

Tattoo removal

Also known as tattoo removal, laser tattoo modification

Background

The origin of tattoos can be traced back to 12,000 BC. Tattoos have cultural, tribal, fashion or personal meanings. The popularity of tattoos is increasing, as is the range of tattoo inks that are being used currently.

What is a tattoo and what makes it permanent?

A tattoo is made up of granules of pigment that are much smaller than a human cell.

White blood cells known as macrophages typically ingest and remove cellular debris, and foreign matter as part of the body's normal immune defense mechanism. However, tattoo granules are too large for macrophages to effectively remove so these remain in the skin permanently unless the tattoo is treated with appropriate lasers.

What is in tattoo Ink?

In the past decade there has been an "explosion" in the composition of tattoo inks. The list below details some of the known substances used. However, with no regulation of ink components, the exact nature of the inks used in an individual tattoo is unknown.

- Red – mercury sulfide (cinnabar), ferric hydrate (sienna), cadmium
- Black – carbon, iron oxide, logwood
- Brown – ferric oxide
- Blue – cobalt aluminate
- Green – chromic oxide, lead chromate, aluminium
- Yellow – cadmium sulfide, lead
- Purple – manganese, aluminium
- White – titanium oxide, zinc oxide, lead
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How are tattoos classified?

Tattoos can be classified broadly as cosmetic (eyeliner and similar), decorative or traumatic (this refers to skin abrasions contaminated with pigment-containing substances such as road surface dirt).

Tattoos are also classified as "professional" or "amateur".

- Amateur tattoos usually consist of black carbon and lie in the more superficial layers of the skin. These tattoos are usually simple outlines and require fewer treatments to fade because they contain less pigment. Traditional tattoos such as Pacific Islander tattoos and Asian 'Sak Yang' tattoos are examples of amateur tattoos.
- Professional tattoos range in size, design and most importantly colour. These tattoos are more densely coloured and more difficult to remove. Professional tattoos are often layered to achieve "transitions".

What are the associated risks in getting a tattoo?

The process of tattooing poses some risks.

- **Infection**

In untrained and unregistered hands there is a real risk of spreading blood borne infections such as HIV and hepatitis C.

- **Allergy**

Some pigments, particularly those containing red pigments can induce allergic reactions such as severe itching and swelling in the portion of the tattoo containing the offending ink.

These kinds of pigments can be difficult to manage as laser treatment runs the risk of spreading the allergic agent, potentially resulting in severe body reactions such as anaphylaxis. Allergic reactions will often respond to repeated cortisone injections into the area of skin reaction. Surgical removal or vaporisation with scarring lasers will also remove the pigment but there will be resultant scarring if the area is large.

- **Carcinogenicity (cancer causing properties)**

- There are some concerns regarding the carcinogenic potential of tattoo inks and the possibility that laser treatment may increase the number of carcinogenic compounds. In reality, many substances in our environment are carcinogenic including alcohol, oestrogen and diesel fumes, to name a few.

Despite centuries of tattooing, and at least 20 years of laser tattoo removal, there has never been a reported case of cancer directly related to tattoo pigment or laser tattoo removal. However, it is prudent for governments to consider regulation to remove the risky components in tattoo inks.

- **Masking of skin cancer**

- In rare cases, tattoos may hide skin cancers such as melanomas and lead to delayed diagnosis because of the difficulty in visualising and detecting changes occurring within tattoos. Any change in the background skin of a tattoo should be assessed medically.

How are tattoos removed?

Laser treatment

- **Q Switched lasers**

These were introduced in the early 90s and were, until recently, the gold standard for scarless tattoo removal. These lasers deliver short duration pulses of light energy in a billionth of a second (nanosecond) and work by shattering ink particles into fine dust via photo-acoustic principles. The white blood cells can then effectively ingest and remove the finer material via the lymphatic system.

Wavelengths of laser light are selected according to the colour of tattoo ink:

- Nd: YAG (1064 nm) for black and blue pigment
- Alexandrite (755nm) for black, blue and green pigment
- Ruby laser (694nm) for black, blue and green pigment
- Frequency doubled Nd: YAG (532 nm) for red, orange and purple pigment.

