

To heal and take care: medical micropigmentation and its role in improving body image

Pier Luigi Santi¹, Simonetta Franchelli², Francesca De Paoli,² Marianna Pesce², Sofia Vachtsenovanos³, Luca Rubino⁴, Aurora Parodi^{1,2}, Daniele Friedman^{1,2}

University of Genova Italy¹, San Martino Hospital Genova Italy², Lilt Sanremo Italy³, Breast unit ASL1 Imperia Italy⁴

Abstract. The practice of tattooing dates back to a remote past and is characterised by its many different purposes. However, in the last decades, such practice has become a cultural phenomenon, extending its reach to a broader population, including adolescents. More recently, in the perspective of enhancing a broader therapeutic approach, heedful of the many different needs of the individual, the practice of micropigmentation has become widespread in the medical field in order to offer the possibility of reconstructing the body image where skin, pathological manifestations, and congenital or acquired imperfections, have altered its physiological appearance with a non-invasive methodology. Its application indicates a commitment to a more humane form of treatment based on a multidimensional approach to the person and on integrating different skills and expertise, not only from the medical area but also from the technological one. However, the practice of dermal pigmentation presents risks that require adequate professional training and broad communication between practitioner and patient to assess the existence of ideal conditions for its implementation carefully.

Keywords: micropigmentation, tattoo, dermal pigmentation, humanisation, medical micropigmentation, reconstructive surgery, camouflage, to care, holistic medicine

Introduction: historical background

In its most widespread form, the tattooing technique consisted of scarifying or incising the skin, delaying its healing through particular substances, making punctures, and introducing dyes into the wound (1). This procedure, seemingly easy to perform, has been made possible over time by the succession and evolution of several methods, some very different from each other, used since ancient times.

The first official record of tattooing is reported in a written by Commander J. Cook in 1769, who noticed marks on the locals' skin while observing the population of Tahiti. These marks were made with the help of a sharpened shell or incisions made in the skin with sharpened wooden sticks that, while being used, pro-

duced a peculiar tapping sound, hence the name "tattoo," later to become tattoo (2).

The origin of this procedure is much more ancient, though, as evidenced by the famous discovery of the Similaun mummy "Ötzi" preserved in the mountain ice (3). The analyses to which this specimen has been subjected over the last two decades have revealed it to be a male, between 40 and 50 years old, who died during the Copper Age between 3100 and 3300 B.C.E., probably as a result of an arrow wound. This find has tattoos on its skin surface consisting of vertical incisions coloured with a black powder. The tattoos of the Similaun man consist of simple dots, lines, and crosses, located at the lower spine, behind the left knee and on the right ankle. Radiological examinations of the mummy have revealed forms of arthrosis at those points (4). For this reason,

it is assumed that such tattoos had a religious-healing function to relieve pain. According to other interpretations, the tattoos would constitute points consequent to the practice of acupuncture (5).

Therapeutic tattoos have also been found on the mummy of the Pazyryk man in Central Asia, which has intricate animal tattoos, and on that of the Ukok princess - Altai Mummy - dated around 500 B.C.E. (6). Inside the coffin of Princess Ukok, archaeologists found cosmetics in a kind of makeup "trousse" that had been placed on the princess's left side and contained a horsehair face brush and a fragment of an eyeliner pencil made from iron rings coiled around a shard of vivianite, capable of colouring the skin dark blue green. There was also vivianite powder, apparently to be used for facial applications. According to Professor Vladislav Malakhov of the Boreskov Institute of Catalysis Siberian Branch of the Russian Academy of Science, the analysis showed that the Pazyryk women knew and used the blue mineral dye called vivianite and made face masks from fats and oils, even quite complex ones, for cosmetic and pharmacological purposes and, in particular, to protect the skin from the extreme climates of the high mountains" (7, 8).

Other forms of skin pigmentation are found on ancient Egyptian mummies and on funerary carvings showing pigmentation patterns on the bodies of female figures, which remained 'invisible' for centuries, and were only revealed when the use of infrared photography allowed researchers to observe them on the skin of seven 3,000-year-old Egyptian mummies (9).

