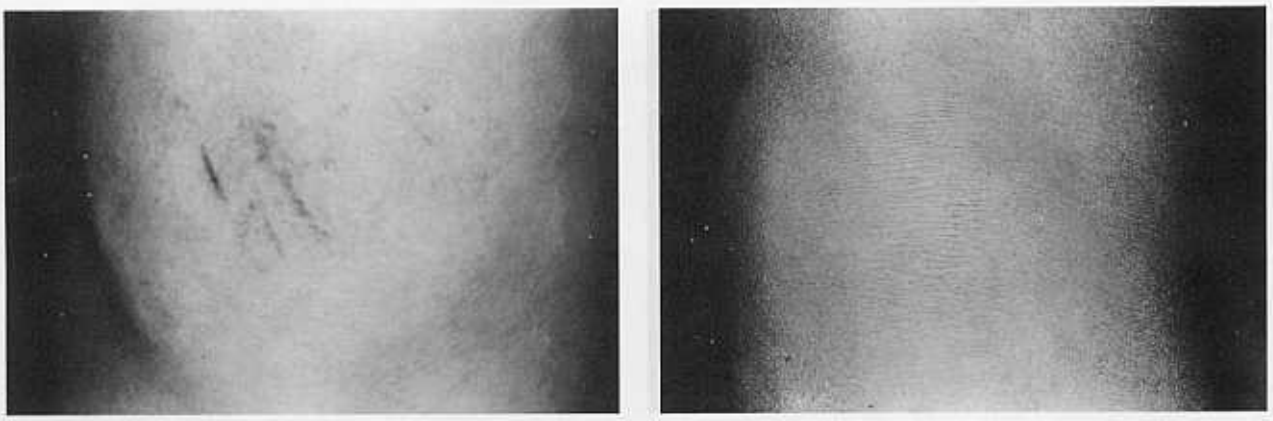
A 43-year-old woman presented with linear tattoos on her left knee as a result of a fall on asphalt during childhood. After four treatments with the Q-switched alexandrite laser at 7.0 J/cm^2 over a period of 4 months, the tattoos were totally eliminated (Fig 1A, B).

Patient 2

A 34-year-old woman presented with a long-standing pencil point–puncture tattoo on her right palm. She received a single Q-switched alexandrite laser treatment at 7.5 J/cm^2, with complete clearing noted within 2 weeks (Fig 2A, B).

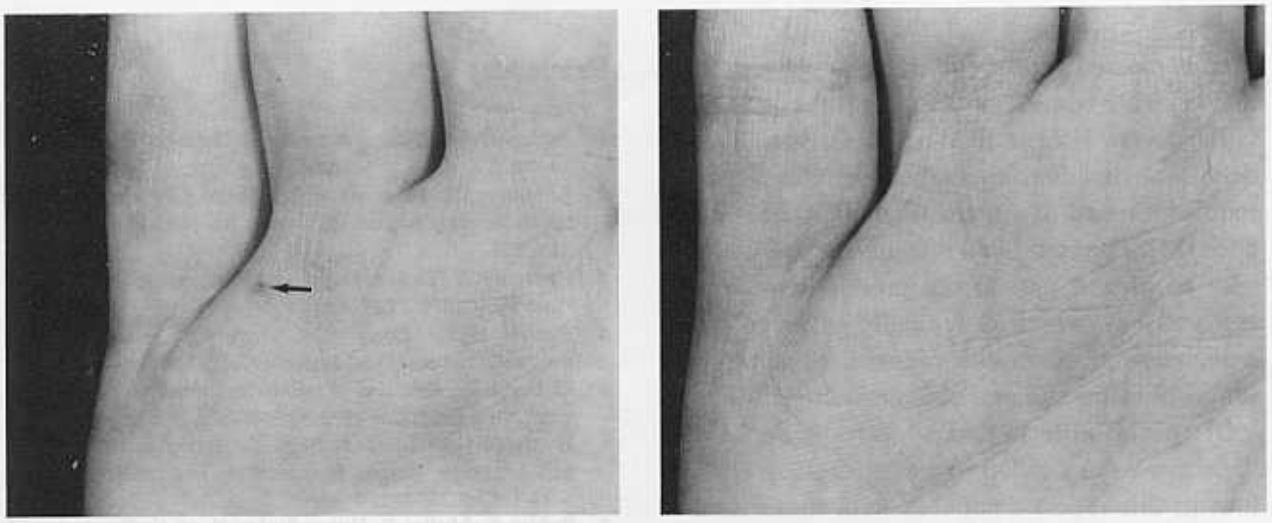
Patient 3

A 14-year-old boy with traumatic abrasions on his right knee from a recent skating accident on asphalt received six alexandrite laser treatments at 6- to 8-week intervals before total elimination of the tattoo particles was achieved. The average energy density used was 7.25 J/cm^2 (range, 6.0–8.0 J/cm^2) (Fig 3A, B).