While Q-Switched lasers are able to achieve scarless removal of tattoos, multiple treatment sessions are required. Lightly inked tattoos such as self-applied lettering with India ink may disappear with less than 5 treatments. However, densely inked professional tattoos take much longer to clear. A recent study demonstrated that even after 15 Q-Switched laser treatments, only 75% of tattoos had fully cleared.

Green and blue inks have traditionally been much slower to clear. This has improved with the development of lasers able to produce pulses in the picosecond (1 trillionth of a second) range to speed up the process of removal.

- **Picosecond lasers**

These were first marketed in 2013 and are gradually appearing in specialist practice. They are proving much faster in the removal of green pigment and early indications suggest that they will be slightly faster in clearing black pigment.

Multiple treatment sessions are needed. Sessions should be spaced a minimum of 2 to 4 months apart. Evidence suggests that treatment intervals shorter than this, increases the overall number of treatments and costs needed for clearance.

It is important to understand that a heavily inked professional tattoo may require upwards of 15 treatments to clear. Hopefully, the newly appearing picosecond laser may reduce this number.

Other factors influencing response to treatment include:

- Amateur versus professional tattoos – professional tattoos require more treatments as the ink is placed more deeply and at greater density than amateur tattoos.
- Location – tattoos located on the extremities will require more treatments than those on the head and neck area.
- Ink colour – black is the easiest colour to remove, followed by red. Multiple colours will require more treatments. Green tattoos can be very difficult to remove.
- Layering – overlay of tattoos will require increased treatments.
- Scar history – those with a history of scarring will usually require more treatments as laser fluences (power) tends to be lower.
- Tattoo size – larger tattoos may require more treatment sessions if the entire tattoo is too large to treat in a single session.
- Smokers do not respond as well to treatment as non-smokers.

Laser removal variations

R20 and Perfluorodecalin modifications of this technique employ multiple repeat treatments at the same session. Initial results were promising. However, longer experience suggests the benefit is minimal and has become less relevant since the release of picosecond lasers.

Fractional lasers drill small holes into the skin to allow extrusion of ink particles. They have the advantage of not inducing scarring. Experience suggests that these methods are extremely slow and will require many treatments.

Destructive chemicals

- Acid and other tissue toxic treatments such as franchised “acid de-tattooing” using tannic and lactic acid, home remedies glycolic acid and TCA peels are not recommended, as they universally cause scarring and permanent damage to skin colour. Unfortunately, they continue to be advertised and promoted as “miracle treatments” but are in fact dangerous and should be avoided

Dermabrasion and salabrasion (mechanical abrasion of skin) are now obsolete treatments that result in incomplete ink removal and scarring.

- Surgery -surgical excision alone or combined with skin grafting is sometimes recommended for laser resistant tattoos or severe tattoo allergic reactions. It is effective at removal but will leave unacceptable scarring in most cases.

What are the side effects of laser treatment?

Side effects are rare if the operators have adequate training and experience. Unfortunately, in some jurisdictions, non-medically trained individuals are allowed to own and operate lasers. This has been associated anecdotally with a significant risk of complications.

Potential but rare complications include:

- Scarring (most commonly seen on the chest, shoulders)
- Blistering, infection and bleeding
- Colour changes within the tattoo especially in flesh tinted and white tattoos that contain iron-based pigments. Lasers may discolour a white tattoo so that it becomes black or brown because the iron in the pigment changes to ferrous oxide in the process.
- Unwanted skin colour changes, including permanent lightening or darkening of the skin
- Changes in the composition of tattoo inks – this may result in an allergic reaction
- Interestingly, people who have been treated in the past with gold salts for rheumatoid arthritis may develop darkening of the skin in treated areas.

Warning

In many jurisdictions, there is no requirement for laser operators to have medical training, or for the lasers that are used to be approved by the appropriate regulatory authorities. Individuals are strongly advised to seek treatment from appropriately trained and equipped medical practices.