Analysis of Incidence of Bulla Formation After Tattoo Treatment Using the Combination of the Picosecond Alexandrite Laser and Fractionated CO_2 Ablation

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BACKGROUND The picosecond Alexandrite laser has shown increased efficacy in tattoo removal in comparison to Q-switched lasers. However, bulla formation is a well-known and expected side effect of this novel treatment and causes patient discomfort.

OBJECTIVE To analyze the incidence of bulla formation after tattoo treatment using the combination of the picosecond Alexandrite laser and fractionated CO_2 ablation.

MATERIALS AND METHODS This is a retrospective chart review to determine the incidence of bulla formation after laser tattoo removal in 95 patients who were treated with either with the picosecond Alexandrite laser alone or in combination with fractional CO_2 ablation.

RESULTS Twenty-six patients (32%) treated with the picosecond laser alone experienced blistering, whereas none of the patients treated with the combination of the picosecond laser and fractionated CO_2 ablation experienced blistering. The difference in incidence of bulla formation between the 2 groups was found to be statistically significant ($p < .05$).

CONCLUSION This study shows a significant decrease in bulla formation associated with tattoo treatment when fractionated CO_2 ablation is added to the picosecond Alexandrite laser, which is consistent with observations from a previous case series. This is important because decreasing extensive blistering likely results in increased patient satisfaction and willingness to return for future treatments.

M. P. Goldman previously conducted research with Cynosure, Inc., and received a discount on the purchase of the Picosure laser. The other authors do not indicate any significant interest with commercial supporters.

Since the advent of Q-switched laser tattoo removal in the early 1990s, the demand for this safe method of tattoo treatment has been increasing. The picosecond 755 nm Alexandrite laser has recently become commercially available and has proven to be more effective than nanosecond Q-switched lasers in the treatment of black, blue, and green tattoos.[1–3] The picosecond pulse more closely matches the thermal relaxation times of tattoo pigment particles, allowing for optimal photomechanical disruption of the target.[4] However, it has been observed that large bulla formation is much more common using this modality due to its very short pulse duration producing greater tensile strength on the tissue from its stronger photomechanical and photothermal effects. Although the majority of patients experiencing this side effect heal without lasting sequelae with proper care, this can be painful and very disconcerting to patients.[5]

The combination of Q-switched lasers and ablative fractional resurfacing (AFR) with a CO_2 laser for tattoo removal has been studied and has been shown to enhance the rate of pigment clearance.[6,7] It is also noted in a small case series that blister formation is decreased when these modalities are combined.[7] This

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is likely because the ablated channels formed by the CO_2 laser allow the inflammatory exudate to be released rather than to build up under the epidermis and cause blistering. It is thought that decreasing the edema and bulla formation shortens the healing time and prevents further damage to the epidermis.[7]

To the authors' knowledge, no previous large-scale studies have compared the incidence of blistering after tattoo removal when using the picosecond Alexandrite laser alone versus in combination with a fractionated CO_2 laser.

Design

Cases were selected retrospectively from patients who underwent tattoo removal at Goldman, Butterwick, Fitzpatrick, Groff & Fabi: Cosmetic Laser Dermatology between April 2013 and April 2014 with either the picosecond 755 nm Alexandrite laser (PicoSure; CynoSure, Inc., Westford, MA) alone or in combination with a fractionated CO_2 laser (Fraxel Re:pair; Solta Medical, Inc., Hayward, CA and AcuPulse; Lumenis Ltd., Yokneam, Israel). In the latter group, AFR was used on the tattoo immediately after treatment with the picosecond laser. Intralesional lidocaine was used for anesthesia. Medical assistants contacted patients the next business day after treatment and recorded any problems and concerns. The incidence of blister formation was determined by reviewing progress and phone correspondence notes, photographs or contacting the patient directly if possible. In the event that no correspondence was recorded and the authors were unable to contact the patient, the case was excluded from this study. The treatment settings, tattoo color, and whether the patients previously tried laser tattoo removal were also noted. Statistical analysis was performed using GraphPad software.

Results

In total, 95 patients received laser tattoo removal under the selection criteria and were included in the study. Eighty-one patients were treated with the picosecond Alexandrite laser alone and 20 patients were treated using the combination of the picosecond laser and AFR. Six patients had their tattoos treated with both protocols on separate occasions. Twenty-six patients (32%) treated with the picosecond laser alone experienced blistering, whereas none of the patients treated with the combination of the picosecond laser and AFR experienced blistering. The difference in incidence of bulla/vesicle formation between the 2 groups was found to be statistically significant ($p < .05$). The mean fluence settings on the picosecond laser were 3.37 J/cm^2 (mean spot size 2.94 mm) on the picosecond alone group that did not blister, 3.09 J/cm^2 (mean spot size 2.95 mm) on the picosecond alone group that blistered, and 2.67 J/cm^2 (mean spot size 3.31 mm) on the picosecond/AFR combination group. The Fraxel Re: pair settings used included fluences of 10 to 60 mJ, with a coverage of 15% to 40%. The AcuPulse settings used included fluences of 10 to 20 mJ, with a coverage of 5%.