In subsequent times, tattoos were intended as a sign of religious affiliation, caste, and honour (10). However, tattoos have also been used in different circumstances to mark outcasts, political and war prisoners, and certain categories of criminals (11).

Well-known scientists, such as Lombroso, considered tattoos, especially when present in particular locations on the body, as a stigmatising mark of a violent and criminal character, along with other physical and behavioural characteristics (12, 13), (fig.1).

More elaborate tattoos found their origins in Japan and were used, again, for different purposes: aesthetic, magical, ritual, or to brand criminals (14).

In 1891 Samuel O'Reilly, the inventor born in Connecticut, patented the first tattooing device in the

U.S., which used an electric motor, a system of tubes to convey pigment into a needle, and a foot pedal to activate or interrupt the movement of said needle (15).

Subsequently, tattoos have been used by ethnic minorities, sailors, war veterans, military organizations, gangsters, prisoners and, generally, considered the prerogative of people marginalized by society, such as "punks" and biker groups in the 1970s like, such as the American "Hell's Angels" (16).

For a few years now, tattooing has become a widespread fashion in many countries, predominantly among young people and adolescents, despite this practice being widespread among all age groups.

More recently, tattooing, alongside a purely ornamental or symbolic purpose, has also been employed in the health care context. In such a context, tattooing or, more precisely, corrective dermal pigmentation has taken on a medical connotation in the scope of a broader and holistic vision of personal care. The possibility of offering, through such a method, the opportunity of regaining the identity of one's own body constitutes an essential aspect of the care of the person itself, which characterises a medicine increasingly aimed not only at "curing" but also at "caring."

For years, indeed, medicine has increasingly turned its attention not only to the elimination of disease or abnormalities but also to the promotion of the person's well-being, according to the broad concept of health as defined by the World Health Organization, as a condition of adaptation and self-management in the face of physical, psychological, and social challenges.

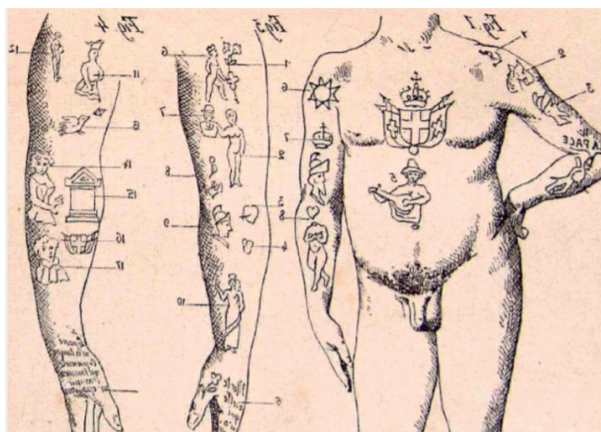


Figure 1. Tattoos like stigmata

Dermal pigmentation in the medical field: an integral approach of the person

Purposes and areas of application of dermal pigmentation

Dermal pigmentation is a technique akin to tattooing that allows skin colouring through the introduction of specific inks into the superficial layer of the papillary dermis, with the help of an electric device - a tattoo machine or oscillating pen - and disposable needles.

Dermal pigmentation aims to improve a person's appearance and aesthetic image by modifying, correcting, eliminating, or alleviating blemishes on the body and face.

This technique differs from artistic tattooing and even permanent makeup in the type of instrument used, the materials employed, the recipients of the treatment, and, again, the personnel involved in its use. Instead, micro-pigmentation is carried out under medical supervision or indication in people who, after undertaking invasive procedures such as chemotherapy, demolition surgery, reconstructive treatments, or even congenital conditions, need to cover pathological skin conditions to restore the appearance of healthy skin.

In some cases, this technique can also be used for the administration of pharmacological substances with specific therapeutic indications (17).

In the medical literature, lemmas dermal pigmentation, micro-pigmentation and dermatography are often used synonymously.

