Accelerated Tattoo Removal With Acoustic Shock Wave Therapy in Conjunction With A Picosecond Laser

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Background: Conventional tattoo removal consists of single-pass treatments, spaced 7–8 weeks apart, for a total of 7–10 sessions. A major limiting factor of this procedure is the development of cavitation bubbles and vacuoles within the epidermis and dermis that result from the rapid heating of tattoo particles by the laser. While multiple-pass methods using the R20 protocol or the PFD patch enhance tattoo removal through epidermal clearance, they have no effect on deep-intradermal pigment associated vacuoles that arise from treatment with lasers such as the Q-switched laser.

Methods: A 28-year-old female with Fitzpatrick skin Type V presented for treatment of a 6-year-old professional black tattoo on the left ventral wrist. She underwent three treatment sessions at 6–8 week intervals using a commercial 1,064-nm picosecond Nd:YAG laser (PicoWay; Candela, Wayland, MA) and a perfluorodecalin (PFD) patch (Merz; Raleigh, NC). At each treatment session, she received two passes with 1,064-nm, 4-mm spot size, a fluence ranging from 2.8 to 3.2 J/cm² and a laser repetition rate of 2 Hz. Between laser passes and following the final laser pass, the medial portion of the tattoo was treated with acoustic shock wave therapy (ASWT) using the Zwave device (Zimmer Medizin Systems; Irvine, CA) with 90 mJ, 22 Hz, and 1,200 pulses.

Results: After three treatment sessions, there was 80% clearance of the medial portion of the tattoo that received the ASWT compared with 60% clearance of the lateral portion of the tattoo that was treated with the picosecond 1,064-nm Nd:YAG laser and PFD patch alone. In the days following each treatment session, the patient noted consistently less edema, erythema and epidermal crusting on the portion of the tattoo that received the ASWT.

Conclusion: We report a case of 80% tattoo clearance with ASWT in a patient with Fitzpatrick type V skin compared with 60% clearance with the picosecond 1064-nm Nd:YAG laser and PFD patch alone. The concurrent use of the PFD patch, which facilitated multi-pass treatments, may have also increased tattoo fading in this patient. ASWT may enhance tattoo clearance by increasing lymphatic drainage and increasing metabolic activity in the treated area, thereby accelerating the clearance of dermal pigment vacuoles produced by the picosecond laser and minimizing epidermal side effects such as erythema, edema, and crusting.

Key words: tattoo removal; acoustic shock wave therapy; picosecond laser

INTRODUCTION

Laser treatment is the gold standard for tattoo removal. The laser assisted tattoo removal process is a result of selective photothermolysis and a photoacoustic effect to produce targeted destruction of tattoo pigment [1]. High energy is absorbed by the ink particles in nanoseconds or picoseconds, producing a shock wave that propagates throughout the dermis causing the ink particles to fragment [1]. The ruptured fragments are directed by tissue macrophages either to the lymphatic channels or to the regional lymph nodes [1].

As laser assisted tattoo removal becomes an increasingly common practice, there is an increased demand for methods to enhance tattoo clearance. Conventional tattoo removal consists of single-pass treatments, spaced 7–8 weeks apart, for a total of 7–10 sessions [2]. A major limiting factor of this procedure is the development of cavitation bubbles and vacuoles within the epidermis and dermis that result from the rapid heating of tattoo particles by the laser. This causes temporary whitening of tattoo pigments and prevents further laser-tattoo interaction [3]. While multiple-pass methods using the R20 protocol or the PFD patch enhance tattoo removal through epidermal clearance, they have no effect on deep-intradermal pigment associated vacuoles that arise from treatment with lasers such as the Q-switched laser [4]. We report a case of 80% tattoo clearance after three sessions using an acoustic shock wave device in conjunction with a 1,064-nm picosecond laser on a professionally applied black tattoo.
METHODS
A 28-year-old female with Fitzpatrick skin Type V presented for treatment of a 6-year-old professional black tattoo on the left ventral wrist (Fig. 1A). The patient had no previous laser tattoo treatment. A picosecond-domain 1,064-nm Nd:YAG laser (PicoWay; Syneron Candela, Wayland, MA) was used to treat the patient. Three milliliters of 1% lidocaine with 1:100.00 epinephrine and sodium bicarbonate were injected into the treatment area prior to each laser treatment. The black tattoo ink was first treated at 1,064 nm with a 4-mm spot size, a fluence of 2.8 J/cm², and a laser repetition rate of 2 Hz. Two passes with the perfluorodecalin (PFD) patch (Merz; Raleigh, NC) with a total of 59 pulses were applied. Between laser passes and following the final laser pass, the medial portion of the tattoo was treated with acoustic shock wave therapy (ASWT) using the Zwave device (Zimmer Medizin Systems; Irvine, CA) with 90 mJ, 22 Hz, and 1,200 pulses.

