Tattoo-Removal: Nano- versus Pico-Laser

KAROLINE GLOCKNER AND DAISY KOPERA

Foto: Stieber

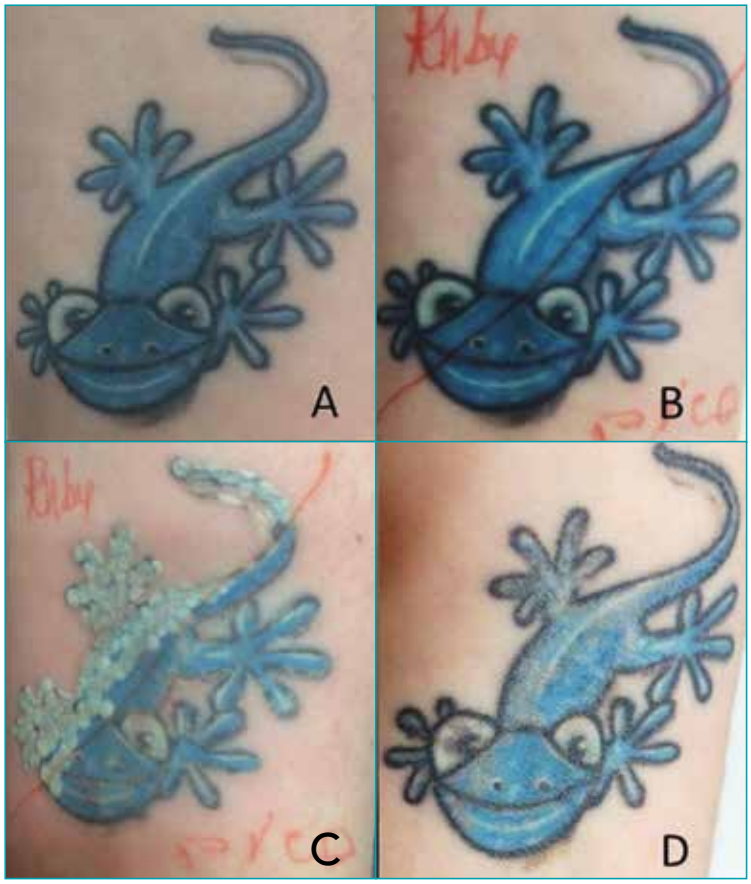
Daisy Kopera

Introduction

Since Anderson and Parish introduced the principle of selective photo-thermolysis (1), q-switched lasers emitting nanosecond pulses have been the gold standard treatment option for the tattoo-removal for almost 30 years.

In the late 20est century, a new type of laser emitting even shorter pulses – in the picosecond-range – has been introduced. It proved successful for the treatment of tattoos. Moreover, it was asserted to act even more effectively than nanosecond laser devices also in multi-coloured tattoos(2-4).

In a pilot study we compared the effectiveness of nano- and picosecond q-switched lasers in the treatment of tattoos.



© Kopera

Figure 1 (multi-coloured tattoo):
A: before first laser treatment; B: devided into nano- and picolaser treatment part; C: immediately after laser treatment; D: 4 weeks after first treatment, showing a slightly better clearing on the ruby laser side.

Material and Methods

7 volunteers with 11 tattoos striving for tattoo removal have been recruited. All of them came in for the first treatment. 4 tattoos were multi-coloured, 7 were black. Every single tattoo was devided into 2 parts, each part assigned to either nano-second q-switched ruby laser (1 ns = 10^{-9} s, 694 nm) or picosecond q-switched Nd:YAG laser (1 ps = 10^{-12} s, 1064 nm resp. 532 nm), both eligible for tattoo removal. Photographic documentation was performed before, after dividing, immediately after the first treatment, as well as four weeks later (*Fig. 1 A-D*).