A B

Fig 1. Asphalt tattoo before (A) and 6 weeks after (B) four alexandrite laser treatments at 7.0 J/cm².



A B

Fig 2. Pencil point tattoo on hand before (A) and 2 weeks after (B) one alexandrite laser treatment at 7.5 J/cm².

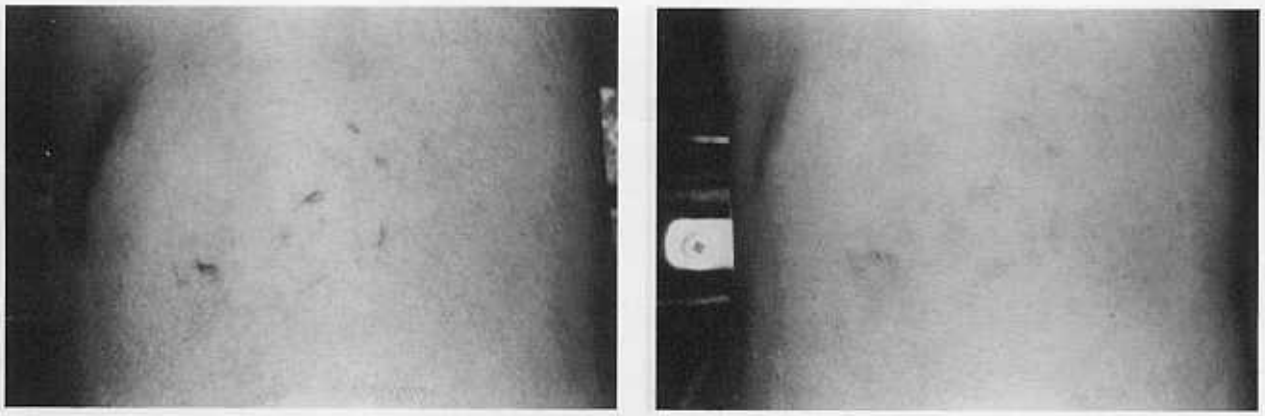
Discussion

Before the advent of laser surgery, tattoos of all types could be treated only using traditional surgical approaches. Several reports have demonstrated the huge success of a variety of Q-switched red and infrared lasers in removing decorative tattoo removal [16–25]; however, before this report, only the ruby laser had been shown to eliminate traumatic tattoos successfully.

The exact mechanism whereby a laser can remove tattoo pigment remains unknown. The majority of pigment clearance is achieved through physical, chemical, and ultrastructural events. Tattoo particles become fragmented because of rapid thermal expansion when laser irradiation produces heat within the targeted pigment granules exceeding 1,000°C. An inflammatory response ensues, with eventual phagocytosis of the tattoo fragments [26–29].

The clinical response observed in laser-irradiated skin supports these histological events. Immediately after laser irradiation, the treated tattoo appears white as a result of water vaporization (or steam) within the skin. Lightening of the tattoo proceeds over the next several weeks during the inflammatory and phagocytic phases of repair.

Whereas professional tattoos usually require an average of 8.5 alexandrite laser treatments for total clearance [18], the traumatic tattoos in this



A B

Fig 3. Traumatic asphalt tattoo before (A) and 8 weeks after (B) six alexandrite laser treatments at fluences ranging 6.0–8.0 J/cm².

report cleared with significantly fewer treatments. The results obtained in the traumatic tattoos were similar to those seen after alexandrite laser irradiation of amateur tattoos, which require a mean of 4.6 treatments to effect clearance [18]. The improved response of these tattoos may be due in part to the predominant carbon composition, which is typically easier to eliminate, as well as to the reduced pigment load found in traumatic and amateur tattoos.

Of special note is that slightly higher energy densities were needed to treat the traumatic tattoos in this report compared with those used to treat decorative tattoos [16–18]. Because higher energy fluences can penetrate tissue more deeply, it is likely that increased energies will result in increased tattoo granule fragmentation. The composition of the traumatic tattoo pigment could also decrease the relative absorption at 755 nm because of the presence of sand, glass, or other particles within the traumatized skin, thereby necessitating the use of higher energy fluences to attain the desired result.

In summary, the Q-switched alexandrite laser can safely and effectively remove traumatic tattoos without scarring or pigmentary alteration within a few treatment sessions. Even long-standing, re-epithelialized tattoos can be treated, thereby eliminating the need for early intervention, as is commonly advocated. Physicians should be aware of this laser treatment and offer it as a viable option to those patients who suffer from traumatic tattoos.