Tattooing for medical purposes has wide application in numerous areas, such as the reconstruction of the areola and nipple of the operated breast, radiation oncology - repair points-, treatment of alopecia areata and vitiligo, camouflage of atrophic, hypertrophic, and keloid scars, treatment of scarring outcomes of cleft lip and palate, pigmentation of the cornea, treatment of nevus flammeus, treatment of areas of alopecia on the scalp, reconstruction following gum implantation.

From an ethical point of view, such a procedure harmonises not merely with a broad view of the person requiring care, heedful to his or her physical, psychological, cultural, and ethical condition, but also with a multidimensional approach to care. In fact, dermo-pigmentation takes place in close collaboration

with a plurality of professional skills and pieces of knowledge: the dermatologist, oncologist and/or plastic surgeon.

The juridical and technical framework of micropigmentation

In Italy, medical tattooing has been the subject of recent institutional debate following the Note issued by the Ministry of Health (M.S.), "Circular Note on tattoos with medical purpose; clarifications regarding areola-nipple pigmentation" (2019) (18).

This Note specifies that tattooing of the areola-nipple complex for medical purposes is included in the Essential Levels of Care (L.E.A. Annex 4, code 86.02.3 "tattooing for pigmentation of the areola-nipple complex").

The Note also specifies that the "areola-nipple pigmentation" service must be performed exclusively by those practising a health profession in an accredited or licensed outpatient clinic, depending on whether or not the procedure is performed at the expense of the National Health Service. Therefore, this service is not allowed to be performed in non-health facilities and by non-health personnel.

In order to ensure the protection of people undergoing this practice, the M.S. Note urged universities to organise courses to train qualified personnel to administer this procedure.

The Italian Association of Aestheticians "Confestetica" filed, against this Ministerial Note, an appeal, which was upheld by the Italian Council of State and thus annulled the M.S. Circular (19).

According to the decision of the Italian court: specialised beauticians, subject to the authorisation of medical specialists, are now granted to practice medical tattoos. However, the obligation for medical personnel to obtain a qualification through participation in specific courses organised by universities as accredited bodies remains in place. To this end, the University of Genoa - northern Italy - has activated specific training courses on medical micropigmentation aimed at health personnel. In these courses, ample attention has been paid to the technical and behavioural norms posed to protect the person, particularly regarding the basics of

oncology and post-mastectomy reconstruction techniques, the issue of communication and informed consent, and the risks underlying this procedure.

The micro-pigmentation procedure: safety

According to the ethical principle of non-maleficence, the performance of the micro-pigmentation procedure requires adherence to strict deontological rules and specific precautions in order not to cause harm to the person. Its implementation is, therefore, ruled out whenever changes in colour and texture, everted lesions, or inflammatory states are found on the skin. Furthermore, special rules of caution exclude its application in the presence of nevi within the area to be tattooed, as other lesions of suspected neoplastic nature, whether benign or malignant.

Special care should also be taken for individuals with sensitisation problems, e.g. in patients sensitive to nickel, latex, or other products commonly used in inks and, thus, in the pigments that are injected or in patients who have a history of delayed healing or pathological scarring. It is, therefore, of considerable importance to carefully inspect the area to be treated and carefully screen the person's medical history concerning the possible presence of acute or chronic infectious pathologies in other sites, whether of a bacterial, fungal, or viral nature. For example, in patients with psoriasis or lichen, two chronic inflammatory skin diseases, following a minimal traumatic stimulus, the body tends to reproduce the same lesion, even in areas distant from the major lesion - Koebner's phenomenon (20). On the other hand, in disorders of the dysreactive type, such as pyoderma gangrenosum characterised by peculiar ulcerative lesions, the introduction of a stimulus, even far from the primary lesion, can lead to the patient developing a new area of pyoderma gangrenosum. Likewise, even in the case of, for example, blood sampling, an inflammatory and pustular lesion can form at the point of needle insertion, which may, in turn, develop into a new lesion of pyoderma gangrenosum, a phenomenon of pathergy, which is quite similar to Koebner's phenomenon (fig. 2) (21).