At 6-week follow-up after the first treatment session, the tattoo showed 20% clearance of the medial portion of the tattoo and 10% clearance of the lateral portion of the tattoo (Fig. 1B). She then underwent her second laser treatment.
with 1,064-nm, 4-mm spot size, 3.0 J/cm² and a laser repetition rate of 2 Hz. Two passes with the PFD patch with a total of 57 pulses were applied. Between laser passes and following the final laser pass, the medial portion of the tattoo was treated with ASWT (90 mJ, 22 Hz, 1,200 pulses).

At 8-week follow-up after the second treatment session, the black tattoo showed 70% clearance of the medial portion of the tattoo and 50% clearance of the lateral portion of the tattoo (Fig. 1C). She underwent her third laser treatment with 1064-nm, 4-mm spot size, 3.2 J/cm² and a laser repetition rate of 2 Hz. Two passes with the PFD patch with a total of 87 pulses were applied. Between laser passes and following the final laser pass, the medial portion of the tattoo was treated with the ASWT acoustic wave device (90 mJ, 22 Hz, 1,200 pulses). At 7-week follow-up after the third treatment session, the black tattoo showed 80% clearance of the medial portion of the tattoo and 60% clearance of the lateral portion of the tattoo (Fig. 1D). An independent physician reviewer graded all postoperative photos compared to baseline.

RESULTS

There was mild and transient localized edema and erythema immediately following each laser treatment. Little to no epidermal crusting was noted following each laser treatment. After three treatment sessions there was an approximately 80% clearance of the medial portion of the tattoo that received the ASWT compared with 60% of the lateral portion of the tattoo that was treated with the picosecond 1,064-nm Nd:YAG laser and PFD patch alone. The patient tolerated the entire procedure well and experienced no side effects. In the days following each treatment session, the patient noted consistently less edema, erythema and epidermal crusting on the portion of the tattoo that received the ASWT.

DISCUSSION

Extracorporeal or Acoustic Shock Wave Therapy (ASWT) is the application of mechanically generated external sound waves. The most widely recognized medical application of this modality is in treating nephrolithiasis. The therapeutic potential of shock waves is also well established in the physical therapy setting for the management of chronic musculoskeletal disorders to clear edema and increase microcirculation after injury, trauma, or surgery [5]. In aesthetics, ASWT is approved by the Food and Drug Administration for the treatment of cellulite, and is also commonly used in conjunction with body contouring devices to improve treatment outcomes [6]. The biologic effects of ASWT are mediated by an increase in mediators such as vascular endothelial growth factor which increases local blood circulation [7]. Repeated use stimulates angiogenesis and remodeling of collagen fibers [8].

AWST may enhance tattoo clearance by increasing lymphatic drainage and increasing metabolic activity in the treated area, thereby accelerating the clearance of dermal pigment vacuoles produced by the picosecond laser. Ibrahim and Kaminer first reported that acoustic wave devices facilitate multi-pass treatment with Q-switched laser, in a study treating 34 black tattoos [4]. Ninety-Four percent of patients had greater fading of tattoos compared to conventional treatment, and 6% of patients achieved 90% cleatans after a single session with the acoustic wave device [4]. We report a case of 80% tattoo clearance with ASWT in a patient with Fitzpatrick type V skin compared with 60% clearance with the picosecond 1,064-nm Nd:YAG laser and PFD patch alone. The concurrent use of the PFD patch, which facilitated multi-pass treatments, may have also increased tattoo fading in this patient. The decrease in epidermal side effects of erythema, edema, and crusting on the side treated with ASWT may be a result of increased microcirculation and lymphatic drainage.

CONCLUSION

The acoustic wave devices may enhance tattoo clearance by increasing lymphatic drainage and metabolic activity in the treated area, thereby accelerating the clearance of dermal pigment vacuoles produced by the picosecond laser. Further studies are needed to determine the long-term efficacy and safety of the acoustic wave devices as an adjunct to laser assisted tattoo removal.

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REFERENCES