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CLASSIFICATION OF TATTOOS AND TATTOO REMOVAL

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Abstract
Tattooing is an ancient procedure and has been identified in different societies for centuries. Tattooing is a process where exogenous pigments are introduced into the dermis and epidermis. Tattoos consist of thousands of particles of tattoo pigment suspended in the skin. While normal human growth and healing processes will remove small foreign particles from the skin, tattoo pigment particles are permanent because they are too big to be removed.

Introduction

Such pigment can be introduced into the skin intentionally to decorate or mark the skin, or as a result of accidents and trauma. Tattoos can broadly be divided into professional, amateur, cosmetic, traumatic, or medical tattoos depending on who performs the tattooing or what the intent of the tattoo is for.

Professional tattoos are applied with a tattoo machine into the deeper layer of the dermis, and are intended to be permanent in nature. The pigments are generally darker, deeper, and often require repeated treatments to remove.

Amateur tattoos are usually smaller using diluted pigments with lighter colors applied more superficially in the epidermis or upper dermis, often with hand held needles or homemade machines, which are generally easier to remove.

Cosmetic tattoos are often referred to as permanent makeup, and are increasingly popular. Permanent eyeliners, eyebrows, and lip liners are examples. The cosmetic pigments are commonly applied using micropigmentation technique to save time (of having to apply cosmetics daily) and enhance facial features. These cosmetic pigments often contain pigments which are red, brown, white, or flesh colored (containing titanium dioxide and iron oxide) which are difficult to remove.

Traumatic tattoos are deposited in the skin following abrasion, laceration, or explosive injuries. Such pressurized penetration of dark particles into the deep dermis give rise to black or blue tattoos, depending on the type and depth of the pigment. Tattoos have also been used in the field of medicine, from corneal tattooing, and radiotherapy field marking to medical alert tattoos, where tattoos etched into skin replaces medical alert jewellery for the purpose of alerting medical personnel during emergency situations.

Before the introduction of selective photothermolysis, removal of unwanted tattoos is carried out by physical destruction and removal of the tattooed epidermis and dermis including full thickness dermabrasion, salabrasion, chemical destruction, cryosurgery, electrosurgery, and surgical excision. Such nonselective destructive modalities often result in incomplete removal, and varying degrees of scarring and dyspigmentation. The introduction of selective photothermolysis, which targets specific chromophores (tattoo pigments) has enabled dermatologists to remove tattoos fully

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or partially. Various wavelengths of light energy can be used to target different colored pigments more effectively with much less complications than before. Q-switched lasers with very short pulsed width (in nanoseconds) have long been the traditional workhorse for the removal of tattoos. The laser treatment of tattoos is based on the concept of selective photothermolysis, where laser light of different wavelengths is preferentially absorbed by different chromophores. If the target chromophore is heated for no longer than its thermal relaxation time (time required for target to lose 50% of its heat), selective destruction of these chromophores can be achieved. In the case of tattoos, the chromophore is exogenously placed ink, which is found in membrane bound granules in macrophages, fibroblasts, or mast cells. Such tattoo pigment is very small, and can reach its thermal relaxation time very quickly. Rapid heating with very short pulse durations, in the nanosecond or picosecond range is, therefore, required to cause photoacoustic injury and rupture of these pigment-containing cells. Laser treatment causes tattoo pigment particles to heat up and fragment into smaller pieces. These smaller pieces are then removed by normal body processes by phagocytosis and the tattoo fragments are packaged for lymphatic drainage and further scavenged by dermal macrophages, fibroblasts, and mast cells, leading to lightening of the tattoo.

Typically, laser treatment sessions are spaced at least 8 weeks apart. Treating more frequently than 8 weeks increases the risk of adverse effects and does not necessarily accelerate the rate of tattoo ink removal. Anecdotal reports of treatments sessions at 4 weeks leads to more scarring and dyschromia. At each session, some but not all of the tattoo pigment particles are effectively fragmented, and the body removes the smallest fragments over the course of several weeks. The result is that the tattoo is lightened over time.

The desired endpoint of Q-switched laser treatment [neodymium doped yttrium-aluminium-garnet (Nd:YAG), alexandrite, or ruby] is immediate tissue whitening, although this may not occur if the tattoo has faded significantly. Such whitening can last approximately 20 minutes, and is a result of rapid heating of the chromophore leading to gas bubble formation. The optimal fluence is the lowest possible setting that elicits this endpoint in order to minimize the risk of thermal injury, such as blister formation and scarring. A low starting fluence should be used to attain this desired endpoint during initial tattoo treatment especially when treating dark and densely pigmented tattoos. The fluence can be increased as the tattoo becomes lighter. Different wavelengths of laser can be used, depending on tattoo color treated, previous response to laser treatment, and also skin phototype of the patient. Laser spots (3–4 mm spot sizes are used usually) are applied with approximately 10–20% overlap, aiming for immediate whitening, and minimizing pinpoint bleeding. Laser treatments can be repeated approximately every 8 weeks.

All in all, the area to be treated should be cleansed thoroughly and free from any residual cosmetics or skin care products with sterile noninflammable solution, e.g., normal saline. Avoid using potentially flammable cleansing agents such as isopropyl alcohol. Laser tattoo removal is uncomfortable and often worse than the tattooing procedure. The pain is often described to be similar to “snapping” from an elastic band. Most patients will require topical and sometimes local anesthesia. Topical anesthetic cream, e.g., 5% lidocaine cream and 2.5% lidocaine and 2.5% prilocaine cream is applied under occlusion for 45–90 minutes prior to the laser treatment. The topical anesthetics should be completely removed prior to treatment. Other methods of reducing discomfort for the patient include the use of cool air during treatment. Occasionally, local

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anesthesia or regional nerve block or a combination of both may be necessary to abrogate the pain completely using 1–2% lidocaine.

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