Possible adverse events of major significance cannot be overlooked either, such as:

- Aseptic inflammation - i.e., inflammation without bacterial or fungal agents -. This complication might

result from the procedure implemented in individuals with psoriasis, eczema, or all those previously named skin manifestations.

- Viral or bacterial infections in case a sterility defect has led to a pathogen being injected into the micro-traumatised area of the skin.
- Allergic-type reactions in individuals intolerant to any of the various components of the pigmentation ink.
- Appearance of hypertrophic or keloid scars in patients prone to an abnormal scarring response.
- Evidence of benign and malignant neoplastic lesions, even in neighbouring areas.

Before performing the procedure, the performing practitioner shall offer comprehensive and empowering communication about the type of procedure proposed to the patient. The communication of the nature of the procedure, its purpose, possible alternatives, risks, and possible complications indeed represents a central ethical and deontological node that requires special care and attention. Its importance is remarked in the recent provisions of Italian Law 219 of 2017, "Norms on informed consent and advance treatment dispositions" (22, 23) as well.

Although micropigmentation is commonly considered a cursory process, pre-treatment clinical and inspection assessment is a well-established practice to be respected. Therefore, a careful anamnesis should consistently be implemented to ascertain whether the subject presents systemic skin conditions overall, not



Figure 2. Koebner's phenomenon

only in the area to be treated with the tattoo. If so, a specialist evaluation is advised.

Evolution of micropigmentation and critical issues

The current spread of tattooing has created a significant economic spin-off and a consequent growth of tattoo parlours with staff and equipment that are not always suitable with the primary safety standards and technical skills.

From its origins as a purely aesthetic, decorative, or ritual, the practice of tattooing has gradually turned to the medical field in the scope of medicine that is increasingly attentive to the patient's different psychic and existential dimensions. Through micropigmentation, the possibility of hiding severely disfiguring lesions, covering imperfections, and reconstructing missing pigmented areas, either due to congenital or acquired problems, can constitute a crucial non-invasive factor for the well-being of a person. Especially if said well-being has been made particularly fragile by physical anomalies that have also led to relational problems in particularly delicate moments of one's life or as a consequence of demolishing and disabling therapeutic courses.

The same possibility of confronting issues related to reconstruction, at least to improving self-image, represents an important moment in recovering one's security towards one's relational life.

Plastic surgery, which for years has been engaged in the search for the best damage-benefit ratio in reconstructive treatments, has found a very minimally invasive and, at the same time, an efficacious possibility in the method of micropigmentation to achieve the goal of restoring conditions of psycho-physical well-being.

An important application of micropigmentation is the nonsurgical option of areola-nipple complex reconstruction for postmastectomy completion of the reconstructive pathway (24).

There are several surgical options for reconstructing the areola-nipple complex, some of which involve simultaneous restoration. For example, the nipple can be reconstructed with local flaps or harvested from the contralateral. In contrast, the areola can be reconstructed by harvesting from the contralateral areola, if

it is of congruous size, or from the thigh root (25). The choice of reconstructive method for the areola-nipple complex depends on the physical characteristics of the patient, their general condition, previous and or current treatments performed on the breast - e.g., radiotherapy -, and finally: on the patient's wishes. Therefore, the tattoo methodology becomes a possibility that is easy to perform, generally well tolerated by patients both psychologically and physically, and capable of giving good cosmetic results. Moreover, the possible complications described above are highly reduced if the good rules of conduct described are followed.

However, using this method for health purposes must involve careful control of the premises where it is practised, the equipment, the injectable substances, and adequate training of the personnel in charge of the treatment.

With regard to standards of good conduct, the following points are of paramount importance:

- The necessity to wear personal protective equipment
 - mask, headgear, sterile gloves after washing hands, sterile gown, goggles, or protective visor
- The preparation of the site and patient: preparation of sterile drapes suitable for delimiting the area of surgery; disinfection of the skin with gauze, preferably soaked in chlorhexidine
- The restriction of access to the area where the treatment is performed
- The assessment of the patient's general condition, any allergies or coagulation problems, and the local conditions of the area to be treated. It is essential to remember that, in the case that the tattoo should be placed in the site overlying a prosthesis, the utmost care must be taken to avoid risks of infection that could compromise the prosthesis, particularly in the case of areas previously treated with radiotherapy where the skin may present with extreme thinness and feeble vascular circulation
- Use of sterile and disposable pigments and materials.
- At the end of the session, the treated area should be covered with a sterile dressing and Vaseline gauze, which should be replaced at least daily until complete healing
- Because this is a procedure involving injury to the skin, medical waste should be disposed of in appropriate "biobox" containers.

