Picosecond pulses - my experience

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Methods of tattoo removal -1

• **QS-lasers (gold standard)**
  – The only ones based on **selective photothermolysis**.
  – With nanosecond (10⁻⁹ sec) pulsewidth.

• **4 wavelengths available**
  – QS-Ruby 694 nm
  – QS-Alexandrite 755 nm
  – QS-YAG 1064 & 532nm

• **NAFR / AFR lasers**
  – UP CO2 or Erbium-YAG for:
    • Darkened pigment
    • Allergy to pigment
    • Resistant pigment
Methods of tattoo removal - 2

PICOSECOND LASERS = new generation = new gold standard

• TOTALLY INADEQUATE = msec systems Argon, Vasc. & LP lasers, IPLS
Picosecond laser pulses for tattoo removal: a good, old idea.
Ibrahimi OA, Sakamoto FH, Anderson RR.

Comparison of responses of tattoos to picosecond and nanosecond Q-switched neodymium: YAG lasers.
Arch Dermatol. 1998 Feb;134(2):167-71

A clinical and histologic prospective controlled comparative study of the picosecond titanium:sapphire (795 nm) laser versus the Q-switched alexandrite (752 nm) laser for removing tattoo pigment.
Herd RM, Alora MB, Smoller B, Arndt KA, Dover JS.
Treatment of Tattoos With a Picosecond Alexandrite Laser: A Prospective Trial.
All 12 patients obtained greater than 75% clearance. Nine patients (75%) obtained greater than 75% clearance after having 2 to 4 treatments. The average number of treatment sessions needed to obtain this level of clearance was 4.25.

Successful and rapid treatment of blue and green tattoo pigment with a novel picosecond laser.
All previously untreated multicolored tattoos as well as tattoos recalcitrant to treatment demonstrated at least 75% clearance of blue and green pigment after 1 or 2 treatments.
**Picosecond lasers**: the next generation of short-pulsed lasers.
Freedman JR, Kaufman J, Metelitsa AI, Green JB.
**Analysis of incidence of bulla formation after tattoo treatment using the combination of the picosecond Alexandrite laser and fractionated CO2 ablation.**
Au S, Liolios AM, Goldman MP.
**New tattoo approaches in dermatology.**
Luebberding S, Alexiades-Armenakas M.
**A novel dual-wavelength, Nd:YAG, picosecond-domain laser safely and effectively removes multicolor tattoos.**
Bernstein EF, Schomacker KT, Basilavecchio LD, Plugis JM, Bhawalkar JD.
**Laser tattoo removal: a clinical update.**
Ho SG, Goh CL.
**Clearance of yellow tattoo ink with a novel 532-nm picosecond laser.**

**Picosecond lasers** for **tattoo** removal: a systematic review.

Successful Treatment of a Red and Black Professional **Tattoo** in Skin Type VI With a **Picosecond** Dual-Wavelength, Neodymium-Doped Yttrium Aluminium Garnet Laser.
Friedman DJ. Dermatol Surg. 2016 Sep;42(9):1121-3

**Lasers** in **tattoo** and pigmentation control: role of the PicoSure® **laser** system.
The use of picosecond lasers beyond tattoos.
Forbat E, Al-Niaimi F.

The picosecond laser for tattoo removal.
Hsu VM, Aldahan AS, Mlacker S, Shah VV, Nouri K.

Treatment of pigmentary disorders in patients with skin of color with a novel 755 nm picosecond, Q-switched ruby, and Q-switched Nd:YAG nanosecond lasers: A retrospective photographic review.
Levin MK, Ng E, Bae YS, Brauer JA, Geronemus RG.
Picosecond Lasers at Skinpulsle Laser Centre

- **Cynosure** – Picosure™
  - Since Sep 2014
  - 755, 532 & 1064 nm

- **Syneron** – PicoWay™
  - Since Jan 2015
  - 1064, 785 & 532 nm
How does a picosecond pulse compare?

<table>
<thead>
<tr>
<th></th>
<th>PICO</th>
<th>Q-Switched Nd:YAG</th>
<th>Q-Switched Alex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pulse Duration</strong></td>
<td>550 ps</td>
<td>5 ns = 5000 ps</td>
<td>50ns = 50,000ps</td>
</tr>
<tr>
<td></td>
<td><strong>Pico pulse is 9x shorter</strong></td>
<td></td>
<td>Pico pulse is 100x shorter</td>
</tr>
</tbody>
</table>

Why it matters:

- The shorter picosecond pulse duration takes advantage of photomechanical impact/stress - instead of heat -- to shatter ink into the smallest of particles. **Goes beyond selective photothermolysis**
- Half the fluence is required compared to Q-Switched nanosecond lasers
- Fewer treatments with significantly better clearance
  - including stubborn greens & blues
  - previously treated, hard-to-clear recalcitrant tattoos
Laser Response

Untreated Tissue/Ink

“Rocks”

Q-Switched laser

“Pebbles”

Picosure laser

“Sand”