Results

The clearing rate of the tattoos after this first laser-treatment was assessed by 3 independent dermatologists, according to a 3 step rating scale: 0 points for no change, 1 point for moderate brightening-up, 2 points for appropriate brightening-up in all tattoos. In coloured tattoos according to the same scale additional points could be given for the eventual brightening of the coloured parts. Overall, in black tattoos the nanolaser achieved 13 points and the picolaser 4 points, in multi-coloured tattoos the nanolaser attained 4 points and the picolaser 2 points.

Discussion

New developments or technological innovations must not necessarily result in better clinical outcome after medical-device driven treatments in aesthetic medicine. Q-switched lasers emitting nanosecond-pulses have proved eligible for tattoo removal (ruby 694 nm, alexandrite 755 nm, Nd:YAG 1064 nm for dark pigments, and frequency doubled ktp-Nd:YAG 532 nm – green light 532 nm for red pigments). Since picosecond lasers have been introduced in the late 1990ies, far better results than in conventional nanosecond-lasers for tattoo-removal have been reported (5, 6).

The efficacy of a q-switched nanosecond laser is based on selective photothermolysis (1), making a pigmented target structure vaporize before heat can be distributed to the surrounding. Theoretically shorter pulses than nanoseconds could enhance this effect by shorter pulses being even more selectively de-

stroying target structures and preventing the surrounding tissue from taking any damage at all (7).

The result of our clinical trial concludes that there was almost no difference in outcome after the first single treatment of tattoos, moreover the well-established q-switched nano-second ruby-laser turned out to be slightly more effective in tattoo-removal surpassing a q-switched picosecond Nd:YAG laser (*Fig. 1 A-D*), thus in accordance to newer clinical trials (8). ▲

Corresponding Author:
Prof. Daisy Kopera, M.D., MBA
Center of Aesthetic Medicine
Department of Dermatology
Medical University Graz
Auenbruggerplatz 8
8036 Graz, Austria
daisy.kopera@medunigraz.at

References:
1. Anderson RR, Parrish JA: Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science. 1983;220: 524-527.
2. Smith J: Tattoo removal: The promise of picosecond lasers. Skin & Allergy News. 2013;44:11.
3. Freedman JR et al.: Picosecond lasers: the next generation of short-pulsed lasers. Semin Cutan Med Surg. 2014;33:164-168.
4. Lorgeou A et al. : Comparison of two picosecond lasers to a nanosecond laser for treating tattoos: a prospective randomized study on 49 patients. J Eur Acad Dermatol Venereol. 2018;32(2):265-270.
5. Ross V et al.: Comparison of responses of tattoos to picosecond and nanosecond Q-switched neodymium: YAG lasers. Arch Dermatol. 1998;134:167-171.
6. Hsu VM et al.: The picosecond laser for tattoo removal. Lasers Med Sci. 2016;31(8):1733-1737
7. Kasai K: Picosecond Laser Treatment for Tattoos and Benign Cutaneous Pigmented Lesions. Laser Ther. 2017;26:274-281.
8. Pinto F et al.: Neodymium-doped yttrium aluminium garnet (Nd:YAG) 1064-nm picosecond laser vs. Nd:YAG 1064-nm nanosecond laser in tattoo removal: a randomized controlled single-blind clinical trial. Br J Dermatol. 2017;176:457-464. C

Background:
Picosecond laser systems claim to act even more effectively than nanosecond laser devices for the removal of black and multi-coloured tattoos.

Objective:
The aim of our clinical trial is to compare the effectiveness of nano- and picosecond q-switched lasers in the treatment of tattoos.

Material and Methods:
Eleven tattoos were treated half by nanosecond, half by picosecond pigmented lesion laser.

Results:
In our clinical trial the well-established q-switched nanosecond ruby laser turned out to be more effective in tattoo-removal surpassing the results achieved with a q-switched picosecond Nd:YAG laser.

Conclusion:
Theoretically shorter pulses than nanoseconds should be able to enhance selective photothermolysis by shorter pulses being even more selectively destroying target structures and preventing the surrounding tissue from taking any damage at all. Still, in practice, the picosecond Nd:YAG laser does not brighten up tattoos more effectively than a conventional nanosecond ruby laser system.