All 6 of the patients who were treated with both protocols were initially treated with the picosecond laser alone and experienced blistering and were subsequently treated with the picosecond/AFR combination and did not experience blistering (Figures 1 and 2).

More than 80% of tattoos in each group were blue-black. Interestingly, it was observed that 4 out of 5 (80%) of the large multicolor tattoos treated with the picosecond laser alone blistered, whereas none of 4 similar tattoos treated using the combination approach blistered. Fifty-three percent of the picosecond alone group that did not blister reported receiving prior laser tattoo removal, compared with 35% of the picosecond alone group that blistered and 25% of the picosecond/AFR combination group.

Discussion

This study shows a dramatic decrease in bulla formation associated with tattoo treatment when AFR is added to the picosecond Alexandrite laser, which is consistent with observations from a previous case series.[7] The microscopic channels created by AFR allow the release of inflammatory exudate and prevent a buildup of fluid, decreasing subepidermal edema that leads to bulla formation and also decreases healing time. This is important because decreasing extensive blistering is associated with decreased patient discomfort during the healing

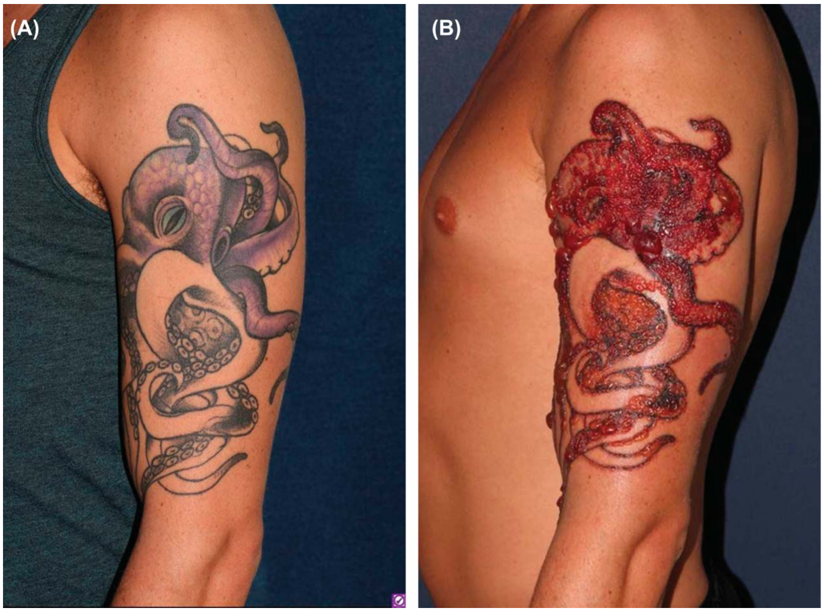

Figure 1. (A) Pretreatment appearance of a large blue, purple, and green tattoo on the patient's left upper arm. (B) Extensive blistering was noted 1 day after laser tattoo removal using the picosecond Alexandrite laser.

process and thus likely results in increased patient satisfaction and willingness to return for future treatments.

Previous case series also showed accelerated and improved outcomes in pigment reduction when AFR is used in combination with Q-switched lasers. The mechanism of the enhance results is likely from the fractionated ablation physically removing microscopic parts of the tattoo and creating channels by which tattoo ink pigments can escape.[6]

It is noted in 6 of the patients in this study blistered after being treated with the picosecond laser alone but did not blister in subsequent treatments when AFR was added. One could argue that this may only be due to the presence of less tattoo pigment during the later treatments. However, one of these patients

Figure 2. (A) Appearance of the patient's tattoo before his second laser tattoo treatment. (B) No blistering was noted after laser tattoo removal with the combination of the picosecond Alexandrite laser and fractionated CO2 ablation.

showed a response that supported this study—she developed blistering after treatment with the picosecond laser alone and did not blister after the combination treatment but blistered again after a subsequent treatment with the picosecond laser alone.

Limitations of this study mostly stem from this being a retrospective chart review, and treatment protocols and recorded information were not standardized. More than 80% of the tattoos treated were blue-black, so the authors were not able to successfully analyze whether specific colors were more prone to bulla formation. In the future, larger prospective randomized controlled trials can be performed to evaluate the efficacy and side effect profile of tattoo removal when AFR is used in combination with Q-switched or picosecond lasers. In conclusion, because bulla formation is a common side effect of tattoo removal using the picosecond Alexandrite laser leading to difficult wound care, the authors highly recommend adding ARF to the protocol to improve outcomes and increase patient satisfaction.

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