Typologies of tattoo machines, inks and pigments

Inks

One of the most critical aspects of tattooing concerns the quality of the inks used.

Manufacturers of tattoo inks are, in fact, not obliged to disclose the components of their products and, in addition, those who practice tattooing mix various inks (26). Most inks, among their components, include: metals, salts, vegetable dyes, and plastics (27). The vehicle has the function of evenly distributing the pigment in a fluid matrix, preventing the occurrence of pathogenic substances, pigment agglomeration, and facilitating the application to the skin. The most commonly used vehicles are ethanol, purified water, witch hazel of plant origin, Listerine, propylene glycol, and glycerol. Sometimes denatured alcohol or other alcohols such as methanol, anti-freeze, or formaldehyde are used. However, the use of all of these substances has to be discouraged since they are toxic.

The most severe issues with inks in healthcare, though, are their interference with M.R.I.s, caused by the metals present in their formula, burn hazards caused by the needle's heat in case of large treated areas, infection, and allergy (28).

Pigments

The pigments are used to achieve the desired colour shade for the ink. Some pigments are of natural origin. In the latter case, they are obtained through treating particular minerals, but in most cases, they are synthetic. The synthesis methods are most varied; they use wet and/or dry processes and include intermediate steps such as dissolutions, more or less complex reactions, precipitation, filtrations, washing, drying, calcination or other types of treatment.

Due to the absence of transparency, including about the pigments used by manufacturers, various studies have been conducted to identify the elements most commonly present (29). Aluminium, titanium, oxygen, and carbon were found to be present (Tab.1). Such evidence urges the need for regulation requiring labelling and full disclosure of the various constituents of inks intended to be injected into the skin due to their potential to cause harmful reactions.

Table 1. Inks used in tattoo.

Color	Chemical Composition
black	acrylic resin, black pigment, glycerin, water, witch hazel, isopropyl alcohol
white	acrylic resin, titanium dioxide, water
red	acrylic resin, pigment red 210, pigment blue15, glycerin, aqua, isopropyl alcohol witch hazel
orange	acrylic resin, pigment orange 13, pigment red 210, glycerin, water, isopropyl alcohol witch hazel
yellow	acrylic resin, yellow pigment65, titanium dioxide
dark green	acrylic resin, pigment green, glycerin, water, witch hazel, isopropyl alcohol
Lightb lue	acrylic resin, titanium dioxide, pigment blue 15, glycerin, water, witch hazel, isopropyl alcohol
Violet blue	acrylic resin, titanium dioxide, pigment violet1, glycerin, water, witch hazel, isopropyl alcohol

Medical tattoo inks require specific studies concerning their application. For example, they must provide for the total exclusion, or maximum reduction, of metal derivatives in order not to be visible in X-rays and not to create artefacts during M.R.I. (30). Such inks must also be subject to a guarantee of sterility through single-use container usage and the obligation to report on the product label their manufacturing lot, quantity, expiration date, and components in descending order of percentage and weight.

The Dermograph

Significant innovations have also been achieved in the design of recent dermograph equipment in order to overcome problems related to the excessive vibrations of the handpiece, thermal expansion of the needles - which results in rapid wear and risk of causing skin injury -, and reflux of the inks due to defective dosage adjustment.

Currently, the most innovative equipment involves an injector attached to the handpiece through a simple but highly stable fixation method, a transparent and sterile Plexi structure equipped with a decompression reservoir useful for a gradual pouring of pigment, needles attached to the propulsive structure and equipped with a thermal laser to allow the operator to use the device with extreme stability and precision thanks to the absence of vibrations.

