

The Science of Tattooing

Ink & Needle Evolution

Tattooing has been practiced since at least Neolithic times, with examples being found dating from as far back as the fourth to fifth millennium BCE!

Tattoos have served many different purposes throughout history, depending on the culture in which they appear. From rites of passage to a statement of social status, from cosmetic to spiritual purposes, tattoos are common in many areas of the world and are met with various levels of social acceptance.

The resurgence in popularity of tattooing throughout areas of North and South America, Europe and Japan has helped led to the development and refinement of tattooing procedure and equipment.

Some aspects of tattooing have never, and likely *will never*, change or evolve. Regardless of the tradition, tattoos are created by placing pigment into the skin's dermis, the layer of connective tissue underlying the epidermis (outer layer of skin). After this injection, pigment is dispersed throughout a homogenized damaged layer down through the epidermis and upper dermis, in both of which the presence of foreign material activates the immune system's phagocytes (biological cell which ingests and destroys foreign matter) to engulf the pigment particles. As healing occurs, the damaged epidermis flakes away (eliminating surface pigment) while deeper in the skin granulation tissue forms, which is later converted to connective tissue by collagen growth. This mends the upper dermis, where pigment remains trapped within fibroblasts, ultimately concentrating in a layer just below the dermis/epidermis boundary. Its presence there is stable, but in the long term (decades) the pigment tends to migrate deeper into the dermis, accounting for the appearance of fading of old tattoos.

Some tribal cultures created tattoos by cutting the desired design into their skin and rubbing the wound with substances such as ink and ash, depending on the desired color. Other cultures created needles with sharpened sticks or bones and used these instruments to hand-tap the ink under the skin. Most modern tattoos are created using an electric tattoo machine. These machines use a group of needles which simultaneously drive needles in and out of the skin, between 80 to 150 times a second.

Early tattoo artists were very limited in the colors and shades they could use, as they used inks derived directly from nature. Today, artists have a virtually unlimited number of shades and colors of tattoo ink. Materials such as titanium dioxide, acridine, carbon black, azo dyes, and iron oxides, as well as Acrylonitrile butadiene styrene (ABS plastic) are widely popular in the production of dyes.

Some concern has been raised about the interaction between magnetic resonance imaging (MRI) procedures and tattoo pigments, due to the fact that some pigments contain trace metals. **Discovery Channel's *MythBusters*** tested the hypothesis that the MRI magnetic field could potentially cause burns or image distortion, and found no correlation.

Health & Safety

The modern electric tattoo machine, when used correctly, is sanitary. All needles used in the modern-day tattoo process are packaged individually and are designed for single use only. It is standard practice for the tattoo artist to wash his or her hands, and to completely wash the area being tattooed. Gloves must be worn by the artist, and the area is wiped frequently with a wet disposable towel. Tattoo studios will use biohazard containers for any objects coming into contact with blood or bodily fluid, sharps containers for old needles, and an autoclave for sterilizing tools. All areas which may be touched with contaminated gloves during the procedure are to be wrapped in clear plastic to prevent cross-contamination.

Tattoo Removal

Complete removal of a tattoo may not be possible, and the attempt to remove a tattoo can be more painful and expensive than the process of getting one! Before laser removal technology, removal methods included:

- dermabrasion (anesthetizing the skin surface and then sanding or scraping off some of the outer skin layer)
- salabrasion (scrubbing the skin with salt)
- cryosurgery (using extreme cold to destroy unwanted tissue)
- excision (surgical removal of the skin and tissue) which is sometimes still used along with skin grafts for larger tattoos.

Tattoo removal is most commonly performed using lasers that react with the ink in the tattoo, and break it down. The broken-down ink is then absorbed by the body, mimicking the natural fading that time or sun exposure would create. All tattoo pigments have specific light absorbance spectrums. A tattoo laser must be capable of emitting adequate energy within the given absorbance spectrum of the pigment in order to provide an effective treatment. Certain tattoo pigments, such as yellows, greens and fluorescent inks are more challenging to treat than the darker blacks and blues. These pigments are more challenging to treat because they have absorbance spectrums that fall outside or on the edge of the emission spectrums available in the respective tattoo removal laser.

Laser tattoo removal often requires many repeated visits to remove even a small tattoo, and may result in permanent scarring. Areas with thin skin will be more likely to scar than thicker-skinned areas.

***This information has not been verified by Science Alberta Foundation, and is for general informative purposes only. For more information about your **body's largest organ – your skin!** – please talk to your doctor or dermatologist.*