Electron Microscopy Photos Courtesy H. R. Jalian, M.D.
Picosecond vs. Nanosecond
755nm
755nm Results

pre 1 year post Tx6 QS YAG 2 month post Tx 4 Picosure
755nm Results

pre  
21442  
post Tx5
# PicoWay ™ Device

<table>
<thead>
<tr>
<th>Laser Type</th>
<th>Nd:YAG</th>
<th>Frequency Doubled Nd:YAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelengths</td>
<td>1064 nm</td>
<td>532 nm</td>
</tr>
<tr>
<td>Maximum Energy</td>
<td>400 mJ</td>
<td>200 mJ</td>
</tr>
<tr>
<td>Pulse Duration</td>
<td>450 ps</td>
<td>375 ps</td>
</tr>
<tr>
<td>Peak Power</td>
<td>0.9 Gigawatts</td>
<td>0.53 Gigawatts</td>
</tr>
<tr>
<td>Spot Sizes</td>
<td>2, 3, 4, 5, 6, 7, 8, 9, 10 mm</td>
<td></td>
</tr>
<tr>
<td>Repetition Rate</td>
<td>Single, 1, 2, 3, 4, 5, 10 Hz</td>
<td></td>
</tr>
<tr>
<td>Delivery System</td>
<td>Articulated arm with zoom handpiece</td>
<td></td>
</tr>
<tr>
<td>Warm Up Time</td>
<td>2 minutes</td>
<td></td>
</tr>
<tr>
<td>User Interface</td>
<td>Touchscreen with GUI</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>42” H x 18” W x 27” D</td>
<td>107 cm H x 46 cm W x 69 cm D</td>
</tr>
<tr>
<td>Weight</td>
<td>275 lbs.</td>
<td>125 kgs.</td>
</tr>
<tr>
<td>Power Requirements</td>
<td>200-240 VAC, 50/60 Hz, 30 A, 4600 VA Single</td>
<td></td>
</tr>
</tbody>
</table>
Compare Efficacy of PicoWay’s 450ps Pulse vs. Q-Switch 5ns Pulse

For typical micrometer sized tattoo granules, 450ps pulse delivers 180 times more energy within the stress relaxation time compared to a 5ns pulse.
PicoWay™ 1064nm - Tribal Black Pigment

![Graph showing particle size distribution](image1)

Control Sample

![Microscopic image of control sample](image2)

PicoWay Treated

![Microscopic image of treated sample](image3)
**PicoWay™ 532 nm** - Crimson Red Pigment
Baseline

1064nm Clinical Results

3 m post Tx4
1064nm Clinical Results

Before

2 m post Tx4
1064nm Clinical Results

Before

Ooh la la!

2 m post Tx4

Ooh la la!

OBJECTIVES: To compare the efficacy and side-effects of a 1064 PSL side by side with an NSL for tattoo removal.

METHODS: 21 patients with 30 black tattoos were treated with PSL and NSL in a split-study design in two sessions at intervals of 6 weeks. The safety and efficacy of laser treatments were determined by blinded observers assessing randomized digital photographs in this prospective clinical study. The primary end point was the clearance of the tattoos ranging in quartiles from 0% to 100%; secondary end points were side-effects and pain.

RESULTS: The average clearance overall as evaluated showed no statistical difference between NSL and PSL (P = 1.00). Using a visual analogue scale (0 = no pain, 10 = maximum pain), a value of 3.8 ± 1.0 was reported for the PSL, which was statistically different from NSL (7.9 ± 1.1, P < 0.001). Transient side-effects were observed, as well as hypo- and hyperpigmentation, but there was no statistically significant difference between PSL and NSL.

CONCLUSIONS: After two treatments of black tattoos with a neodymium-doped yttrium aluminium garnet laser (1064 nm), the use of picosecond pulses does not provide better clearance than nanosecond pulses. However, pain is less severe when using a PSL.
Figure 4: Comparison of 1064nm and 532nm picosecond pulse treatment with nanosecond pulse treatment post four treatments. Top left quadrant was treated with a 50ns 1064nm laser (Alex TriVantage, Candela Corporation) while the top right quadrant was treated with 450ps 1064nm (PicoWay, Syneron-Candela Corporation) at equal fluence. Lower quadrants compare 532nm 50ns on the left side with 532nm 450ps on the right side. Substantially greater lightening of the tattoo is seen on the 1064nm 450 ps side.
Still many open questions…

1. What is the best pulse duration?
2. What is the best «third» wavelength?
3. Do we still need QS for tattoo removal?
4. Ideal interval between sessions?
5. How to avoid or deal with bullae?
1. What is the best pulse duration, if any?

- 750, 500 350 picosec?
- Less than 200? Plasma formation?
2. What is the best «3rd» wavelength, if any?

• 755, 785, 650, 685nm?
3. Do we still need QS for tattoo removal?
3. Do we still need QS for tattoo removal?

Post Tx2
PicoWay
1064nm
4. Ideal interval between sessions?

PRE
1x/month @1064

PRE
2x/month @1064
4. Ideal interval between sessions?

1x/month @1064

IMM POST

2x/month @1064

IMM POST
4. Ideal interval between sessions?

6 m post Tx5
1x/month @1064

30560

6 m post Tx5
2x/month @1064
5. How to avoid or deal with bullae?

**AVOID**

- Use silicone gel or Tegaderm during session.
- Use AF laser imm after (or before?).

**DEAL**

- Moisterize +++ (Bepanthène, Cicaplast)
- Don’t scratch, peel, etc.
- Cover with dressing if large / numerous bullae.
- **CAREFUL with extremities!**
Present with Pico - Tattoos

- Need about $\frac{1}{2}$ of nb of Tx compared to QS.
- Interval between sessions also shorter (4-6 w. vs 2-3 m. with QS).
- Great to remove resistant colours & residual pigment.
- 755 and 1064 seem to be equal in removing black pigment.
- Pico isn’t colour blinded, so we need 755 (785), 1064 & 532nm.
Future with Pico?

Before

After
Present with Pico...

Before

2m post Tx3

After

6 m post Tx6
THANK YOU FOR YOUR ATTENTION

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