Pigment inoculation protocols, both for areola reconstruction and camouflage of scars and dyschro-

mia, contemplate the use of different types of injectors equipped with needles ranging from 1 to 12 tips, with a variable thickness from 0.18 mm to 0.4 mm and capable of puncturing the skin at a permanent and constant depth, adjustable from 0.1 to 3.3 mm.

Different needle-beating speeds are an integral part of the injector's engineering design. The equipment's display makes it easy to vary the number of beats from 900 to 7000 per minute, achieving excellent three-dimensionality, pigment persistence, and versatility.

The synergy of all these innovative technologies, together with sterility precautions, allows for a highly safe operation on the patient, characterised by the absence of pain, bleeding, and risk of infection.

Conclusions

Tattooing, a method that finds its origins in very distant times, has taken on different meanings with historical moments, social situations, fashions, religions and also, and not just of late aesthetic and medical purposes.

The methods and technologies used have been varied, but all shared the intent of leaving an indelible mark on the skin.

In the medical field, micropigmentation is used in selected cases to improve a congenital or acquired abnormality with the best possible result and minimal traumatic impact.

The problems that micropigmentation can procure are many and significant, and therefore adequate training is paramount.

The application of micropigmentation in health care, and its inclusion in the L.E.A.s, is an expression of a broader approach to care and a commitment to building relationships between different professions, medical and non-medical, that play a pivotal role in a good patient's life.

Acknowledgements. The authors gratefully acknowledge the economic support obtained from LILT (Lega Italiana per la Lotta contro i Tumori (Italian League for the Fight Against Cancer) and DDProject for technical support.

A disclosure / conflict of interest statement

None of the authors of this manuscript has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

It is to precisely state that "No Competing interests are at stake and there is No Conflict of Interest" with other people or organizations that could inappropriately influence the content of the paper.

References

1. Rush JA. *Spiritual tattoo: a cultural history of tattooing, piercing, scarification, branding, and implants*. Berkeley: North Atlantic Books; 2005.
2. Dye I. The Tattoos of Early American Seafarers, 1796-1818. *Proc Am Philos Soc* 1989; 133(4):520-54.
3. Bortenschlager S, Oeggel K. *The Iceman and his Natural Environment*. Innsbruck: Palaeobotanical Results. Vienna: Springer Vienna; 2000.
4. Kean WF, Tocchio S, Kean M, Rainsfold KD. The musculoskeletal abnormalities of the Similaun Iceman ("ÖTZI"): clues to chronic pain and possible treatments. *Inflammoparmacology* 2013; 21:11-20.
5. Krutak L. St. Lawrence Island joint-tattooing: Spiritual/medicinal functions and intercontinental possibilities. *Etudes/Inuit/Studies* 1999; 23(1-2):229-52.
6. Ozcan S, Kim BJ, Ro G, et al. Glycosylated proteins preserved over millennia: N-glycan analysis of Tyrolean Iceman, Scythian Princess and Warrior. *Sci Rep* 2014; 4(1): 4963.
7. Gorini I, Iorio S, Ciliberti R, Licata M, Armocida G. Olive oil in pharmacological and cosmetic traditions. *J Cosmet Dermatol* 2019; 18(5):1575-9.
8. Malakhov VV, Vasilyeva IG. Stoichiography and chemical methods of phase analysis of multielement multiphase compounds and materials. *Russ Chem Rev* 2008; 77(4):370.
9. Booth C. Possible Tattooing Instruments in the Petrie Museum. *JEA* 2001; 87:172-5.
10. Scheinfeld N. Tattoos and religion. *Clin Dermatol* 2007; 25(4):362-6.
11. Leschiutta P. Le Pergamene Viventi. Interpretazioni Del Tatuaggio Nell'antropologia Positiva Italiana. *La Ricerca Folklorica*, 1993; 27:129-38.
12. Lombroso C. *L'uomo delinquente [The Delinquent Man]*. Turin: Bocc; 1876.
13. Ciliberti R, Monza F, De Stefano F, Licata M. The trial of the skull studied by the founder of Criminal Anthropology: The war of the Lombroso Museum. *J Forensic Leg Med* 2018; 59:13-5.
14. Mansfield S. The indelible art of the tattoo. *Japan Quarterly* 1999; 46(1):30.
15. Levy JM, Sewell M, Goldstein N. A Short History of Tattooing. *J Dermatol Surg Oncol* 1979; 5(11):851-6.
16. Steward SM. Bad Boys and tough tattoos a social history of the tattoo with gangs, sailors, and street-corner punks 1950-