References

1 Agris J. Adventitious tattooing. J Dermatol Surg 1976;2: 72–74

2 Apfelberg DB, Manchester GH. Decorative and traumatic tattoo biophysics and removal. Clin Plast Surg 1987;14: 243–251

3 Parsons RW. The management of traumatic tattoos. Clin Plast Surg 1975;2:517–522

4 Buncke HJ, Jr, Conway H. Surgery of decorative and traumatic tattoos. Plast Reconstr Surg 1957;20:67–77

5 Claburgh W. Removal of tattoos by superficial dermabrasion. Arch Dermatol 1968;98:515–521

6 Horowitz J, Nichter LS, Stark D. Dermabrasion of traumatic tattoos: simple, inexpensive, effective. Ann Plast Surg 1988;21:257–259

7 Bohler K, Muller E, Huber-Spitzy V, et al. Treatment of traumatic tattoos with various sterile brushes. J Am Acad Dermatol 1992;26:749–753

8 Crittenden FM, Jr. Salabrasion—removal of tattoos by superficial abrasion with table salt. Cutis 1971;7:295–300

9 Koerber WA, Price NM. Salabrasion of tattoos. Arch Dermatol 1978;114:884–888

10 Scutt RWB. The chemical removal of tattoos. Br J Plast Surg 1972;25:189–194

11 Ruiz-Esparza J, Goldman MP, Fitzpatrick RE. Tattoo removal with minimal scarring: the chemo-laser technique. J Dermatol Surg Oncol 1988;14:1372–1376

12 Sunde D, Apfelberg DB, Sergott T. Traumatic tattoo removal: comparison of four treatment methods in an animal model with correlation to clinical experience. Lasers Surg Med 1990;10:158–164

13 Dufresne RG, Jr, Garrett AB, Bailin PL, Ratz JL. CO laser treatment of traumatic tattoos (letter). J Am Acad Dermatol 1989;20:137–138

14 Ashinoff R, Geronemus RG. Rapid response of traumatic and medical tattoos to treatment with the Q-switched ruby laser. Plast Reconstr Surg 1993;91:841–845

15 Achauer BM, Nelson JS, Vander Kam VM, et al. Treatment of traumatic tattoos by Q-switched ruby laser. Plast Reconstr Surg 1994;93:318–323

16 Fitzpatrick RE, Goldman MP, Ruiz-Esparza J. Use of the alexandrite laser (755 nm, 100 nsec) for tattoo pigment

removal in an animal model. J Am Acad Dermatol 1993; 28:745–750
17 Fitzpatrick RE, Goldman MP, Dierickx C. Laser ablation of facial cosmetic tattoos. Aesthetic Plast Surg 1994;18: 91–98
18 Alster TS. Treatment of professional and amateur tattoos with the Q-switched alexandrite laser. J Am Acad Dermatol 1995 (in press)
19 Reid WH, McLeod PJ, Reid WH, et al. Q-switched ruby laser treatment of black tattoos. Br J Plast Surg 1983;36: 455–459
20 Reid WH, Miller JD, Murphy MJ, et al. Q-switched ruby laser treatment of tattoos: a 9-year experience. Br J Plast Surg 1990;43:663–669
21 Taylor CR, Gange RW, Dover JS, et al. Treatment of tattoos by Q-switched ruby laser: a dose-response study. Arch Dermatol 1990;126:893–899
22 Scheibner A, Kenny G, White W, et al. A superior method of tattoo removal using the Q-switched ruby laser. J Dermatol Surg Oncol 1990;16:1091–1098
23 Lowe NJ, Luftman D, Sawcer D. Q-switched ruby laser: further observations on treatment of professional tattoos. J Dermatol Surg Oncol 1994;20:307–311
24 Kilmer SL, Lee MS, Grevelink JM, et al. The Q-switched Nd:YAG laser effectively treats tattoos: a controlled, dose-response study. Arch Dermatol 1993;129:971–978
25 Kilmer SL, Andersonn RR. Clinical use of the Q-switched ruby and the Q-switched Nd:YAG (1064 nm and 532 nm) lasers for treatment of tattoos. J Dermatol Surg Oncol 1993;19:330–338
26 Yules RB, Laub DR, Honey R, et al. The effect of Q-switched ruby laser radiation on dermal tattoo pigment in man. Arch Surg 1967;95:179–180
27 Laub DR, Yules RB, Arras M, et al. Preliminary histopathological observation of Q-switched ruby laser radiation on dermal tattoo pigment in man. J Surg Res 1968; 8:220–224
28 Diette KM, Bronstein BR, Parrish JA. Histologic comparison of argon and tunable dye lasers in the treatment of tattoos. J Invest Dermatol 1985;85:368–373
29 Taylor CR, Anderson RR, Gange W, et al. Light and electron microscopic analysis of tattoos treated by Q-switched ruby laser. J Invest Dermatol 1991;97:131–136