1965. Binghamton NY: The Haworth Press Inc; 2008.
17. Panfli E, Esposito S, Di Cara G. Temporary Black Henna Tattoos and Sensitization to para-Phenylenediamine (PPD): Two Paediatric Case Reports and a Review of the Literature. *IJERPH* 2017; 14(4):421.
 18. Ministero della Salute. Nota circolare sui tatuaggi con finalità medica; chiarimenti in merito alla pigmentazione dell'areola-capezzolo. (DGPRES-MDS-P 0014138-15-05-2019). <https://media.confestetica.it/files/doc-8-circolare-ministero-della-salute-annullata-con-sentenza-cds-0473221-tatuaggio-medica-areola-e-capezzolo-.pdf>
 19. Consiglio di Stato 04732/2021. <https://media.confestetica.it/files/doc-7-sentenza-consiglio-di-stato-0473221-annullamento-circolare-ministero-salute-tatuaggio-medica-areola-capezzolo-attivita-propria-dellestetista.pdf>
 20. Weiss G, Shemer A, Trau H. The Koebner phenomenon: review of the literature. *JEADV* 2002; 16:2412–48.
 21. Moreira de Vasconcelos IC, Brandão AJ, Batista da Cruz J, Cangussu Oliveira Gois A, Freitas da Silva GR, Delmondes de Brito A. Pathergy: implications for the treatment of Pyoderma Gangrenosum lesions. *REUFPI* 2020; 9: e9976.
 22. Patuzzo S, De Stefano F, Ciliberti R. The Italian code of medical deontology. Historical, ethical and legal issues. *Acta Biomed* 2018; 89 (2):157– 64.
 23. Ciliberti R, Gulino M, Gorini I. New Italian law about end of life: Self-determination and shared care pathway [La nuova normativa italiana sul fine vita: L'autodeterminazione e la condivisione del percorso di cura] *Recenti Progr Med* 2018; 109(5): 267–71.
 24. Garg G, Thami GP. Micropigmentation: Tattooing for Medical Purposes. *Dermatol Surg* 2005; 31: 928–31.
 25. Sisti A, Grimaldi L, Tassinari J, Cuomo R, Fortezza L, Boccchiotti MA, Roviello F, D'Aniello C, Nisi G. Nipple-areola complex reconstruction techniques: A literature review. *EJSO* 2016; 42(4) 441–65.
 26. Timko AL, Miller CH, Johnson FB, Ross EV. In vitro quantitative chemical analysis of tattoo pigments. *Arch Dermatol* 2001; 137(2):143–7.
 27. Forte G, Petrucci F, Cristaudo A, Bocca B. Market survey on toxic metals contained in tattoo inks. *Sci Total Environ* 2009; 407(23):5997–6002.
 28. Huisman S, Van der Bent SAS, Maijer KI, Tio DCKS, Rustemeyer T. Cutaneous non-allergic complications in tattoos: An overview of the literature. *Presse Médicale* 2020; 49(4):104049.
 29. Beute TC, Miller CH, Timko AL, Ross EV. In vitro spectral analysis of tattoo pigments. *Dermatol Surg* 2008; 34:508–16.
 30. Nouredine Y, Bitz AK, Ladd ME, TurlingM, Ladd SC, Schaefer G, Kraff O. Experience with magnetic resonance imaging of human subjects with passive implants and tattoos at 7T: a retrospective study. *Magn Reson Mater Phys* 2015; 28:577–90.

Corresponding author:

Pier Luigi Santi, University of Genova, Italy,
E mail: plsanti@unige.it